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WITH WHICH ARE INCORPORATED

"THE MECHANIC," "SCIENTIFIC OPINION," AND "THE BRITISH & FOREIGN MECHANIC."

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THE ENGLISH MECHANIC

AND WORLD OF SCIENCE.

THE DEAD-CENTRE LATHE.—I.

Preparation of Wood for Turning.

BEFORE putting a piece of wood in the lathe it is necessary, knowing what you wish to make, to take careful measure, so that after it shall have been turned it shall suffice for the intended purpose. Beginners are very often deceived in this respect. They think that a selected piece is sufficiently large, and after being rounded it proves too slender. The fear of this, moreover, frequently causes them to fall into the opposite extreme, and in turning a bit of costly wood they lose in chips that which, under better management, would have served another purpose, or could have been usefully employed.

It is necessary, then, in order to make sure that the piece which it is proposed to turn will fulfil its intended purpose, to take a point at each end, and to verify if from this point as a centre a circle can be described of a diameter equal to that of the cylinder which it is intended to obtain. This plan will suffice if the piece is straight, or if it has been previously dressed with the hatchet or draw-knife. But if the piece is not perfectly straight it is evident that when mounted between centres the projecting part will fall in chips, but that the hollow part will not be reached except by reducing very considerably that which is in excess. In such a case that part must be centred at which the full diameter is needed, by placing eccentrically the two extremities which allow of further reduction. In order to dress a bit of wood with the hatchet it is impossible to dispense with the chopping block set on end, of greater or lesser height, according as one may intend to work sitting or standing. For this purpose one generally makes use of a bit of elm of gnarled, and seldom of straight grain. The hatchet falling on a log of this kind is not likely to get notched, and its cutting edge is, moreover, much better preserved than if it fell on a piece of wood laid plankwise. This block should be as heavy and as large as it can be without endangering, by its weight, he floor upon which it rests. The heavier t is, the less the blows will be heard in the ooms adjoining the workshop. Moreover, he physical reason for this is easy to understand. It is the same with all appliances intended to receive heavy and repeated blows, such as anvil blocks, vices for forging and planing, work-benches, lathe-beds, which, as will be seen hereafter, should have a certain depth. The reason is as follows: A blow struck upon any body tends to displace it. It is for this reason that a nail enters under the strokes of a hammer; but if it is attempted to drive the nail with too light a hammer it will not enter, and the resistance being greater than the power, the blow will be heard at a distance; but if the hammer is much heavier the nail will enter and the noise will be much less, because a part of the mass about equal to the force of the blow being displaced, a great part of this mass loses almost all its reaction. If, then, the chopping-block is light, almost all its mass being displaced, it communicates its impulse to the floor, and the shock of each blow will be sensibly felt in the adjoining apartments. If, on the contrary, the block is very heavy, inasmuch as it will need a great effort to displace it, a blow, however violent it may be, will be deadened by the mass, and the noise will be as nothing to one's neighbours. It is by following out this principle that, when it is desired to drive a nail into a wooden partition, something is placed behind it by way of a counteracting force; otherwise the partition, being compelled by the blow to yield, the force of the hammer upon the nail is partly lost. It is on the same principle that a bullet fired perpendicularly to the vane of an easily-moving weathercock will pierce it without giving it time to be misplaced, because the motion being exceedingly rapid, and the air acting as a bolster, the hole is made before the vane can be displaced.

There is yet another very ingenious plan for preventing the shock of an anvil or forging stake from being heard in the neighbouring rooms. This is by placing the block in a barrel sufficiently large to contain it with plenty of room to spare. All the space left by the block is filled with earth, or, better still, with fine sand, taking care that there shall be at the least three or four inches underneath the block. It is evident, from what has just been said, that the blows will be found to be deadened, and that the soft substance interposed is unfitted to transmit the motion, and, consequently, the sound.

When, for the purpose of turning, it is desired to take the piece in the log, or, in the case of any such piece, with the bark on, it is necessary first to examine with attention in what direction it will be best to use it to avoid a knot, or shake, or sap, or other defect. Having arrived at a decision, the piece must be cut to length; next, examining, supposing it to be with the grain, whether any knot interferes with this grain, an attempt must be made to split it with an axe or wedge. But too much attention cannot possibly be given to splitting a piece of wood. Except after long practice, it is seldom that a novice does not reduce to too small a size a piece that was much too large: just when he least expects it, the grain alters, and the cleft runs askew; in fact, there are few woods that one ought to run risk of splitting. The safest plan is to saw them out. This is the method to be adopted for all the woods for cabinet work, of which we have spoken elsewhere. Of all woods ash is the one which splits the straightest, because the annual layers being very decided and of much greater density than the medullary substance, the split cannot pass from one layer to the other; and without naming here all the other kinds of woods, it is enough, in order to judge of their fitness for splitting, to be well acquainted with their texture, with their peculiarities of growth, and the accidents to which they were subject. Thus a gnarled elm can never be split, because, bristling along its length with a multitude of branches which are pruned back, and which form so many excrescences or knobs by extravasation of its nutritive juices, the texture is interrupted by an infinite number of knots which twist the fibres and reduce them to a mass of filaments interlaced one with the other. It is on this account that it is very suitable for making large wheel stocks, and that it receives and holds the spokes in the most solid and substantial manner. The wild crab-apple tree cannot be split for another reason. Whoever has seen the roads of Normandy bounded by apple trees must have noticed that their position and manner of growth must so dispose their fibres as, that they can never be straight. These fibres are, if one pays attention to the fact, generally arranged in a twisted form. Moreover, if one persists in splitting a piece of crabtree, it often happens that the cleft winds round and arrives at the other end at right angles to the line from which it started. The workmen call woods of this nature "wood with a rolled core."

It will be readily understood that the precautions we have set forth for the conversion of wood suitable for the lathe must also be applied to their dressing with the hatchet—that it is not enough to have split the piece of wood if, in the attempt to trim it, too much of the stuff is removed across the grain.

Suppose that it is desired to turn a cylinder of 1in. diameter, and that we must take it from the log or plank; in either case this is the way to set about it. It is first of all necessary to examine whether either of the

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two ends will serve, though in regard to the log the end is always split into a number of radial cracks, which open out after the work is finished; and even when these cracks cannot be perceived, they nevertheless exist, and when the work is completed the mouldings fall to pieces. Nothing can render this fact so apparent as when the feet of garden boxes are turned. If the apple which is at each foot, has been taken out of a shaky bit of wood, we shall, after a time, see a part of the sphere become detached, and it then ceases to be what it was.

It is necessary, therefore, to cut off with the saw the end of every bit of wood that is in the log, or of any other piece that has been for sometime exposed to the air. It is, moreover, necessary also to take a greater length than is needed if it is desired that the marks of the centre points shall not be seen. Lastly, as it is seldom that one saws the wood perfectly straight across, it is necessary in every case to take more wood than the length of the article requires. If there is any fear of spoiling a precious bit of material, or want of practice has rendered one an insufficient master of the hatchet, we may take with a pair of well-pointed steel compasses strong enough not to bend, about two lines more than the semi-diameter of what we wish to copy measures. This opening of the compasses will give the radius of the circle to be traced. One point must be placed upon one end of the piece which it is desired to turn, and twirling the compasses round, it will be seen if the circle is inscribed within the limits of the wood. If it is found defective on one or the other side, the point of the compasses must be moved back in the contrary direction until the other point describes a circle on the end of the piece, and this must be traced in a sufficiently decided manner. The operation must be repeated at the opposite end, then, placing the piece of wood upon the carpenter's bench, all the angles are to be removed with a jack plane or roughing-down plane, until the circle at each end is approached, but without trenching on the mark made by the compasses. The work is to be extended to all the angles which are outside the circle, and the piece will be prepared for turning. If we have no work-bench we must needs use the hatchet; but as we are supposed not to have had much practice, and that if we are desirous of giving heavy blows, we shall risk hurting ourselves, these are the main precautions for the prevention of danger.

The piece must be placed upon the block, being held by the other end. The chopping must be done gently, and with light blows, as if it were desired to render the billet slightly conical at the lower part. By this means we shall be sure to remove only as much wood as is necessary to secure the circular form. The piece will be turned end for end, and the same operation repeated, after which it can be judged by the eye in cutting along from one circle to the other whether the cut is straight, and where more stuff must be removed.

We must repeat here for the benefit of beginners that it is not necessary to strike with the hatchet upon the wood held at a considerable inclination, for fear of taking away too much of the wood, or making the cuts too deep, which cuts will not be effaced by the lathe, and, which is more important, for fear that the blow struck with some force may cause the piece to fall from the hand which holds it, and that the hatchet then swerving may inflict a wound, especially as the attention is chiefly directed to the work; and the desire to trim it quickly, and to take off large chips further distracts it. This is not so uncommon as might be supposed. We have seen it happen many a time. If not perfectly *au fait*, it is better, at the risk of being longer about it, to give the hatchet strokes almost parallel with the wood, or to take off but little stuff. The hatchet will more often fall on the chopping block; but, at the same time, no risk is incurred, and the material is not damaged. When the wood has been thus prepared, as cylindrical as possible, it can be gripped in a strong vice of wood or iron, and then with a flat rasp the angles can be removed which the hatchet has necessarily left; but however little the gouge has been handled, this will be absolutely unnecessary.

DUJARDIN'S IMPROVEMENTS IN ACCUMULATORS.

THE improvements in electrical accumulators recently patented in this country by Mr. A. J. Boult, of High Holborn, on behalf of M. P. J. R. Dujardin, of Paris, seem to avoid some of the defects of existing devices of the kind. The construction of electric accumulators in which salts of lead are formed by electro-chemical agency is attended with serious inconveniences, which may be remedied in the following manner:—As regards the formation of the salts of lead, instead of deriving the oxygen necessary to effect the oxidation of the lead entirely from the water, it is derived from an acid solution of an oxidising salt added to the water, such acid solution being capable by the passage through it of an electric current of producing a soluble salt of lead, which is immediately decomposed by the acid of the bath into an insoluble salt assuming the state of peroxide of lead.

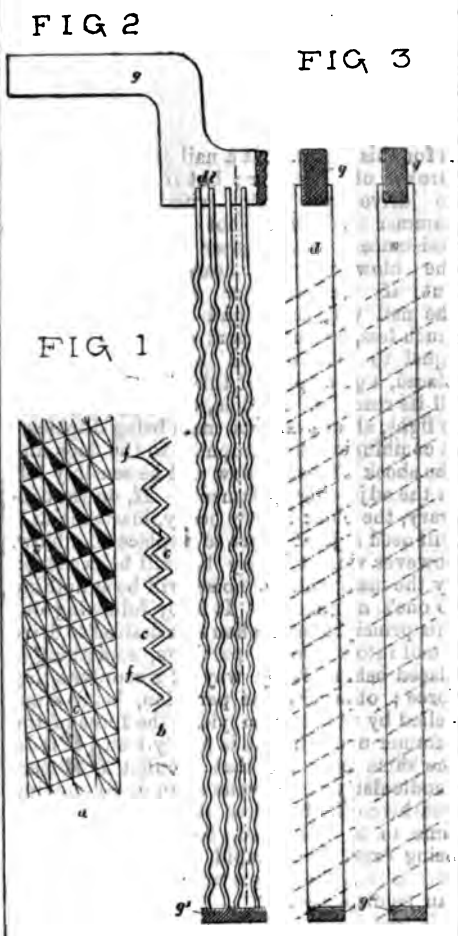
FIG 2

FIG 3

FIG 1

Thus by employing alkaline nitrates the bath may be composed as follows:—10 kilogrammes of water, 2 kilogrammes of sulphuric acid, 1 kilogramme of alkaline nitrate (of soda, ammonia, potash, or other suitable alkali). By the passage of an electric current nitrate of lead is formed, which, by the acid of the bath, is converted in a continuous manner into sulphate of lead and afterwards into peroxide of lead. In some hours, without discharging or reversing the current, the positive plates become covered with an adherent layer of crystalline peroxide of lead, which may be over a millimètre thick, and of a great electrical capacity. In order to increase and regulate the formation of the salts of lead, it has been found that it is useful to introduce large volumes of air into the bath. This may be effected either by forcing the air into the bath by raising and lowering the plates or by other convenient means. The reaction is thus doubled whatever may be the composition of the bath. In order to facilitate the adhesion of the peroxide upon the plates, the latter are constructed in a cellular manner as shown in Fig. 1, *a* representing the surface of the plate, and *b* an edge view thereof. The form of the cells *c* may be varied as well as the size thereof, those in the drawing being magnified to about four times the original size. It will be observed that in forming the cells the lead plate is not perforated in such a manner as to afford a passage from one side to the other. In a few hours the peroxide which is formed at the expense of the lead fills the small cells and adheres strongly thereto. To prevent the plates from coming into contact with each other in such manner as to interfere with the free circulation of the acid and the gases, they are corrugated as shown in Fig. 2, the corrugations running obliquely across the plates, the obliquity of adjacent surfaces being in opposite directions. Thus the surfaces of the plates *d e* which are opposed to each other in Fig. 2 are shown opened out bookwise in Fig. 3, the oblique lines indicating the direction of the corrugations, which in this position of the plates are all in the same direction; but if one plate be turned and laid with its face downwards or towards the other, then the corrugations will be in opposite directions, and will cross each other, and will only be able to come into contact at points separated by the width of the corrugations. Instead of corrugating the plates, projecting points *f* (see Fig. 1, *b*) may be formed thereon, which will prevent too close contact, and leave a free passage for the circulation of water and gas. As the dilatation or expansion of the corrugated plates subjected to an active formation may amount to 10 per cent. of the length of the plates, it is practically impossible to pack them in a rigid frame. To allow for this dilatation, the plates may be suspended from a bent rod or bar *g* shown in elevation in Fig. 2, so that the plates are free to expand towards the bottom of the cell. The plates may be soldered to the bar *g*, and also at their bottom edges to a second bar g^1 parallel to the bar *g* as shown in Figs. 2 and 3.

It will be readily understood that the composition of the bath described in the first part of the specification may be varied as to the quantity or proportions of the salts or acids employed, and also as to the particular salt or acid employed, as others might be used having the same properties of giving rise to the continuous formation of peroxide of lead by the continuous formation of an insoluble salt of lead capable of being immediately peroxidised.

TELEPHONOGRAPHS AND PRINTING TELEGRAPHS.

THE weak point in the telephone system is widely recognised in the United States, and is apprehended even in this country, for many of those who have had occasion to use the telephone have had cause to regret that it leaves no record of the actual message sent. The majority of cases of dispute depend no doubt on simple mistakes, the receiver fancying he has correctly understood the transmitter; but there are some cases in which messages have been sent through the telephone, and repudiated subsequently, merely because it is known that the instrument keeps no record of what has been transmitted. It is possible that before long Mr. Edison may provide us with an instrument which will transmit and record speech at the same time; but two inventions tending in a similar direction, or rather, to supply the well-known "felt want," are just now attracting attention in the United States. One of these is called the telephonograph, and is an instrument for recording in legible characters articulated and musical sounds. It consists essentially in an arrangement of a flexible diaphragm to receive the impact of sound-waves, which, vibrated by such impact, causes vibrations of the diaphragm that governs an ink-discharging pen, or electrical discharging point, a movable ribbon or paper being arranged to receive the discharge of the pen, whereby legible characters are recorded, representing the articulated or other sounds, as the case may be, received by the primary diaphragm. The depending hollow pen is suspended from a second thin flexible diaphragm, so as to render the pen more sensitive in its lateral or vibratory movements. A vibratory rod connects the pen with the primary diaphragm, so as to cause the pen to vibrate in unison with the diaphragm. The pen is connected with the ink reservoir by means of a flexible tube. The ink reservoir discharges a continuous jet of ink through the pen whenever the instrument is put in operation. The ribbon of paper, having uniform motion imparted to it by clockwork, is caused to pass just under the pen so as to receive the jet of ink as it is discharged. When the apparatus is ready to receive or transmit, but the primary diaphragm is not vibrated, the ink makes a straight line on the paper. When vibratory movement of the diaphragm occurs the pen moves substantially at right angles to the paper, describing a figure on the paper, corresponding to the sound actuating the diaphragm. These figures always have the same character relative to the sound-waves discharged upon the primary diaphragm. They are legible, and may be learned as other characters. This instrument records the spoken thoughts of men, and saves them the drudgery of the pen. It may be connected to a telephone where it will record all that is said. The listener, while hearing the words spoken at the other end, can see them being recorded. How that arrangement will work in practice remains to be seen; but meantime, another device may outstrip it in the race towards practical perfection. The writing telegraph is comparatively an old idea, and has already been brought to a degree of perfection which encourages other inventors to take it up and develop it: hence we find that the other week an exhibition was given in Philadelphia of an electrical contrivance for printing by telegraphy, the invention of a Mr. J. H. Winville. Prof. Hughes's famous type-printing telegraph instrument is well known to all who have followed the developments of telegraphy, and the new apparatus seems to be a modification of that and its more modern representatives. The machine, we learn, is a combination of a typewriter and an ordinary telegraphic instrument, by means of which the operator, pressing the keys on the board of a typewriter at one end of a telegraph wire, may make a typewriter copy at the other end of the wire. The transmitting machine also makes a copy of the message. The same machine can be made a transmitter. At the exhibition both transmitting and receiving instruments were in the company's office in Philadelphia; but the message was said to go out to Pottsville and thence back to Philadelphia by a loop in the telegraph wire. Several pages of matter were printed. The manager of the company acknowledges that the idea is not new; but states that the trouble has always been to get up a contrivance in a compact, uncomplicated, and inexpensive form, that would stand practical tests. "We believe," he said, "we have such an instrument now. We intend that it shall take the place of the telephone for use among business men. Unlike the brokers' 'ticker,' it prints upon a broad sheet. Its messages are absolutely secret, as the sending operator can cut all the instruments out of the circuit, except the one upon which he desires to record the message. The receiving machine works automatically. Anybody who can work a typewriter can send a message. The instruments are not liable to get out of order." Making due allowance for slight exaggeration, it will be readily understood that an inexpensive apparatus which will print as rapidly as a type-writer will be preferred for many messages to a telephone, though the latter may be the more rapid transmitter. Possibly, however, when the delay experienced through such questions as "What did you say?" is taken into account, the telegraph printer may be preferred to the mere sounder which leaves no record behind.

THE European standard of time is now used in Japan, where it was officially introduced at the New Year. The time is exactly nine hours ahead of Greenwich.

EVOLUTION AND IDEALISM.*

By Prof. E. D. COPE.

THE doctrine of idealism is naturally attractive to the minds that believe in mind. To feel that mind is all in all, and is not bound to "low material things," is as agreeable to the metaphysician as it is to the seeker for immortality. Moreover, the doctrine seems to have a certain support from the scientific side. We know that our knowledge of what are vulgarly supposed to be the properties of matter is not derived from a single sense, and we readily understand that those properties would appear to be greatly modified were the number of our senses reduced or increased. Moreover, we know from experience of the abnormal or diseased states, both of ourselves and of other men, that the appearances of the objective world may be wonderfully modified by changes in ourselves. The hallucinations of delirium and other forms of mental disorder are matter of every-day knowledge; and the illusions that may deceive the healthy mind are equally well known. The question between the realist and the idealist is, What do these facts prove?

They certainly do not prove that a universe which presents in its parts, and therefore in its entirety, the two properties of extension and resistance has no existence. They certainly do prove that our knowledge of such universe and of its parts is imperfect. It is to remedy this imperfection and to enlarge our knowledge that many men spend much labour and time. And the knowledge thus acquired and exactly systematised is called science. The pursuit of science postulates the existence of that which it pursues, not as states of consciousness, but as objective realities. There are reasons for the soundness of this view, which I propose briefly to enumerate.

If a given supposed object be in reality a purely mental state on the part of the subject, a rational cause for the production of that state is wanting. But letting this difficulty pass for the time, and letting it be supposed that there is some apparent undefined cause for such state existent when the subject is present to it, if the phenomenon be only a mental state, so soon as the subject mind betakes itself to some other locality, the supposed cause must cease to exist to that person or subject. To a second person or subject who may remain behind the first, the cause of the mental state does still exist. On the departure of the second person it ceases to exist for him, but continues for the third person, and so on. In the presence of these facts, consistency requires one or two conclusions on the part of the idealist; either he must deny the validity of the mental states of other men, or he must believe in the Hegelian aphorism, "Existence and non-existence are identical." Some idealists adopt the one and others the other of these two horns of the dilemma.

But the difficulty is immensely increased when we contemplate the mental lives of the lower animals, with their varied sense organs and media of contact with the so-called material world. We can readily imagine the limitations under which many of them exist through their structural deficiencies; but we cannot so well imagine, though we are compelled to believe in, the wonderful acuteness of the perception, and the to us incomprehensible peculiarity of sensation, produced by the various special organs of sense with which many of them are furnished. Think of the tactile sensibility to slight movements of the water possessed by the blindfish of the Mammoth Cave. Think of the sense impressions of which we know nothing conveyed by the antennæ of insects. Think especially of the "other world than ours," in which many of the Mammalia live, in consequence of the high development of the olfactory sense. We can easily perceive the result of the idealistic reasoning on the part of the inferior animals, were they capable of it. To many of them mankind would not exist; to others the sun would be a fiction. Those to whom low tones are imperceptible would deny the existence of the only vibrations that some other species is adapted to hear.

The idealistic position which denies the existence of matter results from a process of cancellation of the objective universe bit by bit. One animal after another, and one sense after another, are proven fallible, and so the entire objective superstructure disappears. The realist, on the other hand, adds together all the phenomena derived from all the senses of all conscious beings, thus getting a positive result where the idealist gets a negative one. Which is the more rational of the two methods? The actual result to thought is that we learn the insufficiency of each and every sense, but not its impotency. We are instructed that our true policy is to use our senses to the best purpose, and to add to their number, so that the defect of our knowledge may be remedied, and our mental vision enlarged more and more. And this is the mission of science.

But all knowledge, we are told, is relative, and that of the absolute reality we can learn nothing. This doctrine does not necessarily involve idealism, but it is necessarily held by consistent idealists. One can believe in a material universe and still hold that we do not know it absolutely or even truly. And as "we are all poor creatures," many of us are prone to repeat "great is the doctrine" of the relativity of knowledge! And the scientist echoes, but in a different spirit, great is the doctrine of the relativity of knowledge; yea, great is our ignorance! Great is *our* ignorance, indeed; but not "great is ignorance!" The scientist does not worship ignorance; he worships knowledge, and his occupation is to increase knowledge. To the responsive intellect and enterprising spirit, the knowledge of our ignorance is the stimulus to unceasing labour. To men of a more lymphatic temperament the knowledge of ignorance seems to paralyse their lives. But science has done much towards elucidating the order of the universe, and will do more.

Evolution gives the *coup de grace* to idealism of the consistent type. In the gradual unfolding of organic life it sees the two universal facts, subject and object. It sees them interact and influence each other. Under the influence of active, conscious life thousands of tons of substances are transported from place to place and metamorphosed in the process. Under the influence of life, from which consciousness may or may not be absent, thousands of tons of matter have been made into soil, rocks, and living tissue. On the other hand, the objective environment has constrained all living things into rigid modes, and has extinguished millions. In the midst of all this turmoil, consciousness has picked and wound its way, ever gaining in strength and skill, till now we behold man. Of all animals, man controls his environment most completely. He begins by making his own heat and light; he makes his food to grow, and his skin is partly his own manufacture. He does this, and very much more, with infinite pains and toil, and yet some individuals of his species actually deny the existence of this environment, which has compelled him to be what he is!

It is equally competent for the materialist to deny the existence of mind, as for the idealist to deny the existence of matter. The materialist, beholding the imperfection of the senses, may pronounce them to be, one by one, incompetent witnesses, and declare them to be illusions. The mind, which is the product of these impressions, immediate or remembered, falls with them; it is also an illusion. But the fact is, both exist, object and subject, matter and mind. And since matter cannot study mind, mind must study matter, and by so doing grow to more absolute knowledge and greater control of its physical basis, and therefore of itself.

It can now be seen why the study of the "problem of cognition" has little interest to progressive science. Its result is an expression of our ignorance in philosophical form, a proposition which the scientist is not disposed to deny. But when he asks the philosopher "What do you propose to do about it?" and gets the same old story reiterated from the old scholastics to the latest relativist, he turns from such blind guides to his own, and to Nature's laboratories, and goes to work. And the theologian applauds the philosopher, and says of the scientist in his prayers, "I thank Thee that I am not as this section-cutter, this bug-hunter, nor even as this bone sharp." But the scientist knows that he holds the key of the situation, and he lets the philosopher and the theologian rejoice themselves, each in his appropriate department of Swedenborg's heaven. The field of idealism has been well worked out, and we of this age should thank the mighty men of the past for having done it for us. We can now go on with an easier mind in a more profitable pursuit.

Doctor Montgomery's last article in No. 21 of *The Open Court* states at once the strength and weakness of idealism. Its principal weakness is that it is unable to stand alone without a good realistic prop somewhere behind. Thus the Doctor says (page 587): "The tri-dimensional, hard, coloured, sounding, scented, heated matter—fancied by Prof. Cope and others to subsist outside consciousness, and believed by them to be directed and organised by such consciousness—is, indeed, through and through, a fictitious entity, consisting of nothing but a set of our own percepts illusively projected into non-mental existence." This looks like pure idealism; but he lets in a "non-mental existence." Now what is this? On page 589 (bottom) he says: "Now the realistic assumption which the philosophy of organisation here makes is, indeed, the simplest possible, and is in full agreement with given facts. It supposes that there subsist in nature non-mental existents possessing the power of specifically affecting our individual sensibility, and of manifesting their special characteristics by means of the different conscious states they arouse in us." This is a little more definite, and the Doctor even calls it by its right name, a "realistic assumption." This is quite to my liking; but I cannot perceive how such "non-mental existent" can have less than three dimensions and still exist. And in order to prove to me that mind or consciousness has no control over this tri-dimensional "non-mental existent," Dr. Montgomery must go into further particulars. He must prove to me that an animal does not eat or drink because it feels hungry or thirsty; does not seek shelter on account of weather or temperature; expresses nothing in its voice of pain, desire, or pleasure; that the horse does not run because he is whipped, or the bird build because it feels the necessity of laying, &c., &c.

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* From *The Open Court*, No. 23.

I must here protest against the misinterpretation of an expression contained in one of my earlier articles, which was not sufficiently guarded, it is true, to preclude such misconstruction. It is possible to say correctly that "mind is a property of matter, as colour and odour are properties of the rose," without meaning to say that the two properties are such *in the same manner*, as is inferred by my critic (p. 589). My article in No. 19 of *The Open Court* is sufficiently clear as to what I understand by mind as a property of matter, so that it is unnecessary to go into a fuller explanation. Suffice it to say that the conscious and the unconscious properties of matter cannot be confounded by any rational thinker, and that such confusion is entirely foreign to my thoughts. More than one-third of Dr. Montgomery's article No. 5 is thus irrelevant. In the other two-thirds I fail as yet to find a definite theory which shall explain the apparent facts of designed movements of animals, differently from that which is held both by physiological science and by popular belief. That is, that the design in them is the direct result of a limited control which conscious states have, or did once have, over the energy and the matter concerned in producing them.

SPUR WHEEL MOULDING FROM A SEGMENT AND SPINDLE.*

NO foundry should be without good facilities for moulding circular castings with sweeps; for if the necessary rig was always on hand, numerous methods would suggest themselves to the founder whereby much would be saved both in time and lumber in the making of many such castings. Much loss is suffered by some firms because of the supposed cost of preparing the spindle and its adjuncts for this class of work, but I am persuaded that this supposition is purely imaginary, as I shall attempt to show. All that is needed to secure good work by this method is to have the spindle of sufficient strength to support the sweep, and resist the thrust whilst it is being forced round.

Fig. 1 is a plan of the centre required, and Fig. 2 is a sectional elevation of the same with the spindle set in; its dimensions are as follows: Arms, 2ft. radius, 9in. wide, 1in. thick all through. The spindle shown is 2½in. diameter, tapered to 1¼in. along 18in. of its length at one end, so that, the hub in the centre being 12in. deep, 1in. of the spindle will protrude. Have the spindle no longer than is absolutely necessary to allow of 9in. below the casting to top of centre, and as much above the mould as will allow of the sweep being firmly attached, as shown at Fig. 3.

Let the spindle be turned and tapered in the lathe, and after moulding the centre (in open sand) set it on end in the hub, pressing it down about 1in., taking care not to have the centre reach above the taper when cast. To insure an easy withdrawal of the spindle, have a little tallow melted thin, with which to cover the taper end; over this sprinkle a little fine parting sand, and be careful, when pouring the centre, not to direct the stream of iron against it. Another important feature is to have the spindle at right angles with the centre.

By referring to Fig. 3, it will be seen that two kinds of arms are shown for securing the sweep. The one shown at A will doubtless recommend itself to most moulders, on account of their being no machine work needed in its construction. The one at B needs boring and also fitting with a set screw; it is less troublesome to set, but it must be remembered that it can only be placed on and taken off by passing over the top of the spindle, whilst the one at A can be released on any part of it by simply knocking out the key. Fig. 4 shows a bushing or collar to be screwed fast to the spindle when it is thought best to turn the arms loose on the spindle, as is sometimes the case.

The spur wheel illustrated in this article is about 6ft. in diameter, 12in. deep, 8in. centre core, and hub 14in. deep, 4in. thick; the arms have a centre web and come flush with the rim, as shown in elevation on right-hand half of Fig. 5. For such a wheel the centre must be sunk 2ft. below the floor, and to set it securely, let the end of each arm rest on an iron block or weight firmly bedded down. This done, a hard bed is made level with the floor and swept off as seen at Fig. 3. The sweep and arms are now removed and a washer pattern, same diameter as the hub, and as thick as the distance the hub extends past the face (which in this case is 1in.), is slipped over the spindle; the hole in centre of washer being made to fit the same, to insure a correct match with the cores. The cope is now rammed over the surface and staked at the corners; these stakes must be protected during the process of moulding the wheel, so that the cope, when closed, will be sure to rest in its original position. After the cope is lifted off and finished, a hole of the requisite dimensions must be dug and the washer again slipped over the spindle, point downwards, and bedded correct to depth. This can be accomplished either by marks made on the spindle, or from two points set in the joint to the cope sweep, on which a straight-edge can rest.

The bottom bed can now be swept off similarly to the top, only that more care is needed to have the parts which form the casting as true as possible. I am aware that in ordinary practice all that is now required is to place the dry sand teeth cores in position, and set in the arm cores, also made of dry sand; but a large experience in this class of work has convinced me that it is impossible to make a true spur wheel by this method; for, however careful we may be to avoid it, the ugly fact still remains that no two cores are alike; consequently, the wheel must be untrue throughout its whole circumference, and is therefore untrustworthy. Spur wheels thus made usually have short lives, and such as do not crash during the first few revolutions are broken piecemeal, the faulty teeth snapping off from time to time, to be replaced by wrought-iron ones at considerable cost.

Fig. 6 will explain a method which obviat
difficulties spoken of. The corebox A fo
arms is made so that the outside shall corre
with the thickness of the rim; on this the
must be secured, and the best way to effect t
to dovetail them on, so that they can be rem
when not in use. After laying out the arm
down lifting plates shown in plan at B (F
and in section at A (Fig. 5). The pattern car
be placed over and the cores rammed. I
shown a core ready for lifting away at C (Fi
when the cores are all. out, the way is cle
moulding the teeth. In this drawing I hav
posely left out the spindle, that I might
clearly explain the arrangement for settin
teeth. The pattern sets back a little fro
spindle, but an iron guide, D, is let in, whi
accurately and clips the spindle. This guide
slot hole in it, through which a good screw s
it to the pattern. By this method the patte
be moved in or out if it should be found nec
to alter the diameter. This, of course, w
discovered when the segment has been tri
round. Be sure of a well-defined mark all
the teeth before commencing to ram, and s
segment to them accurately each move t
made, and the result will be a comparativel
wheel.

The drawing shows the segment as havin
rammed once and moved around; the side of
is set against the sand at E and also to the
mark at F. When the teeth are all ramm
spindle can be taken out and a piece of
thrust in the centre hole, over which sand
rammed firmly, level with the bottom of core

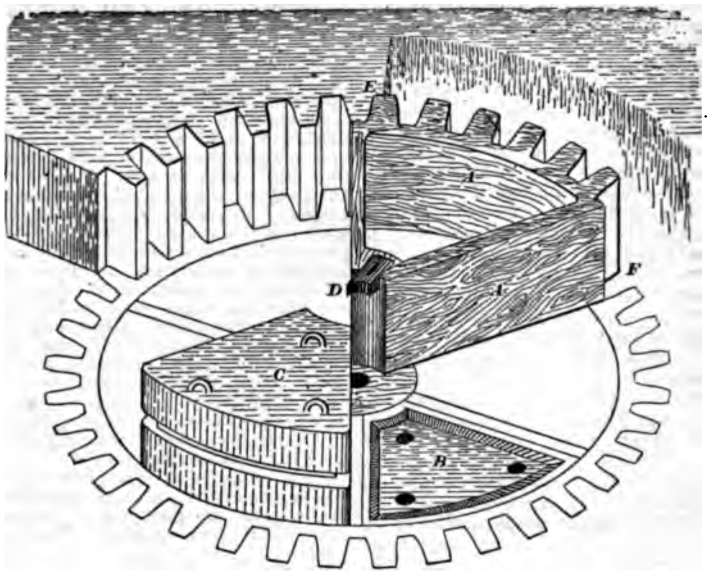

Fig. 6

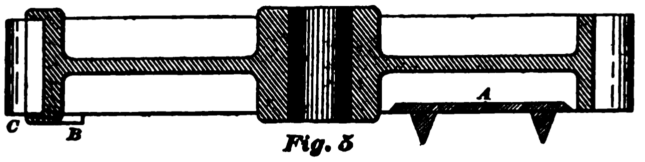

Fig. 5

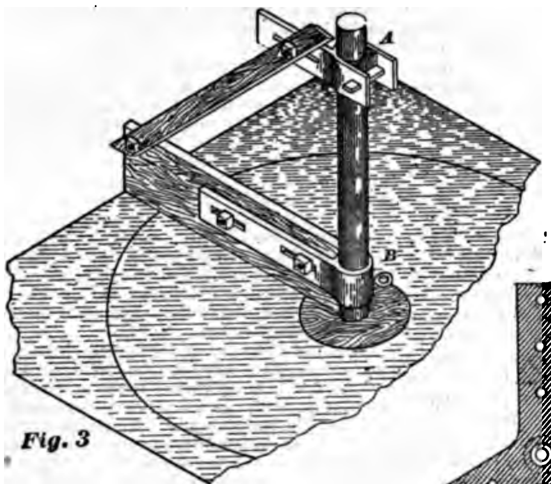

Fig. 3

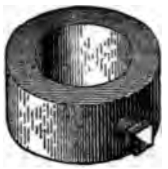
Fig. 4

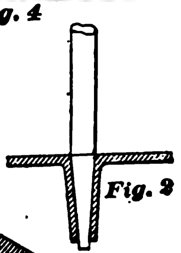
Fig. 2

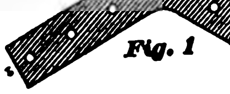
Fig. 1

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* By S. BOLLAND, in the *American Machinist.*

The advantage gained by ramming the cores on the bed will be appreciated when the mould is ready for closing, as the feet will guide them to their respective places with absolute correctness. Another advantage is that cores and outside being made from the same pattern insures an exactness which cannot be expected by any other method.

Should it be required to cast a shroud over the teeth on the top side, cut the cope sweep to correspond with the form and position of the shrouding; this will leave a sand pattern, as it were, the imperfections of which can be made good by finishing to a short segment pattern when the cope is lifted off. But should the shrouding be needed on bottom side as well, it will then be necessary to put back the bottom sweep (after the cores are all out), fitted with a tongue which will not only form the shrouding, but will also strike out clearance sufficient to allow of the segment being withdrawn after the teeth are rammed over it, as shown at B (Fig. 5).

A good method of making the segments to be used in forming the bottom shrouding is to halve them along their length so that they fit wedge form at the ends, the top half to have its thickest edge to the front; this, of course, allows the upper half to slide down the incline, freeing itself from the teeth as soon as it is touched—a desideratum to be appreciated. My meaning will be seen at once by consulting Fig. 5, at C.

The space at B (Fig. 5) will, of course, require filling up after the teeth are all rammed; this can be accurately done by using a segment made to clear the teeth when it is drawn out. The teeth will serve as a guide to set it by, and a few holes can be bored, through which spikes can be thrust to hold it in place whilst the sand is being pressed against it.

JOB DYEING RECIPES.

THE following recipes, which may be useful, are given in *The Dyer*:—

Rose Cherry, Currant, Red Garnet, &c., upon Silk Garments.—The article ought first to be cleaned with a soft brush and white soap, and well rinsed. Silk is dyed at a temperature between 60° and 90°; it rarely needs boiling to make the dye run up. First method: Prepare a bath of water at 60°, slightly acidulated with acetic acid, and add a sufficient quantity of safflower carmine; for roses work cautiously, but afterwards force the bath for reds and cherries. Second method: Prepare the first bath with water, yellow catechu, and a little sulphuric acid; rinse very well, and prepare the second bath at 50° with sufficient fuchsine. The goods ought to be finished without delay after lightly gumming them. For currant fuchsine alone is applied in a bath at 50—60°. For garnets a bottom is given with boiled archil in a slightly acidulated bath; take up, rinse, and dye upon a light fuchsine bath.

Straw Yellow, Old Gold, Buttercup Yellow, &c., upon Silk Garments.—These colours, which are very little different from each other, are obtained either with picric acid, or annotto, weld, turmeric, or fustet. The bath must be slightly acidulated, and the goods must be worked for a pretty long time to dye well level.

Navy Blue upon Silk Garments.—Prepare a bath of 100 lit. water, 1 tin of soft soap (the author, M. Batifois, does not state the weight of a "cassin"), Nicholson blue a glassful, according to strength, very little archil, first boiled. Enter goods at 40° heat gradually to nearly boiling in half hour, take up, rinse upon two hot waters and one cold to remove the soap; the silk is now grey; pass then through hot water with some sulphuric acid, when the blue is at once developed. The blue can be modified at will by adding archil or blue. Ordinary blues are dyed upon silk the same as upon wool.

Sky Blue upon Silk Garments.—Sky blue upon silk is dyed with indigo carmine in slightly acidulated water, and after rinsing the article ought to be finished at once.

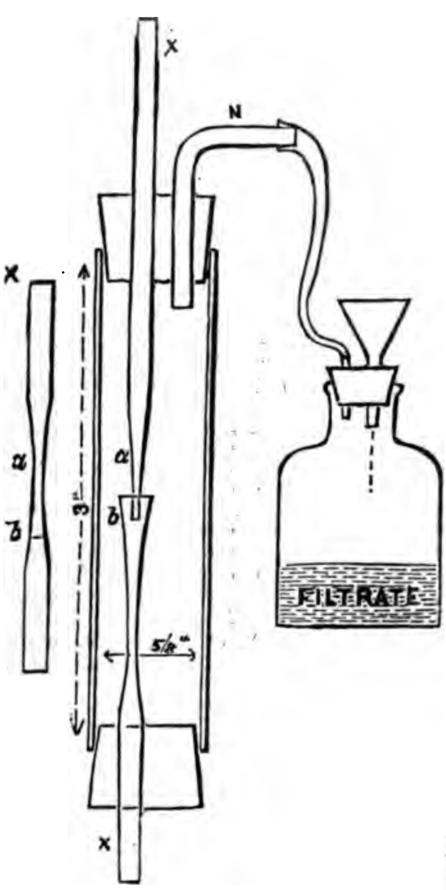
Prune upon Silk Garments.—Give first a bottom of Nicholson blue of the desired shade; take up, rinse in hot and cold water, and pass through a sharp acid, lukewarm bath of sulphuric acid, to which add a little archil, which is boiled and passed through muslin or a very fine sieve. The goods ought to be worked for one hour at least to produce level dyes. By this process all shades of prune can be obtained.

Violet, Pansy, Maroon upon Silk Garments.—These colours are obtained with aniline violet; for violets a pretty large quantity of dyestuff must be taken, but gradually added to the bath in very small quantities at a time; the bath is slightly acidulated with acetic acid. For the pansies very little dyestuff is required, and the article worked in the bath for one hour. For the maroon, red bluish aniline violet is preferably employed in very small quantities at a time.

Pearl Grey, Mouse Grey, Iron Grey, &c., upon Silk Garments.—The greys are obtained by means of ammoniacal cochineal and indigo carmine; picric acid and fustic are added in small quantities, and the bath slightly acidulated with acetic or tartaric acid. Silk can also be dyed grey with aniline grey, which gives very good results.

SIMPLE FORM OF FILTER PUMP.

A VERY simple and efficacious form of filter pump can be made as follows: Select a piece of stout glass tube, 8in. long and ⅝in. bore; fit this with corks, one with two holes, the other with one hole. Now take three pieces of ordinary glass tubing $\frac{1}{10}$in. bore, and draw two of them out as shown in the Fig.; cut the one at *a*, and the other at *b*; bend the third piece at an angle of 90°. Insert *x a* and the bent piece through one cork and *x b* through the other, so that *x a* will project inside of *x b*. Attach *x a* to a water supply. On allowing water to run through the apparatus, a vacuum will be caused in the tube, N, and, if connected as shown in sketch, filtering becomes a great deal more pleasant. I have found this apparatus to work very well. It gives a vacuum = 28·5in. of Hg.—ROBERT LAW, in *Chemical News*.



THE ADULTERATION OF LARD.*

SOME time ago I had a number of American lards sent to me for examination, being suspected of adulteration. With such a substance it was of course very difficult to specify what the genuine article was mixed with; but after many trials I managed to discover that in the instance before me cottonseed oil was the adulterant. After trying many processes and failing with them all, I hit upon the use of chloride of sulphur as being a reagent likely to be of some use in the inquiry. It is well known that chloride of sulphur (the S_2Cl_2) when mixed with a drying oil gelatinises it, and the product so obtained is sold under the name of indiarubber substitute. This "substitute" is insoluble in petroleum "benzoline," and these reactions seemed to indicate to me a process for the separation, or at least the detection, of cottonseed oil and other oils of a similar nature, in the presence of such fats as lard, tallow, &c.

In order to see how oils and fats would behave under the influence of this reagent, I first mixed them in various proportions, and finally discovered that 5cc. of the lard melted at 85° C., and mixed with 1cc. of benzoline, and also 1cc. of the chloride of sulphur, and well stirred, leaving the mixture at rest for twelve hours, was all that was necessary.

Pure lard remained unaltered by the foregoing treatment, and after standing twelve hours the mixture is soluble in benzoline. On the contrary, other oils and fats were variously affected, as will be seen by the following table, which shows the rise of temperature on the addition of the chloride of sulphur, and the behaviour of the mixture at the time.

Description of oil or fat.	Rise of temp. C.	Colour of mixture.	Physical condition.
Cocoanut	8°	Light amber ...	Liquid.
Pale rape	40	Dark „ ...	Solid.
Palm	31	„ red brown	Liquid.
Castor............	51	Very dark „	Solid.
Linseed	61	Dark „	„
Cottonseed ...	57	Light „	Viscid.
Sesame	59	Red „	Solid.
Walnut	16	Light amber ...	Liquid.
Almond.........	12	„ „ ...	„
Poppy............	66	Dark „ ...	Solid.
Sperm............	10	Light „ ...	Liquid.
Olive	10	„ „ ...	„
Theobroma ...	7	Dark „ ...	„
Lard	20	Light „ ...	„
Butterine	10	„ „ ...	„

After standing twelve hours, the following table shows the change which had taken place and the behaviour of the mixture with benzoline:—

Description.	Physical state.	Behaviour with Benzoline.
Palm	Viscid	Soluble.
Almond......	Yellow, transparent, hard......................	Not dissolved.
Walnut......	Yellow, transparent, hard......................	„
Theobroma.	Liquid......................	Easily soluble.
Sperm	Viscid	„
Olive.........	Transparent, hard ...	Not dissolved.
Cottonseed..	Brown, hard mass......	„
Cocoa.........	Very liquid	Easily soluble.
Lard	Liquid......................	„

A suspected sample of lard or tallow may be treated as before described, the rise in temperature noted, and then left at rest at the ordinary temperature for twelve hours. If any cottonseed oil is present there will be a glue-like formation, which will be insoluble in benzoline.

All the details of the operation before mentioned must be strictly followed, as by particular methods of treatment even pure lard may be rendered insoluble in benzoline after treatment with chloride of sulphur. It is very doubtful whether so small a quantity of cottonseed oil as 5 per cent. can be detected in lard or tallow by this means, as, after treatment and standing for 24 hours, the mixture is dissolved by benzoline; but there is the rise of temperature to guide the operator, which, in a mixture of 5 per cent. cottonseed oil and 95 per cent. of pure lard, made in the laboratory, amounted to 32° C.

In a trial—side by side—of pure lard and a sample of adulterated with 10 per cent. of cottonseed oil, the former easily dissolved in benzoline after having remained at rest for 12 hours, while the latter proved insoluble. I do not give this method as an infallible guide for the detection of *cottonseed oil* in lard or tallow, but as a rough method for preliminary examination, in order to see whether the sample requires a further examination. Adulterated lards do not always show even such a rise of temperature with chloride of sulphur as pure lard, but of course this shows the sample under examination to be abnormal.

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* By J. CARTER BELL, A.R.S.M., in the *Chemical Trade Journal.*

Rule and Paper-knife.—The Britannia Company, of Colchester, have hit upon a neat way of keeping the address and name of the firm constantly before the eye of likely customers, for they send out a boxwood rule which will measure a foot and serve as a paper-knife, and also as a letter opener. It is a useful implement on the desk, and as an advertisement the Britannia Co. supply the rules for 3d. each post free.

THERE is nothing new under the sun, as that distinguished architect and engineer, Solomon, remarked. We have already recorded how the compounding of locomotives was anticipated years ago on the old Eastern Counties line; and now, we are informed by Mr. Kitson, of Brussels, formerly locomotive superintendent of the Grand Luxemburg, that the steam jet for securing adhesion of the wheels was adopted thirty-five years ago on the same railway. It was found that the four-couple goods engines slipped a good deal and lost time, and even sometimes stuck fast on a bank, owing to the rails being made greasy by the drippings from the fish sent from Yarmouth to London. Accordingly, Mr. William Naylor, of steam-hammer celebrity, who was then district superintendent of the Eastern Counties line between Yarmouth and Cambridge, led a couple of ⅜in. pipes from the boiler to near the rails, just in front of the wheels, which had the effect of cleaning the rails and completely mastering the difficulty.—*Engineer.*

SCIENTIFIC SOCIETIES.

LIVERPOOL ASTRONOMICAL SOCIETY.

THE fifth meeting of the session was held in the Royal Institution on the 13th of February, Mr. James Gill, F.R.A.S., in the chair. Thirty-seven candidates were elected and proposed.

Mr. Gill read a paper on "The Effect of Difference of Latitude on Occultations." He remarked that the occultation of a star of the first magnitude by the moon is an event of comparatively rare occurrence; hence the interest which attached to occultation of Aldebaran on the 20th. In this case the star, as seen from Greenwich, will not be occulted at all, and yet it would be at Liverpool and places further north. Mr. Gill then explained the effect of parallax in occultation, and gave a series of computation, with regard to occultation in question for Liverpool, Manchester, Dublin, &c.

Mr. Denning contributed another of his series of illustrated notes on the planets, dealing on the present occasion with the planet Jupiter. He observed that there was no planet of our system that demanded to a greater extent than Jupiter the attention and persevering scrutiny of observers, or which offered a more likely field for new discoveries. Speaking of the great red spot, he mentioned that his own opinion was that it represents an opening in the aërial envelope of Jupiter, through which, in 1879—82, we saw the red denser vapours of his lower strata. The lighter tint observed during the last few years was probably due to the filling in of the cavity by the encroachment of clouds in the vicinity. Parts of some of the more prominent belts display an intense red hue like that of the old red spot, and they may be due to the same causes.

A paper was read by Herr Kühl on "Possible Changes in the Magnitude of some of the Stars in the Great Stellar Cluster in Perseus (H.G.C. 584)." The author found that the stars of Dr. Pitt's map of this interesting object had apparently increased considerably in magnitude since Dr. Pitt's observations twenty years ago.

In a note on "Some Recent Observations of Saturn," Mr. Elger collected and summarised a series of observations relating to the ring-system and ball made last year by MM. Paul Stroobant and Stuyvaert with the 15in. equatoreal of the Brussels Observatory; Dr. Terby, of Louvain, with an 8in. equatoreal; and by Mr. Elger with an 8½in. Calver reflector. Mr. Elger said that the observations, when collated, indicated, whether they related to the rings, the shadow of the ball, or the details of the disc, the importance of a careful and continuous scrutiny of the planet during the present season, and of noticing every circumstance in connection with its aspect, however strange or hitherto unlooked-for.

A large number of other papers were taken as read. At the educational meeting, after the close of the ordinary meeting, Mr. Gill gave explanation of apparent time, mean time, the equation of time, &c.

Cocoanut Oil in Sugar Making.—In the West Indies much interest is felt in an alleged successful use of cocoanut oil in a prominent factory on the West Coast as a new sugar-making agent. It is claimed that its addition to the pan prior to striking, at the rate, it is understood, of about a pint to the ton, produces an enormously increased return of sugar from the massecuite. Abnormally high figures have been given for the increase; but the *Colonies and India* says:—"After making every allowance for unintentional exaggeration and want of true experimental conditions, it would appear that advantage really accrues from its use. As no chemical action would be likely to occur, this advantage probably lies in the ability to concentrate the massecuite further than under ordinary conditions, the lubricating influence of the oil facilitating the striking of the pan, and preventing too tumultuous boiling at the finish. Nothing is heard of its use in making yellow sugar, and experience will have to show how far the colour, taste, and smell of the sugar will be influenced by it."

New Automatic Relay and Switch.—Messrs. Day and Co., of 60, Queen Victoria-street, E.C., have designed, with the idea of doing away with the necessity of having a continuous ringing bell in conjunction with burglar systems, an automatic relay and switch, by which the ordinary trembling electric house bell is continuous when rung by a contact, but non-continuous when rung from the push. Whether the burglar system switch is on or not makes no difference to the ringing from the ordinary house pushes, and the act of taking off the burglar switch resets the apparatus, which, however, cannot be called into play until the switch is on again. The apparatus can equally well be applied for making the bell when rung from some pushes continuous, and others not.

SCIENTIFIC NEWS.

IN the report of the Board of Visitors of the Melbourne Observatory, an account of the work done there is given, together with the report of Mr. Ellery, the Government Astronomer. Some of our readers may be interested in the statement of Mr. Ellery, that the mirrors of the great reflector are still optically fit for certain work; but the loss of light from tarnishing is so great that he considers it undesirable to make further observations of the fainter nebulæ until the mirrors have been repolished. He thinks it would be better to have the repolishing done on the spot rather than incur the risk and loss of time which sending them to Sir H. Grubb would involve. It would be interesting to learn whether the mirrors have been cleaned, or, in short, the treatment to which they have been subjected; for they have now been a good many years at Melbourne, and are still, as we understand, capable of doing all ordinary astronomical work. The telescope itself is mechanically in good order. The new transit circle of the observatory is in excellent condition, and observations with that are the chief work. The observatory is, however, to take part in the international photographic survey of the heavens, and the necessary funds have been provided by the Government.

We learn from Dun Echt Circular No. 152, that Prof. Krueger telegraphs from Kiel that a bright comet with a tail was discovered by Saverthal, at the Cape of Good Hope, on Feb. 18th. Its exact position was found to be: Feb. 18, 15h. 46·4m. Cape M.T.; R.A. 19h. 11m. 32·8s.; Dec. S. 56° 3′ 44″. Daily motion in R.A. + 9m. 36s.; in Dec. N. 2° 35′. Dr. Copeland appends a note:—Although the comet is moving so rapidly northwards, it is at present (Feb. 22) uncertain if it will become visible in this country.

Mr. John Tebbutt, of Windsor, N.S.W., has issued a little work giving a history of his private observatory, which is well known by repute to all astronomers. For many years his instrumental equipment consisted of a sextant and a telescope of little more than 1¼in. aperture; but in 1861 he obtained a refractor of 3¼in., and in 1872 an equatoreal of 4½in., which was supplemented about 18 months ago by a fine 8in. equatoreal by Grubb, once the property of Dr. Bone. Mr. Tebbutt has not only been a pioneer amongst amateur astronomers in a far-off part of the world, but he has done excellent work, as astronomers know, and until recently has done it all himself, having since 1881 had assistance in performing the reductions.

The death is announced of Mrs. Anna Kingsford, M.D., in her 42nd year. She was a daughter of Mr. Bonus, of Stratford, Essex, and married in 1867 the Rev. A. G. Kingsford, vicar of Atcham, Shropshire. In 1870 she entered the Roman Catholic communion, and taking great interest in medical and philosophical subjects, studied medicine for six years at Paris, where she obtained the degree of M.D. in 1880, choosing for the subject of her doctorial thesis "De l'Alimentation Végétale chez l'Homme." She will be remembered in scientific circles for her spirited attacks on vivisection, and for her advocacy of vegetarianism; outside those circles as the founder of the Hermetic Society for the study of religious philosophy and as president of the Theosophical Society in 1883.

Prof. Prestwich having resigned the chair of Geology at Oxford, Prof. A. H. Green, of the Yorkshire College of Science at Leeds, has been selected to succeed him. The veteran has completed his great work on geology, and retires to his country home with the good wishes of all, for he shed lustre on his university, and added much to our knowledge of geology. His successor is well known, having been on the Geological Survey for many years, and the author of a valuable treatise on physical geology.

In the second volume of his "Geology: Chemical, Physical, and Stratigraphical," which has been recently published, Prof. Prestwich says:—"My own opinion, based on the facts here named is, that the time required for the formation and duration of the great ice-sheets in Europe and America (the Glacial period) need not, after making all allowances, have extended beyond 15,000 to 25,000 years, instead of the 160,000 years and more which have been claimed."

A deputation from the Sussex Association for the Improvement of Agriculture, and another from the Aberdeenshire Agricultural Research Association, have already waited on Viscount Cranbrook to ask for Government grants. Lord Cranbrook seems to have been equal to the occasion, for he said that at present the Agricultural Department had no funds at its disposal for the purpose, and that, although research was one of the things that the Department would have to consider, its duty would only be to supplement local efforts—not supply the means. The "research" the Agricultural Department should foster is the discovery of a method of giving the "three F's" to the agriculturists—that is, fixity of tenure, fair rents, and free sale.

Dr. E. B. Tylor's "Anthropology" has been translated into Spanish by Dr. Antonio Machado, and in a preface the author reminds the Spanish student of the important part played by his ancestors in the foundation of anthropology, and of the large field open for its study in Spanish America.

A marble medallion put up by personal and scientific friends and fellow townsmen of the late distinguished palæontologist, Dr. Thomas Davidson, F.R.S., in recognition of his services to science and the Brighton Free Museum, was recently unveiled by the Mayor of Brighton in the geological rooms of the museum. Sir R. Owen sent a letter excusing his absence on account of failing health, and Prof. Judd wrote a letter bearing testimony to the admirable character of the work done by Mr. Davidson.

Prof. E. Ray Lankester, lecturing on Monday last on the "Struggle for Life" at the London Institution, said that a considerable number of the most fatal diseases in man, oxen, and sheep were due to poisonous matter produced in the blood which was known as bacteria. When this poison got into the system the duty of the corpuscles was to go for it, and they proceeded to eat as much as they could; but sometimes they could not attack it at all. The bacteria was too much for them, with the result that the bacteria grew, and very soon proved fatal to the body in which it existed. The corpuscles could, however, be educated to deal with the bacteria, and the future of preventive medicines would be the education of the white blood corpuscles. The fact that one man, by constant use, could without injury take a dose of arsenic that would kill six ordinary men was due to the fact that he had by weakened doses been educating and training the white corpuscles. They could be taught to eat and flourish under conditions which, if not commenced gradually, would be destructive to them, and that was the principle at the base of protective inoculation. As a preventive of many fatal diseases in sheep and oxen, inoculation had been remarkably successful. The corpuscles first received a weakened breed or disease by inoculation, and thus when a violent attack came they were ready to receive and dispose of it. This education of the corpuscles, it seemed to him, was the explanation of the success of vaccination. They received a weak dose of the poison from the vaccine, and were in that way prepared for a stronger dose in the way of small-pox. He believed the white corpuscles could be trained to receive the most virulent poisons, and he hoped this training would be carried on so as to deal with a great number of diseases.

According to Dr. V. Galtier, in a communication to the Paris Academy of Sciences, the virus of rabies preserves its activity in buried bodies. He has proved the accuracy of his statement by investigations on the bodies of rabid dogs which had been buried for more than a fortnight.

At a recent meeting of the Paris Academy of Sciences a memoir on the variability of Saturn's rings, by M. E. Trouvelot, was read, in which the author pointed out that the observations made during the last few years by Perkins, Offord, Davis, Stanley Williams, Stroobant, and others all tend definitely to establish the proposition announced by him in 1884, that, so far from being stable, the rings of Saturn are, on the contrary, essentially variable, and subject to constant fluctuations ae truth is confirmed by the author's ervations made in 1886 and 1887 at the tory of Meudon, and now communicated .cademy in this paper.

Donders, of Utrecht, completes his score and ten" on May 27, when the aires him to resign his duties as pro- it the university and director of the ogical laboratory. A Donders' Memo- id is being collected to mark the appre- of the donors of the work accomplished istinguished ophthalmologist.

largest steamship ever constructed in has been handed over to the Penin- nd Oriental Co. by the builders, Harland and Wolf, of Belfast. The is 466ft. long and 6,380 tons gross , with triple-expansion engines, indi- some 7,000 horse-power, capable of her at a speed of 16 knots at sea. She to leave London with the mails on ; but is noticeable here because she fitted with certain appliances which ble the Government to equip her as a ing cruiser on the shortest notice.

instance of the remarkably high steam- s which are now adopted in first-class Belleville and Co., of St. Denis, Seine, w under construction for the *Austra-* vessel belonging to the Messageries .es, boilers to work at a pressure of er square inch, the engines being of xpansion type.

.tue of the late John Elder is to be at the entrance of Elder Park, Govan. epresent the distinguished engineer in ing garb standing beside the model of und engine. A memorial will also be erected in honour of another distin- representative of the industries of the Villiam Denny, of Dumbarton; but it be a statue—it will take the form of ute or an hospital.

Ramsay, of Glasgow, has an article hnical Education" in the March num- *Blackwood*, in which he argues that the success in manufactures which, in of other countries, has been credited to l education, is due to general educa- concludes that neither the advocates ical education nor the Royal Commis- ich dealt with the question had any ar conception of the subject.

Blackie, replying to a correspondent of *sman*, tells him the meaning of educo, : "I may remark, in passing, that the word for *educate*, *erziehen*, tells the same tale, being compounded of nsive partial *er* and the verb *ziehen*, to *pull*, which is the aspirated form of Perhaps your correspondent might n etymology of *educo* which would to signify to *drive in*, or *cram in*; but aid he will beat the books long enough ie finds any such etymological aid to gogic practice."

lammarion calls our attention to *nomie* for March and June, 1883, the ontaining an article by M. Lepaute on nmence Lundi? où finit Dimanche?" er contains a note on the subject with published by Dr. Gleuns in the *Album wren* for 1870, in which places keeping and Monday respectively are divided . This line passes through Behring leaving the Aleutian Isles on the East, harply in between the Philippines (W.) Carolines (E.), then curves again sweeping North of New Guinea, and the Chatham Isles on the West. All rest of the line have Monday, while the east keep Sunday.

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irectors of the Italian Exhibition, which opened in London this year under the of the King of Italy and the presidency rown Prince, have already received more applications for space.

a view to meeting the general convenience tobacco-growers interested in the forth- mpetition for a prize of 50 guineas offered ndon Chamber of Commerce for the best s of home-grown tobacco, it is intended to e time up to which specimens can be sent petition from the 1st of March to the 1st this year.

LETTERS TO THE EDITOR.

◆

[We do not hold ourselves responsible for the opinions of our correspondents. The editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, *332, Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

⁂ *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

◆

LUNAR ECLIPSES—SATURN.

[28450.]—MR. B. J. HOPKINS has (letter 28415) given us a short *résumé* of M. Dufour's hypothesis, which attempts to account for the darkness of the lunar disc when eclipsed in 1884.

It seems that the Krakatoa eruption, after being pressed into service to account for the red sky glows of that and other years, and failing to do so satisfactorily, is now to figure as an agent in the phenomena attending lunar eclipses.

Your correspondent urges, justly, I think, some objections to the Krakatoan hypothesis, which is however, an attempt, at all events, to account for the variable luminosity of our satellite when eclipsed. The generally-accepted refraction theory does not satisfactorily explain how and why the moon's disc should appear at one time conspicuously luminous, and at another totally invisible.

The apparent atmospheric ring surrounding the earth's disc, as seen from the moon, is subject to all varieties of climate, temperature, refraction, and absorption in its different parts, and surely it would not, as a whole, vary appreciably, at least sufficiently to account for the eclipsed moon's varying brightness. The annulus of light round the earth, 8,000 miles in diameter and 50 miles at the least in thickness would be in some places cloud-laden, at others free from clouds, and so on, embracing probably all varieties of atmospheric condition, but not varying much, on the whole, at any time.

Dr. F. Burder, of this city, has advanced an hypothesis which is, I think, open to fewer objections than any yet suggested, and is, moreover, of an extremely simple character. Shortly, he suggests that light from the Sun's Corona is the chief factor in making our eclipsed moon visible, and that this light, coming from a certainly variable object (as we know the Corona to be), would cause her to present the varying degrees of illumination observed. It seems strange that so very simple and obvious an explanation should not have been propounded before, and it is to be hoped that its author will take the necessary steps to bring it before the astronomical world.

One would like to hear "F.R.A.S." on this subject.

I inclose a sketch of Saturn made on the 17th inst. at from 9.30 to 11h., power 800 on my Calver reflector. The crape ring was easily seen in *p.* ansa; but I could only obtain just a suspicion of it in the *f.* one. No trace could be seen of the dark patches observed last season by Elger and Terby, and although I have observed the planet on most clear nights, have not succeeded in detecting them. Have they been seen by any of our correspondents this season?

Encke's division was just discernible on the p. edge of ring A, and appeared centrally situated; on the *f* edge, however, it was not to be seen with any amount of coaxing or change of eyepiece. Has it ever been observed that this division has been seen more distinctly *p.* or *f.* at the same time that Ring C has shown the same appearance?

Bristol, Feb. 19. **Jno. Harvey Jones.**

THE MOON'S WATER.

[28451.]—CRITICISING my letter (28361) on this subject, "F.R.A.S." asks me (28425) to tell him in what form water would exist in space. Would you kindly allow me to say I did not mean to suggest that water exists diffused in space, but that so far as our earth is concerned water exists outside us in space on Mars, Venus, and elsewhere. If that water travelled to us, I imagine it would come in its solid form. He points out a forcible objection to one of my suppositions by reminding me that the moon has a retaining pull of 24,000 miles on her own matter at present. My idea is that formerly the moon from meteoric sources had not attained her present size. She was relatively less to the earth, and at least one theory supposes she was nearer. The earth and the sun in their pull upon her would be relatively stronger than now. Supposing the moon possessed an aqueous atmosphere, would it be possible for a time to arrive in the relative growth of the earth and her satellite when the mutual revolutions of the bodies concerned would subject the moon to the greatest possible conjoined pull of the earth and sun, so that by a sort of reflex tidal evolution the lunar gaseous envelope would be drawn away? When we are dealing with such immense masses as the earth and moon, 24,000 miles is not so great, after all. It is scarcely the distance from England to Melbourne and back, or four times to New York and back.

Leeds, Feb. 29. **Francis E. Cane.**

WATERS OF THE FLOOD.

[28452.]—NOTHING would have given me greater pleasure than to reply to the request of "F.R.A.S." (letter 28425) had he not given me to understand, in a few sentences afterwards, that he regards with derision and contempt all the inspired records respecting it as fabulous and mythical. Surely, he cannot wonder at my hesitating to subject myself to the charge of insane credulity for believing in the truth of this catastrophe as firmly as I believe in the Mediterranean Sea or the rock of Gibraltar. But whether "F.R.A.S." believes me a fool or not, I am sure he will be too courteous to tell me so. The waters of the Flood *did* return from whence they came. Certainly not from any of the existing oceans, or nothing would have saved us from a periodical repetition of this awful visitation. "F.R.A.S." cannot seriously dispute or deny the positive assertions of all geologists that every portion of the earth shows evidence of such a Flood as the Bible records. Of course the astronomer or globe theorist is obliged to ignore and deny such testimony, whether sacred or scientific. But those who believe in a flat and motionless world know that the waters of the Flood came from regions far beyond any latitude or circumference with which we are acquainted. "The waters of the great deep" certainly did not refer to the existing oceans, for the reason I before stated. But as soon as we disabuse our minds of the Pagan fiction of a spherical earth, we are able to admit the testimony of the geologist as well as the known traditions of all the nations on the face of the earth.

I am quite familiar with the voyages of Capt. Ross; but they consist of a startling admixture of truth and error. No living authority will venture to assure me that he has circumnavigated the south Polar centre, or ever seen the midnight sun at the time of the southern solstice. The conditions of the northern and southern regions are as distinct as it is possible to be. Why does "F.R.A.S." venture to believe what no living authority will attempt to confirm? The *Nautical Almanacs* are in no respect dependent on such fictitious theories. They are compiled for practical men, and not on conjectural data. **John Hampden.**

P.S.—The admission of "the elementary fact that all water instantly and invariably finds its own level" places "F.R.A.S." in the dilemma of either acceding all that I require, or else of resorting to the subterfuge of declaring that black means white, and "level" means convex. I do not see how it is possible to argue on such ill-defined conditions.—J. H.

FOUNDRY CUPOLA.

[28453.]—YOUR article taken from the *American Machinist*, describing the mode of working, directs that the first charge of iron should be made thirty minutes before the blast is turned on. This may lead some of your readers into a serious error. An instance came under my notice where the usual preliminary thirty minutes' "blow" previous to charging with the pig-iron—said by the old rule-of-thumb hands to be necessary *for blowing off the sulphur*—seemed to a young technically-educated fresh master to be so much time blown away. The cupola hand, in spite of the warnings of the moulders, obeyed the fresh master's instructions to the letter, with the result that all the castings proved to be the most worthless, hard, brittle *white* iron—as if chilled, in fact. Now, then, for the old hands' jubilee, "'Tis the sulphur as did the mischief," they cried one and all.

A hasty perusal of poor Samuel Rogers' work on "Iron-Making," &c., convinced the writer that the mischief lay, not in the sulphur, nor yet in the pig-iron, which was of the best South Wales brand, but *in the low temperature* at which the fusion took place. A return to the usual preliminary blow was henceforth the order.

Poor Rogers, whose researches, and their results when put into practical operation, were the means whereby all the great iron kings made their fortunes, died in great poverty—a melancholy instance of the fate often befalling those having brains and industry, but not possessing that capital, a sine quâ non for the first start and its reaction.

The Lydney Dispenser.

THE ROGET SLIDE-RULE.

[28454.]—Having been requested to give some examples of the use of this arrangement, I offer the following:—

(1) To find the 43rd root of 17, call the log. logarithmic scale R, and the logarithmic scale S. Place 43 (S), that is, 43 on the scale S, under 17 (R), and the result, 1·068 (R) is over 1 (S).

(2) What is the amount of £1 at the end of 75 years at 3·25 per cent. compound interest? Adopting the usual formula, place 1 (S) under 1·0325 (R)—the position of the 4th decimal figure lying between two sub-divisions of the scale—and over 75 (S) is the answer, 11 (R).

(3) Required the value of the $\frac{16}{27}$th power of 5. Place 27 (S) under 5 (R), and over 16 (S) is the result, 2·6 (R).

(4) In how many years will £1, laid out at 2·7 per cent. compound interest, amount to £5. Here we have to determine log. 5 to the base 1·027, or to solve the equation $1{\cdot}027^x = 5$. Place 1 (S) under 1·027 (R), and under 5 (R) is the answer 60 (S). Dr. Roget applied his principle to a circular instrument, which is of somewhat greater power than the straight one. This he describes in his paper in *Philosophical Transactions* for 1815.

Charing, Kent. **J. R. Campbell.**

PAINLESS EXTINCTION OF LIFE.

[28455.]—Some time ago I happened to kill a frog for experiment by the method described in Mr. Wire's letter (28444) last week. After having laid it in the carbon dioxide for about half an hour, I electrified it by the primary current from a bichromate battery; the usual contractions of the muscles ensued, hands, legs, head, chest were all in turn electrified, after which I laid it in a saucer with a little water. Two hours later I came into the room for a book, and in doing so I touched the saucer, when, to my intense astonishment, the frog jumped out and hopped away as sound as when I caught it. This seems to show that suffocation by carbon dioxide produces at first a kind of catalepsy, but ultimately death—this is, of course, only a suggestion. In the "Grotto del Cane," in Italy, and a certain valley in Java, great masses of carbon dioxide are given off, which, being much heavier than air, and therefore forming a layer of gas along the ground, suffocates all animals whose heads are in the gas. In the Italian place the layer is only from 2 to 3ft. deep, so that people in going in are not suffocated, but dogs and small animals are. If reptiles can be brought to life by the electric current after suffocation, mammals may also be revived. This, I think, is worthy of further investigation (if it has not already been investigated), as it may apply not only to carbon dioxide but also to choke damp and any other dangerous gases, and hence save life after suffocation in a mine or burning house, &c. I hope Mr. Wire's "pussy" was sufficiently dead so as not to wake up again in his grave. **Satine.**

POLISHING AND NICKEL-PLATING.*

[28156.]—In these papers my endeavour will be to describe polishing and nickel-plating as performed in factories with modern machinery and appliances, so that the reader, knowing the best way of doing it, may devise modifications to suit his particular work, or to bring it within the capabilities of an amateur's sanctum.

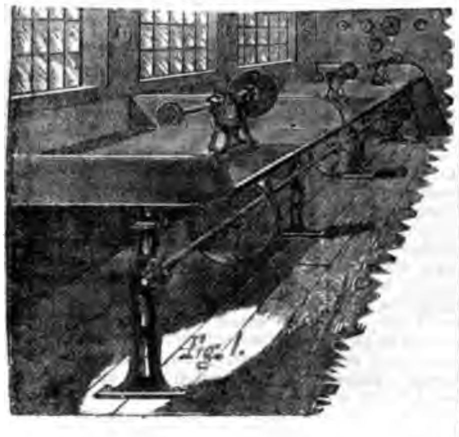


Fig. 1.

Comparatively few articles are nickel-plated without the preliminary process of polishing. The exceptions are in most cases with such articles as require a protecting surface only, appearances being of no consideration. Calico printing rolls are nickel-plated, as they thereby resist the corrosive action of the dyes. Ships' lamps, side lights, mast-head lights, riding lights, &c., resist the action of sea-water better if well coated with nickel. The reeds of weaving machines are plated to resist the rusting effects of the damp cotton; but we will study appearance in these papers, as the bulk of goods are plated for their improved appearance only.

A modern polishing shop is a well-lighted and ventilated room with one or more lines of benching fixed to the wall and floor close to the windows. These benches are fixed to cast-iron uprights or standards, with wooden bearers into the wall. The standards are made to also carry a line of shafting under the bench, with the necessary pulleys. The general size of shaft is 2¼in., and pulleys of 24in. diameter with 6in. faces. Standards are generally about 4ft. apart, and are connected by a stout wood beam at the top, on to which are bolted the polishing lathes (Fig. 1).

In the centre of the floor would stand a lathe for extra large work, having a clear space all round, and generally driven from the shafting under the bench, the band being well protected (Fig. 2.)

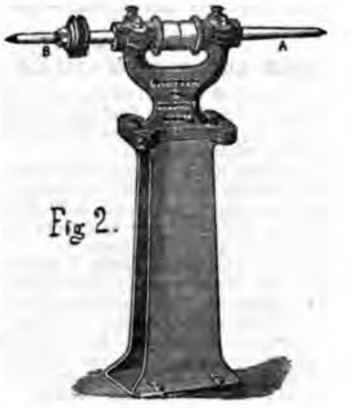


Fig 2.

Tape machines are used for some kinds of polishing: they are made with two side frames, carrying a shaft above and below. These shafts are fitted with suitable pulleys. The top one will carry at each end a 12in. shrouded pulley. The bottom shaft has a 24in. shrouded pulley at each end, and a tight and loose driven pulley in the centre of it. The top and bottom shrouded pulleys are lineable, and carry an emery tape—*i.e.*, a stout tape coated with grain emery. One tape would be coarse and the other fine, generally 90 and 60 mesh emery. Suitable tape tighteners are fitted, and with the tape travelling 2,000ft. per minute are very effective machines. Nearly all of what might be called plumber's work is ground and finished by this machine, but if required for nickelling, it has to pass a much better finishing process than the tape machine can give it (Fig. 3).

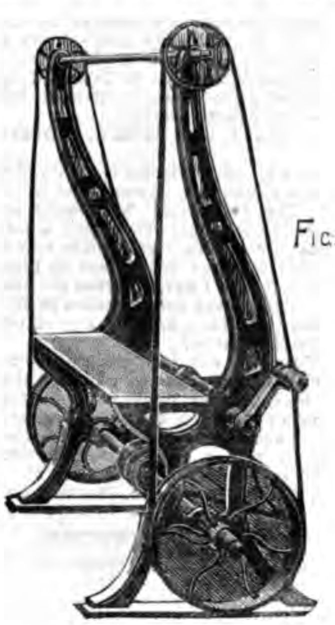


Fig 3

Another machine we will just touch on, not very complicated, but very much used by polishers for glazing cycle spokes.

A frame carrying two blocks of lignum vitæ in which the centres of the spindle run; the driven pulley and the emery wheel are mounted on the spindle side by side. These emery wheels are sometimes 6in. on the face, and a smart man can glaze a dozen or twenty spokes together. He holds the ends in his right hand, presses them on, and gives a rolling motion to them with the thumb and first finger of his left hand (Fig. 4).

Very few solid emery wheels are used, except for dressing heavy cast-iron goods.

The emery wheel, or bob, mostly used is made with a wood centre, covered with buff leather. The glue-brush is then run round it so as to completely coat the rim; it is then rolled with a lumping movement in grain emery of the requisite mesh, and left to dry.

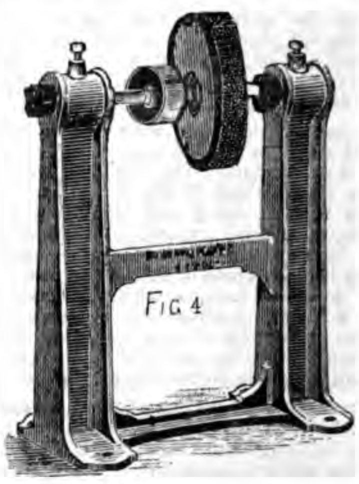


Fig 4

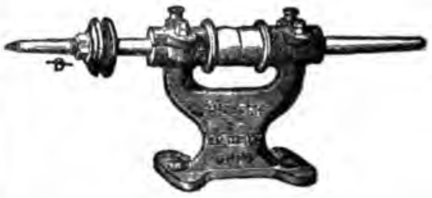
Walrus wheels are made with a wood centre or core, covered with walrus hide. In using these Trent sand is the cutting material. The next wheel in the order of fineness is a felt bob. These are cut from hard felt, and can be procured in single thickness up to 1½in.; the usual diameter runs from 9 to 12in. Calico mops come next: these are made of circular pieces of calico laid together and riveted through leather washers at their centre. Crocus composition is the cutting material used with the felt bob and calico mops. This can be bought in cakes ready for use; it is made of crocus powder and wax.

Different grades of crocus compo are made, and known in the trade as "rough cut," "medium," and "fine cut."

Mops made of swan's down, rough compo, and rouge powder are used in the finishing after plating.

Now, after a short description of the polishing lathe, we will follow a few articles through the polishing process (Fig. 5).

Fig. 5.



The most convenient lathe is made with plates or washers and a tightening nut halfway between the point of spindle and the bearing. Emery, walrus, or other hard wheels having a hole in the centre can be slid on the spindle and fixed securely between these plates. Cotton mops or other soft wheels are turned on to the taper screws at the end. The reason for this is obvious, although in a new wheel the taper screw will give a secure grip, yet in an old one that has been taken on and off dozens of times, and perhaps used on lathes by different makers with different tapers and pitch of thread, it is very insecure, and accidents do occur with them. The usual speed for these lathes is 2,000 to 2,500 revolutions per minute. A wheel, say 12 x 3in., running at this speed coming off generally drops on the bench and then leaps forward; if you can get out of the way it may run harmlessly across the shop, but if you stick to your place the least it will do is to run itself down by frantically trying to polish the polisher.

Tight and loose pulleys are fixed between the bearings. The taper screws are cut right and left hand, so that the mops have a tendency to screw themselves on at either end of the spindle by the pressure of the work against them. Never buy a common polishing lathe, or you will regret it; the dust and great speed soon tell on them. The taper screws in these cheap lathes are generally chased on, and are generally chafed off in a few weeks. The price will not allow of a solid steel spindle or of cutting a taper thread. Note the difference of a chased thread and a cut one (Fig. 6).

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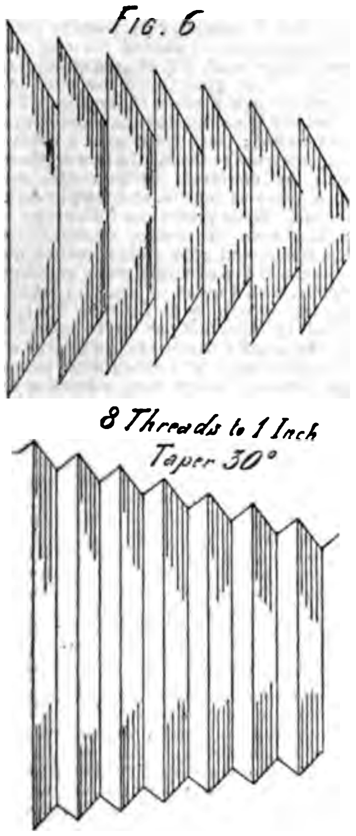
* *All rights reserved.*

The following specification of a polishing lathe is one to give satisfaction:—Solid steel spindle, cut threads, cast-iron bearings bored out of the head, caps fitting down into the lower half of bearings, held by studs, nut, and lock nuts, each cap fitted with Stauffer's patent lubricator. These lubricators are grand things on a polishing lathe: it is impossible for sand or emery to get into the bearings.



Now guard against these things: iron spindles, chased threads, caps held by set pins, caps not let down into the bottom half of bearing. The vibration in a lathe of this kind is enormous; the caps are jumping about, nothing to hold them but the set pins, set pins loose in their holes, and nothing but worry with it. Oil cups cast in the caps with a little brass flap cover are a receptacle for all the dirt having a nature to stick to greasy things.

For a spindle 3ft. 6in. long, have it at least 1¼in. thick in the bearings, and have the bearings not less than 4½in. long at each side.

Now we will follow a bicycle fork and backbone through the polishing shop. It arrives black in parts, with other parts roughly filed over.

We take the nut and one plate off the spindle, and slip an emery bob on (60-mesh emery); tighten it up and put the band on the tight pulley, and away it spins. Take the fork and commence a cross cut at the bottom end, rolling it on the wheel to the curve of the fork. A stream of sparks and an uncomfortable warming-up tells that the treatment is effective, looking at it occasionally to see no part is missed, and holding it firmly to the wheel, and the black soon disappears. Treat the backbone the same. Of course, an amateur would find this an awkward job at first, but experience is the best school. Now go over it with a 90-mesh wheel, but put the cut on lengthwise till all cross cuts have vanished, and the polishing should be complete; but if it is gone over again with a calico mop and crocus composition it will give it almost a black polish.

The calico mop is screwed on to the end of the spindle, and the cake of compo held against it while it is revolving till it has a decidedly crocus colour; nothing is gained by putting too much compo on. If the compo has a tendency to stick to the work, it can be improved by cleaning the mop and going lightly over the marks. The mop is cleaned by holding a piece of Sheffield lime against it for a second.

Black sheet iron, such as theatrical breast-plates originally were, are treated just the same, and after being plated, what invulnerable steel they look! Cast-iron goods receive much about the same treatment, altered at times to suit particular shapes. Malleable cast goods, such as buckles and other light work, are first treated to a few hours in a shaking barrel with the "Egyptians."

The shaking barrels are made of plate iron, six-sided, with stout iron arbors, and revolve at about 60 revolutions per minute. They should not be overloaded, or the rolling action of the small articles inside is impeded. To prevent them clogging together, shreds of leather and little cubes of iron (or a diamond-shape cube, if such a term is admissible) are thrown in with them. These cubes are known as "Egyptians." They certainly resemble two Pyramids base to base, but who would attempt to trace the origin of some trade technicalities? **Bijli.**

(*To be continued.*)

CURIOUS ALLOYS—(*Continued*).

[28457.]—AS a result of Dr. O'Shaughnessy's laborious experiments in metallurgy, with the addition of wonderful improvements in machinery, the Calcutta mint in 1842 had become a model establishment—one of the modern sights of India—and soon a select body was sent out by the authorities in London to copy the works and study everything connected with the Indian coinage, the whole of which was eventually adopted—an immense honour to the Anglo-Indian originators. The East India Company was princely in its expenditure on Science and Art. As an instance, I will mention the great gold battery (platinum being unprocurable) consisted of forty-eight gold cylinders, each 2in. broad, 4in. deep, with a gold strap ½in. broad, 3in. long. The cost of the precious metal was £500! The Medical College laboratory was then unrivalled.

Alloy of Gold with Platinum.—Put into a clean crucible seven drachms and a half of pure gold; when perfectly melted throw in half a drachm of platinum. The two metals will combine intimately, forming an alloy whiter than pure gold, but remarkably *ductile* and *elastic*; it is also less perishable than pure gold or jeweller's gold, though more readily fusible than that metal. These excellent qualities must render this alloy an object of great interest to workers in metals. For springs where steel cannot be used it may prove very advantageous.

It is a curious circumstance that this alloy of gold and platinum is soluble in nitric acid, which does not act on either metal in a separate state. It is remarkable, too, that the alloy has very nearly the colour of platinum even when composed of *eleven* parts gold to *one* of the former metal.

Eos.

(*To be continued.*)

ESTIMATING THE SPEED OF DYNAMO MACHINES.

[28458.]—REFERRING to letter 28449, signed "Vulcanite," I have for some time used a telephone to ascertain how a dynamo at a distance was running. Not only does it indicate the speed, but it also gives notice if there is much sparking, as this causes the note in the telephone to be louder than if it is running well. Also, there is no necessity to put the telephone in circuit at all; it is quite sufficient to hold the instrument close to the main wire from the dynamo, as this induces a current in the telephone. **E. Churchill.**

VOSS OR WIMSHURST MACHINES.

[28459.]—SUCH of your readers as have not tried the experiment cannot fail to be pleased with the beautiful effects of fluorescence, obtained by immersing a common 1s. 6d. vacuum tube in a glass basin filled with a solution of sulph. quinine and then sending the current through it. Use a little citric or sulphuric acid to make the solution complete; no great strength is necessary. If quinine should not be at hand, a decoction of the inner bark of the horse-chestnut will do. **W. J. B.**

CURIOUS ELECTRICAL PHENOMENA.

[28460.]—MR. G. RALPH, in his communication (28432) last week, seems to have entirely overlooked a very material and obvious factor in the case—viz., the presence of the already erected wires, which were feeding lamps.

Now if the currents in these were alternate, or pulsatory (such as would happen on a "direct" system, while an arc was "jumping" or adjusting itself), of course there would be momentary currents induced in any neighbouring conductor forming part of a complete circuit. This is the conclusion one would naturally arrive at, but it does not explain the fact that the shocks were felt only at the moment of touching the wire.

W. Perren-Maycock.

BREAKING STRAINS OF CABLE.

[28461.]—A SHIP anchored in a tide running 7 knots subjects her chain to same degree of horizontal tension as would come upon the tow-rope if the same ship were being towed at the speed of seven knots on a dead tide. "Sailor" will therefore see that the horizontal pull on the chain for seven knots' tide is the ship's resistance at seven knots speed. "Sailor's" main question therefore amounts to this: "What is the resistance of a ship 560ft. long by 52ft. beam by 26ft. draught?" Now, this ship's displacement and lines cannot be ascertained from "Sailor's" data of mere length, breadth, and draught. These three items multiplied together produce the displacement, not of the ship, but of the parallelopipedon which contains the ship's displacement; or, in plain English, the particulars given by "Sailor" are simply the length, breadth, and depth of a box exactly fitted to receive the immersed portion of the ship's hull. "Sailor's" ship, for aught he has stated contrary, may be a very bluff ship, of displacement nearly equal to the cubic contents of the long box containing her; or she may be a very fine (i.e., sharp-ended) ship, whose displacement is very greatly less than that of the box or parallelopipedon. And if the ship be bluff, her resistance for seven knots speed will be greater than if she be fine. What is wanted to complete "Sailor's" data is what is called by naval architects "the coefficient of fineness"—i.e., the proportion which the displacement of the ship bears to that of the parallelopipedon. For example, to find the displacement of a fast steam yacht or packet, we should multiply the displacement of the parallelopipedon by the coefficient of fineness = ·45 or thereabouts; but for an "ocean tramp" merchant steamship of moderate speed we should multiply by ·7. I will assume that "Sailor's" ship's coefficient of fineness is = ·5. Then her displacement will be $= \frac{560 \times 52 \times 26 \times \cdot5}{35\text{ft. per ton.}}$ $= \frac{378{,}560\text{c.ft.}}{35} = 10{,}816$ tons. About 650 indicated, or say, 260 effective, H.P. would drive a steamer of this class and size at a speed of seven knots. The 650I.H.P. is found by comparison of performances of similar steamers. The 260E.H.P. is taken at 40 per cent. of I.H.P., the remaining 60 per cent. being presumably expended in overcoming friction of engines, in loss by slip of propeller, and in various ways not yet wholly traceable by science. The 260E.H.P. is reduced to its value in terms of resistance as follows—viz., 550lb. raised one foot high per second per H.P., multiplied by 260 effective H.P., and divided by 11·8ft. per second (i.e., at the rate of seven knots), equals 12,118lb., or nearly 5½ tons resistance. Thus 5½ tons would be, approximately, the horizontal pull on the chain, when the tide was running seven knots. "Sailor" also asks, "What would be the depression on the bow?" There will not be any depression; but, on the contrary, a slight elevation; because the dead-weight of the paid-out chain and anchor would (under the conditions stated by "Sailor") be greater than the vertical pressure from the paid-out chain. I cannot imagine what "Sailor's" object can be in paying out 90 fathoms of chain in seven fathoms of water. A great part of the chain's length will lie useless on the sea-bottom, and the anchor will not feel the pull of the ship at all. I think those who are acquainted with practical seamanship would confirm these statements from their experience. But they can also be proved mathematically, as follows:—A 2½in. chain cable may be reckoned to weigh about 330lb. per fathom. Then the weight of 90 fathoms of cable paid out would be $= \frac{90 \times 330}{2{,}240\text{lb. per ton}} = 13\frac{1}{4}$ tons. Add for the weight of anchor, say, 3¼ tons. There is, then, a gross reduction of 16½ tons from the displacement at ship's bow. We shall presently see that the vertical pressure due to the pull of the chain does not very materially lessen this reduction of bow displacement; so that, as already remarked, the bow under the circumstances becomes elevated rather than depressed. Of course, I am assuming that, though seven knots tide is running, the sea is smooth. I will refer to the influence of billows further on. The specific gravity of iron is about 7·75 times that of water; hence, each submerged fathom of chain will have a virtual weight of (330lb. real weight, less $\frac{330}{7\cdot75}$lb. deduction due to specific gravity =) 287·4lb. But, of course, the small portion of the paid-out chain which is between the hawse-hole and the water-line will have a virtual weight equal to its real weight of 330lb. per fathom. I will suppose the hawse-hole to be 2 fathoms above the water-line, thus the highest point of the chain-curve is 9 fathoms above its vertex, which rests on the sea-bottom. We are now acquainted with the horizontal tension,

= 12,118lb., also with weight per fathom,

$= \left\{ \begin{array}{l} \text{330lb. above water} \\ \text{287·4lb. under ,,} \end{array} \right.$; also with the dip

$= \left. \begin{array}{l} \text{2 fathoms above water} \\ \text{7 ,, under ,,} \end{array} \right\}$ 9 fathoms total. From

these data we can find the horizontal distance in front of ship's bow at which the chain first touches the sea-bottom, also the vertical pressure of the pull on the bow, and also the maximum stress on the chain which occurs at its issue from hawse-hol The horizontal tension of 112,118lb. is the same every point of the chain-curve. Dividing this horizontal tension by the weight of chain per fathom, we get the parameter in fathoms: thus $\frac{112{,}118}{330} = 33{\cdot}97$ fathoms parameter for the whole chain out of water, and $\frac{112{,}118}{287{\cdot}4} = 39$ fathoms parameter for the whole chain submerged. The parameter is the master key, so to speak, by which the other functions of the chain-curve are measured and governed. The length of a piece of chain which would have a dead weight equal to the horizontal tension is the parameter, or modulus, as it is often also called. Having found the parameter, both for chain whose fathom unit is 330lb., and also for chain whose fathom unit is (thanks to the specific gravity) only 287·4lb., we can find the remaining information desired either by calculations (including the use of hyperbolic logarithms), or by the graphic method, together with angular measurements. The distance, horizontally measured, in front of the stem to the point where the chain first enters the water, after leaving the hawse-hole, is calculated as follows:—

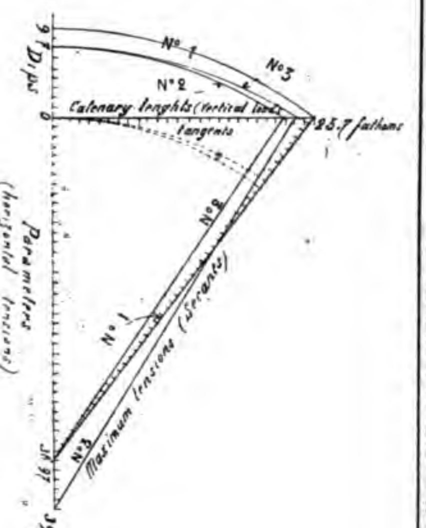
$$33{\cdot}97\ (\text{hyp. log.}\ \frac{33{\cdot}97 + 9 + \sqrt{2 \times 33{\cdot}97 \times 9 + 9^2}}{33{\cdot}97} = 24{\cdot}22.$$

$$33{\cdot}97\ (\text{hyp. log.}\ \frac{33{\cdot}97 + 7 + \sqrt{2 \times 33{\cdot}97 \times 7 + 7^2}}{33{\cdot}97} = 21{\cdot}44.$$

Then 24·22 − 21·44 = 2·78 fathoms = the horizontal distance from ship's stem to the point where chain cuts water-line. The horizontal distance between the point where chain cuts water-line and the point where chain first touches the bottom, is calculated as follows—

$$39\ (\text{hyp. log.}\ \frac{39 + 7 + \sqrt{2 \times 39 \times 7 + 7^2}}{39} = 23{\cdot}12\ \text{fathoms.}$$

Thus the horizontal distance from the stem of the ship to the point where the chain first meets the ground is only (2·78 fathoms above water + 23·12 fathoms under water, =) 25·9 fathoms. It is now necessary for us to ascertain the weight of the suspended portion of the cable, in order that we may tell exactly the vertical force exerted by the pull of the chain on the bow. We cannot find the true weight of the chain-curve unless we learn its exact length. The readiest way to arrive at the catenary length is the following:—Mark, by a vertical line, the parameter, and, immediately above the same, by a continuation of the same line, mark the dip of the chain, setting out the said dip and parameter to a proper scale of fathoms, as indicated on the diagram. Where the line of dip joins the line of parameter, draw a horizontal line of indefinite length, and cut this horizontal line by an arc struck from the top end of the line of dip, with the bottom end of the line of parameter for its centre. The length of the horizontal line, from its intersection with the vertical line to its intersection with the arc, is the length of the catenary or chain-curve (straightened out, so to speak) to same scale of fathoms as dip and parameter. Owing to the effect of specific gravity in virtually depriving the submerged chain of some of its weight, the diagram is made to answer for three distinct catenaries—viz., 1st, the catenary of 9 fathoms dip and 36·97 fathoms parameter; 2nd, the catenary of 7 fathoms dip and 36·97 fathoms parameter; 3rd, the catenary of 7 fathoms dip and 39 fathoms parameter. The first is the curve in which the chain would hang at 9 fathoms dip if there were no water in the case, and if its horizontal tension were 5½ tons. The second is the chain curve if wholly out of water, and with 7 fathoms dip and 5½ tons horizontal tension. By deducting the second from the first, we have for remainder the portion of chain which is above the water line. The third catenary shown on the diagram is of seven fathoms dip, is wholly submerged, and has consequently a parameter of 39 fathoms with the same 5½ tons horizontal tension. The differences due to these conditions of chain below and above water cannot be properly neglected if a true result is to be got. The lines on diagram are marked Nos. 1, 2, 3, for distinction. By reckoning the parameters as radii, and the dips as versines (transposed from upper to under side of tangent's line), we are enabled to obtain the chain curve lengths by the corresponding tangents (the greatest of which reaches, in this case, nearly 6½ tons); and the maximum tensions appear then as the secants. So that, without really drawing a diagram at all, but simply carrying it in the mind, we get from a table of natural sines all we need, when we have already learnt the parameter and dip, as above. It will, however, serve our present purpose to scale the catenary length from the diagram. No. 1 is 25·7 fathoms, from which deducting No. 2, which is 22·3 fathoms, we have a residue of 3·4 fathoms, which is the portion of cable out of water. The No. 3 chain curve is 23·8 fathoms, so we have 3·4 fathoms above water + 23·8 fathoms under water' making 27·2 fathoms of suspended cable, which leaves 90 − 27·2 = 62·8 fathoms of cable trailing along on the sea-bottom. The virtual weight of this trailing portion of cable being $62{\cdot}8 \times 330 - 62{\cdot}8 \times \frac{330}{7{\cdot}75} = 20{,}457\text{lb.} = 9{\cdot}13$ tons. This weight of ground chain will more than counterbalance the 5½ tons horizontal pull of the ship, and will leave the anchor free of tension entirely. The weight of the suspended chain will be virtually as follows:—3·4 fathoms above water × 330 = 1,129lb., 23·8 fathoms under water $\times\ 320 - 23{\cdot}8 \times \frac{330}{7{\cdot}75} = 6{,}840\text{lb.}$ Thus, 1,122 + 6,840 = 7,962lb. = about 3½ tons, is the vertical effect of the pull on the bows, and seeing, as I before said, that 16½ tons dead weight of chain and anchor are cast overboard, it appears that the ship's bow gets a net lightening to the extent of 16½ − 3½ = 13 tons. The effect of heavy seas and wind is to vastly increase the cable stresses. I meant to have remarked on this branch of the subject more fully, but my time and the "E. M.'s" space will not admit now. Proof or test strength of any and all materials (cables included) should never be more, and should generally be less, than half the breaking strength. No structure should be loaded to within one quarter its breaking strength at any time; the breaking weight of a 2½in. steel cable should be about 200 tons. My anxiety to make all clear, and also the involved character of the problem, must be my excuse for so very lengthened a reply.


9
7
Dips
No 1
No 3
No 2
0
Catenary lenghts (vertical lines)
tangents
25.7 fathoms
No 2
Parameters (horizontal tensions) Radii
No 1
Maximum tensions (Secants)
No 3
36.97
39 fathoms

Sunderland. **Frank Caws.**

POLISHING WOODWORK.

[28462.]—As I often notice queries about polishing articles of wood, I send some hints which may be useful to my fellow readers. Many of them are no doubt handy with tools, and make little articles in mahogany, rosewood, oak, and ash, which they would like to "finish" in the approved manner. Some woods, it is true, look better with the simplest possible "finish"—just enough, say, to keep the dust and dirt out; but most woods, especially those having a "figure," are decidedly improved in appearance by the regular polish. Scraping should precede filling, when the tool has not left the surface sufficiently clean; but I would not advise the use of glass paper, except to rub down "filling" or coats of varnish. Having given on page 417, last volume, a general idea of "filling in," we will proceed to polish or finish the work, which consists in applying a coat of varnish and polishing that. All polishes are used much in the same way, and for porous or coarse-grained wood of no special "figure" it is sufficient to fill in with size, and rub down gently with No. 0 glass-paper. The size will fill up the pores and prevent waste of the polish, by being absorbed into the wood, and it will also save time.

Make a wad with a piece of coarse flannel or cotton wool, or drugget, by rolling it round and round, over which, on the side meant to polish with, put a very fine linen rag several times doubled, but as soft as possible; put the wad or cushion to the mouth of the bottle containing the preparation (or polish) and shake it, which will damp the rag sufficiently; then dab the work or the rubber with a drop of oil and proceed to rub the work in a circular direction, taking care not to do more than a square foot at a time. Rub lightly till the whole surface is covered; repeat this three or four times, according to the texture of the wood. Each coat is to be rubbed until the rag appears dry; and be careful not to put too much on the rag at a time. Be particular that the rags are clean and soft, as the polish depends in a great measure on the care taken in keeping it clean and free from dust during the operation.

If you find it necessary to prepare your own polish take one pint of alcohol (60 o.p.), and add to it ¼oz. of gum copal, ¼oz. of gum arabic, and 1oz. of shellac. Let your gums be well bruised, and sifted through a piece of muslin. Put the spirits and the gums together in a vessel that can be closely corked; place them near a warm stove, and frequently shake them. In two or three days they will be dissolved. Strain the mixture through a piece of muslin, and keep it corked up tight for use. Some prefer the following:

Take 1oz. each of mastic, sandarac, seedlac, shellac, gumlac, and gum arabic, reduce them to powder, and add ¼oz. of virgin wax; put the whole into a bottle, with 1 quart of alcohol; let it stand 12 hours, and it will be fit for use. To apply it, make a ball of cloth and put on it occasionally a little of the polish; then wrap the ball in a piece of calico, which slightly moisten with linseed oil. Rub the furniture hard with a circular motion until a gloss is produced; finish in the same manner, but, instead of all polish, use one-third polish and two-thirds alcohol. Or, again, put into a bottle 1oz. of gumlac, 2 drachms of mastic drops, 4 drachms of sandarac, 3oz. of shellac, and ½oz. of gum dragon; reduce the whole to powder; add to it a piece of camphor the size of a nut, and pour on it 8oz. of alcohol. Stopper the bottle close, but take care when the gums are dissolving that it is not more than half-full. It may be placed near a gentle fire; but a bath of hot sand is preferable, as avoiding all danger, the compound being so very apt to catch fire. Apply as before directed.

Here are some more useful recipes for polishes which may be of interest to the amateur:—

To a pint of spirits (methylated alcohol 60 o.p) add, in a fine powder, 1oz. of seedlac, 2 drachms of gum guaiacum, 2 drachms of dragon's-blood, and 2 drachms of gum mastic; expose them, in a vessel stopped close, to a moderate heat for three hours, until the gums are dissolved; strain the whole into a bottle for use, and shake up a quarter of a gill of the best linseed oil with it.

A strong polish, to be applied with a brush to the carved parts of cabinet-work, as standards pillars, claws, &c., is made by dissolving 2oz. of seedlac and 2oz. of white resin in one pint of spirits of wine. This varnish or polish should be laid on warm, and if the work can be warmed also it will be so much the better—at any rate, moisture and dampness must be avoided.

To finish all these polishes, we go over the work with what is commonly called "finish," and the operation is called spiriting off. The simplest is half-pint of spirits, 2 drachms of shellac, and 2 drachms of gum benzoin. Put these ingredients in a bottle, and keep in a warm place till the gum is all dissolved, shaking it frequently; when cold, add two teaspoonfuls of the best clear white poppy oil; shake them well together, and it is fit for use. This preparation is used in the same manner as the foregoing polishes; but, in order to remove all dull places, you may increase the pressure in rubbing.

Instead of French-polishing, as it is termed, which, it will be seen, consists in rubbing on several coats of a varnish, some varnish with a brush in the usual way, and then polish the varnish. To polish varnish is certainly a tedious process, and considered by many a matter of difficulty. The following is the mode of procedure:—Put 2oz. of powdered tripoli into a basin, with water sufficient to cover it; then, with a piece of fine flannel four times doubled, laid over a piece of cork rubber, proceed to polish, wetting the varnish well with the tripoli and water. You will know when the process is complete by wiping a part of the work with a sponge and observing whether there is a fair and even gloss. Clean off with a bit of mutton suet and fine flour. Be careful not to rub the work too hard or longer than is necessary to make the face perfectly smooth and even. Or with a piece of fine pumice-stone and water pass regularly over the work in the direction of the grain; then, with powdered tripoli and boiled linseed oil, polish the work to a bright face. This will be a very superior polish, but it requires considerable time.

It sometimes happens that the cabinet-maker has a table-top of marble to remount, which is scratched and requires repolishing. The following is the process used by the mason for this purpose:—With a piece of sandstone with a very fine grit rub your slab backward and forward, using very fine sand and water, till the marble appears equally rough all over; next use a finer stone and finer sand, till its surface appears equally smooth; then, with fine emery powder and a piece of felt or old hat wrapped round a weight, rub it till all the marks left by the former process are worked out, appears with a comparative gloss on its sur- Afterwards finish the polish with putty- : and fine clean rags; do not put any more : on your rags, but rub it well, and in a short will appear as when fresh out of the mason's

A. Kurtz.

AUL'S ORGAN AND ITS ORGANIST —TO "BACH."

53.]—THE organ in St. Paul's Cathedral iginally built by Father Smith in 1697. It ed of a "Great and Choir organ," with ly a small echo. In 1874 an almost entirely gan was supplied by Mr. Henry Willis, who the fine old case into two parts, repairing eserving the two original 16ft. metal dia- as the front pipes.

organ now consists of four complete manuals, C to A, 58 notes, and two octaves and a concave and radiating pedals, from C C C 0 notes. The instrument now contains the ng stops:—

SOLO (4th Manual).

hrmonique	8ft.	4. Oboe...............	8ft.
cert Flute...	4ft.	5. Tuba Major ...	8ft.
10-di-Bas-to	8ft.	6. Clarion	4ft.

SWELL (3rd Manual).

ntra Gamba	16ft.	13. Fifteenth	2ft.
en Diapason	8ft.	14. Echo Cornet...	
blich gedact	8ft.	15. Cntra Posaune	16ft.
icional	8ft.	16. Cornopean......	8ft.
x Angelica ..	8ft.	17. Hautboy	8ft.
ncipal	4ft.	18. Clarion	4ft.

GREAT (2nd Manual).

le Diapason	16ft.	26. Octave Quint..	3ft.
en Diapason	8ft.	27. Super Octave..	2ft.
en Diapason	8ft.	28. Furniture......	
ribel Flute	8ft.	29. Mixture.........	
int	6ft.	30. Trombone......	16ft.
e hrmonique	4ft.	31. Tromba	8ft.
ncipal	4ft.	32. Clarion	4ft.

CHOIR (1st Manual).

urdon.........	16ft.	39. Flte hrmnique.	4ft.
en Diapason	8ft.	40. Principal	4ft.
lciana	8ft.	41. Flageolet	2ft.
loncello ...	8ft.	42. Corno-di-Bstto	8ft.
ribel Flute.	8ft.	43. Cor Anglais ...	8ft.
blich gedact	8ft.		

PEDALE.

able open psn. (wood)	32ft.	48. Octave (metal)	8ft.
en diapason ood)	16ft.	48. Mixture (metal)	
lone (metal)	16ft.	50. Contra posaune	32ft.
oloncello etal)	8ft.	51. Grand bombard	16ft.
		52. Clarion	8ft.

COUPLERS.

o to Great	58. Swell to Pedals
oir to Great	59. Great to Pedals
ell to Great (sub-tave)	60. Choir to Pedals
	61. Solo to Pedals
ell to Great (uni-on)	62. Ventil Pedale
ell to Great (super-tave)	

: patent pneumatic combination pistons for upon the different stops are applied to each l organ.

pneumatic lever is applied to the great

swell and choir organs, which are on the e side of the choir, are acted upon by the pneumatic tubular apparatus, connected pneumatic lever of a peculiar construction, has the advantage of working noiselessly ever failing. The draw-stop movement is l in a similar manner.

pedal organ is on the floor of the cathedral the choir stalls, and standing away from ner portion of the instrument. The organ its wind from three very powerful bellows in the crypt, having each four feeders. bellows are worked with three hydraulic s, and supply the wind to the different reser- laced above in the organ automatically.

C. W. Stear.

SHORT-FOCUS SPECULA.

54.]—"AMERICAN ASTRONOMER" (letter p. 487) may perhaps be interested in my nce of above.

w years ago I came into possession of a 6in. nian silvered-glass equatoreal of only 21in. very nicely mounted, and very compact and but the definition was far from good, a lare of light surrounding *all* objects with ers. It had a 2in. minor axis plane, which he black spot very large—in fact, the image ar was a confused ring of light. Well, of this would not do, so I sent the telescope minent firm of opticians, asking them to try hey could do with it, and suggesting that it might be converted into a modified Cassegrainian on Nasmyth's plan.

They made some experiments in that direction, and endeavoured to improve the curve of the speculum; but it was no good, and, after some time the instrument was returned to me, they generously declining to charge me anything for their trouble.

I was still unconvinced, however, of the impracticability of successfully working a speculum of such short proportionate focus, and got a clever practical working optician to try his hand. He supplied me with a 6in. speculum of only 18in. focus, and, though it was somewhat better than the other, the same objectionable characteristics remained, and I then gave the matter up as hopeless. Some time afterwards I purchased from Mr. With a beautiful 4½in. speculum of 36in. focus, had the tube of my "dumpy" lengthened to 3ft., put in a smaller plane, mounted the 4½in. in a brass ring to fit the cell, counterpoised it, and at once had an excellent telescope, which gives me complete satisfaction.

Meanwhile, I had myself been working a 6in. disc to 36in. focus, which I polished and silvered, and the other night, during a clear interval, tried it on the moon, Saturn, and Castor. The result was so satisfactory that I am sure, with a little more correction, it will make a capital speculum. As it is, it is infinitely superior to the "dumpies," and I have come to the conclusion that six, or at least five diameters are the shortest foci that ought to be attempted by an amateur. "American Astronomer" is to be congratulated on his success with his 5in. of 25in. focus, and if he will work a 6in. of 36in., or an 8in. of 48in. focus, I think he will be still more gratified. I may add that I have used silvered-glass Newtonians for years, and have lately mounted an admirable 10¼in. that Mr. With sent me, and I think I know what good definition is.

I believe the Newtonian reflector is the telescope of the future, and that Mr. Common's 60in. will far surpass the 36in. Lick refractor. The difficulty of procuring large discs of glass of the requisite quality, their necessarily increased thickness with every increase of diameter, and the consequent loss of light from absorption, must eventually bar further advance; but who will say that 8ft. or even 10ft. specula will not be made?

Mr. Calver is prepared to undertake an 8ft. speculum, and before the close of the century such an instrument may be at work, and then, perhaps, some interesting questions, such as the existence of planetary systems among the stars, and the condition of the surfaces of Mars and Jupiter may be solved.

Moonstarer.

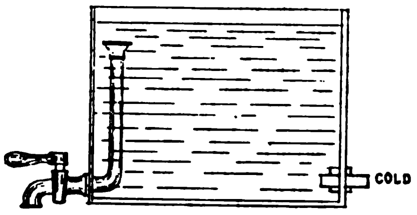
BURNS.

[28465.]—IF W. M. Simpson (28440) will look up pp. 514, 561, 612, Vol. XLV., and p. 13, Vol. XLVI., he will find all the particulars in regard to the application of soda and Epsom salts to and for burns, having used them myself for nearly forty years without a failure.

Dens.

RANGE BOILERS.

[28466.]—THE annexed sketch shows an addition to an ordinary range boiler, which I find



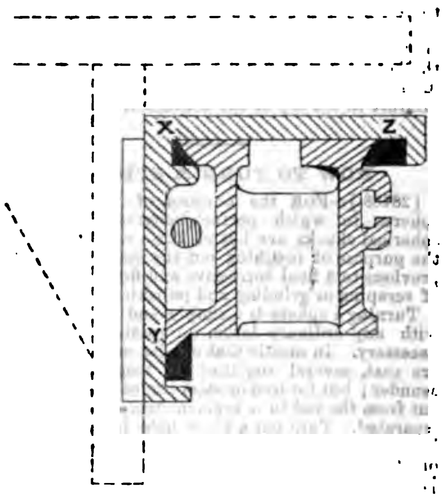
answers well. In ordinary cases the cold-feed water is admitted and the hot water drawn off at the same level, so that as soon as the tap is turned the cold water enters and chills that which is being drawn off — as hot water ascends, the hottest stratum is at the top of the boiler, and my addition enables this hottest stratum to be continually drawn off, while the cold water is admitted at the bottom, and gradually displaces the hotter water above it.

It is better to make the top of the upright pipe funnel-shaped, as shown. The arrangement has the further advantage that the boiler can never be drawn dry if the feed apparatus fails to act.

A. S. L.

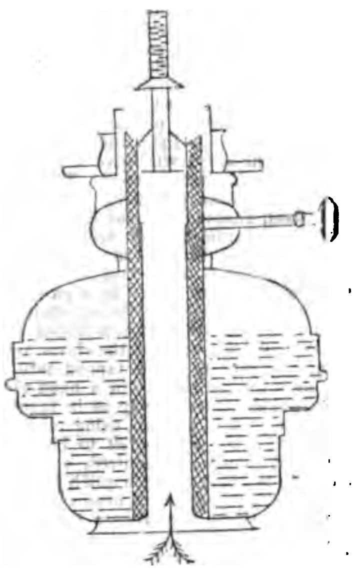
A SEMI-FRONT SLIDE—SAFETY-LAMPS.

[28467.]—YOUR readers will remember that it was only because it seemed to lend itself to the permanent vertical slide that I advocated the front slide. So many having objected to the front slide, I have been trying to arrange the vertical so as to do without it. Evidently a V.S. cannot be put upon the apron of an ordinary saddle, or the stress when the V.S. is raised would spring the plate at X (see fig.); the bottom of the apron must



then be supported in some way, as at Y. The gibs at X and Z allow the saddle to be adjusted to the face of the bottom flange of the bed at Y. The gib X is supposed to be tapered lengthways, the adjusting-screws being one at each end. The slot at the back of the bed would take a traversing bar screwing apparatus, or form a point of fixture for shaper-plates and many other things. Now, will our friends who have objected to the F.S. kindly say whether this form of section meets their approval?

A few weeks ago there was a notice of a safety-lamp arranged so that the flame would be put out the moment the lamp was tilted from the perpendicular. This reminds me of an interesting pamphlet by Charles Marvin (Anderson and Co., 14, Cockspur-street), which explains very clearly the danger of ordinary lamps. The greatest danger of all appears to be the breakable container of glass or china; the lamp is upset, the container breaks, and the escaping oil is lighted by the flame and sets fire to all around. The best way of guarding against this appears to be to use none but metallic containers. The next greatest danger lies in the possibility of the flame creeping down till it communicates with the mixture of gas and air at the upper part of the container, causing the container to explode when the burning liquid is thrown around, and a person sitting quietly by the lamp becomes a column of fire and dies in fearful agony. Not a week passes in London but someone loses life in this way, the verdict at the inquest being "died by the explosion of a spirit lamp." "Oh!" people say, "how common those nasty spirit lamps must be, and



what a comfort we haven't one in the house"; little thinking that *spirit lamps* means *paraffin lamp*. No clever arrangement for putting out the flame meets this danger. Let everyone see that their wicks really fill the wick holder, so that the flame cannot creep down, and let them abstain from the common practice of blowing down the chimney, which has so often caused death by driving flame down some crevice and exploding the

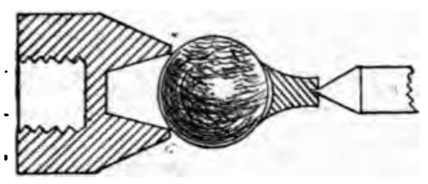
The tracing inclosed shows the Defries patent, which so simply and so completely obviates the danger just referred to. The wick is a round one, and, as well as the usual tube within the wick, there is another outside it, which does not, as usual, stop when it reaches the container, but continues down through the liquid to within ¼in. of the bottom, so cutting off all possibility of a communication between the flame and the explosive mixture in the top of the container.

F. A. M.

HOW TO TURN A SPHERE.

[28468.]—FOR the purpose of turning small spheres in which perfect accuracy is required, spherical chucks are but of little value except for the purpose of roughing out the material to shape previous to a final corrective and finishing process of scraping or grinding and polishing.

Turning a sphere is a simple and easy operation with any ordinary lathe, no special tools being necessary. In metals that can be melted the balls are cast, several together in lengths and sawn asunder; but for iron or steel the balls are roughed out from the rod to a segment template, and then separated. Turn out a taper hole in a pewter or boxwood chuck, rather less than half the diameter of the intended sphere; the rough ball is jammed in this by the shifting centre, interposing a cupped piece of metal, preferably of steel, as a guard to prevent contact of the centre against the ball, as shown by the cut. Set the T-rest high, or rather above the centre, and with a sharp graver used overhand shave down all the prominent parts till a zone on the ball, a shade larger than the finished size, runs quite true, then slack the centre and twist the ball half round, so that the zone just turned is in the line of centres. By cutting round right and left down to this circle a great step is made towards accuracy. Again shift the ball as before, and continue the operation till the graver, by touching every part, will only take a faint scrape equally over all the surface. The edge of the chuck should be trimmed perfectly true towards the finish. If the ball is liable to slip under the cut, the edge may be touched with resin. The ball, though now quite accurate, has not a fine polish, but appears scraped over with segmental scratches intersecting each other in every direction. In order to produce a final polish, a "sphere-cutter" should be used. This is a tubular piece of steel or ferrule, hardened, having a bore ranging from half to two-thirds the diameter of the sphere. Exact size is of no consequence. After this is hardened the inner edge should be ground out with oilstone dust to a true circle on a brass or metal cone to fit, and the square end cutting-edge is kept sharp by rubbing it on a flat lap with fine emery. This ferrule, if of large size, is driven on to a short wooden handle; but the small sphere-cutters consist merely of a piece of rod-steel, with a hole drilled in the end. A light touch with this tool with a slow lathe-speed will give a fine polish to the ball, which is then finished. The action is rather a scraping than a cutting one, and if the ball is of steel, soapsuds should be used. If the steel balls are hardened they are sure to suffer slight distortion, to remove which they must be ground true by means of a clam made of a rod of metal of suitable size bent like a pair of sugar-tongs, having an eye drilled at the extremity of each arm, into which the stems of cup-shaped pieces of lead are riveted; the arms of the clams are closed on the ball by a long screw tapped into one of them, or by a winged nut, as in a hand-vice; the ball is shifted about frequently as in turning, and the clam is twisted to and fro, using oilstone dust or fine emery till the ball is *felt* to be quite true. If a brilliant polish is required, a wad of fine woollen cloth is cemented with pitch into the cups of the clam, and charged with crocus and water.



The above method may appear to be slow and tedious, but after a little practice it is really not so. I have turned spheres from 2in. in diameter (for the clacks of feed-pumps) down to steel balls of less than ¼in., both easily and expeditiously, as there are no troublesome adjustments or chuckings to be attended to.

F. H. Wenham.

IT is stated that the large Russian ironclad *Tchesme*, now being finished at Sebastopol, and *having* a displacement of over 10,000 tons, is to *have boilers heated with petroleum.*

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[63852.]—**Pewtering.**—Allow me to refer Mr. Geo. Wells (p. 604) to my reply on p. 535 for the answer to his question. A little technical education is sadly needed amongst "we in the trade."—NUN. DOR.

[64125.]—**Spherical Turning.**—I append sketches, which I will briefly describe, and then give the method of procedure. A (Fig. 1) is a chuck made of same material as that which is to be turned, and screwed on lathe mandrel. The section shows it to be a hollow cylinder, allowing a bearing, on sphere of about ⅜in. or ½in.; C is a small piece of metal holding ball in chuck between centre. The centre next to ball is much larger than that at poppet centre. D is poppet centre. A and B are plan and elevation of a tool used for finishing process. It may be made of a piece of cast steel tubing, bored or lapped a perfectly true circle—i.e., for practical purposes. It should be from $\frac{3}{16}$in. to ¼in. thick and marked with circles on the outside, the distance apart being equal to the thickness of the shell. These lines will be a guide to the grinding of the tool, which should have a bevel of about 45°. A wooden handle may be knocked in about 10in. long. Arrange the sphere as in Fig. 1, and turn up with an ordinary turning tool, reversing the sphere as convenient. With a diamond-pointed hand tool take out the tool-marks from last process, leaving the ball about $\frac{1}{16}$in. larger than the finished size. For small spheres—1in. and less—this tool must be ground to a point; but for larger sizes it may be slightly rounded at the point. Now take the tool (Fig. 2), and work around one hemisphere, always taking care that the tool does not get in the same straight line as the lathe centres. The cutting edge of the tool should be at right angles to the bore of this tool, and its diameter should not be more than three-quarters the diameter of the finished sphere. The chuck in Fig. 1 should not cover more than half the sphere, thereby allowing a hemisphere to work upon at once. The poppet head may be pushed away for the finishing process, the cup-tool being sufficient to hold the ball in the chuck.—WILLIAM HY. RUSSELL.

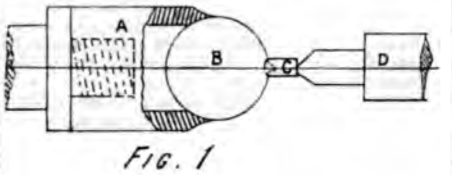


FIG. 1

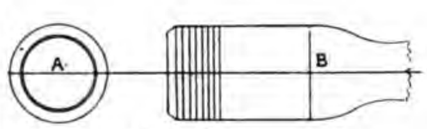


FIG. 2

[64169.]—**Chemical Balance.**—The period of vibration of beam of balance is inversely proportional to square of length of beam, and inversely to square root of distance between centre of gravity and point of suspension of beam; on this latter distance also depends the sensitiveness of balance. Thus in a short-beamed balance the period of vibration is considerably lessened, while the loss in sensitiveness can be made up by shortening the distance between centre of gravity and point of suspension, as well as by the lightness of short beam as compared with long beam. The friction will also be lessened. Again, the beam possesses much greater stability than a long one.—R. H. A.

[64232.]—**Wines and Spirits, Cordials, &c.**—As no one seems to have replied to this query, perhaps I may be permitted to hint that probably Gardner's "Brewer, Distiller, and Wine Manufacturer," giving directions for the manufacture of beers, spirits, wines, liqueurs, &c., published by J. and A. Churchill, New Burlington-street, W., may suit the querist. I know nothing about the book: I reply merely because no one else seems to have answered a question the insertion of which invites an answer.—NUN. DOR.

[64237.]—**Steam Launch.**—As no one seems to have taken any notice of this query up to the time of this writing, may I venture to ask "Investor" if he ever heard of a 90-ton yacht which could do 15 knots? He should seek information in the published details of torpedo boats.—NUN. DOR.

[64242.]—**Patent Fuel.**—As no one seems to have replied to this query, I may perhaps be allowed to inform the querist that he will find all the information he requires by searching the indices of back volumes or the records of the Patent Office. Coal-dust, mixed with pitch or coal-tar, has been made into "blocks" for many years.—NUN. DOR.

[64245.]—**Tool Wanted.**—T. G. Brisco will get the moulding for single or double dark slides from one or other of the following makers:—Henry Park, Acton-street, Kingsland-road, E.; Pumphrey, 2, Stanhope-street, Birmingham; or Tylar, 31, Yates-street, Birmingham.—B.SC., Plymouth.

[64252.]—**Pendulum Indicator.**—Six cells are quite sufficient to work the indicator you mention. The deflection of 5°, and the state of your zinc rods show that you have a serious short-circuit in one of your 15 lines. To find which is the faulty wire, place the detector in circuit, and then disconnect the wires from your indicator one by one until you find one that stops the short circuit when you disconnect it. You must then examine that wire from the indicator to the push, and find the bad place. You have most likely driven one of your staples too far, and cut the insulation.—AMPERE.

[64359.]—**Wheatmeal Bread.**—Try the following method:—Flour, 8½lb.; baking-powder, 1½oz.; salt, ½oz.; water, 2 pints. Mix the baking-powder and salt well into the flour, then add the water, beat up all together for about a minute; have ready the tins well greased, put in the oven (which must be hot) at once, on the top shelf; the door must not be again opened for half an hour. A 2lb. loaf should bake in 1¼ to 1½ hour. The result will be a light, palatable loaf when you have had a little—EXPERIENCE.

[64378.]—**Testing the Compass.**—"F. C. P.," I suppose, means finding the deviation of the compass. The compasses of every ship are subject to derangement in pointing to the magnetic north. This is due to the iron employed in the construction. In the case of an iron ship the continual hammering it undergoes in the progress of building causes the hull to become a magnet of a variable nature, and acts upon the compass needle. The angular amount that it is drawn to the right or left of the magnetic, is called "the deviation of the compass." The manner in which this deviation is corrected is by "swinging" the ship, or, in other words, to turn slowly the ship's head right round the compass. When a ship is "in dock," this can be done by reciprocal bearings—that is, with a compass on board and a compass on shore, the observations to be taken by a preconcerted signal as the ship's head comes to each point of the compass. Another way is by the bearings of a distant object, or two lighthouses when they are in a line, or "on," whose magnetic bearing in this position is known. A third way, and the best, is by azimuths and altitudes of the sun. This method is always at the navigator's hand when the sun is visible, and is the most reliable, because in every change of the ship's geographical position the deviation alters. Some of the American liners find their compasses alter a point to a point and a quarter between land and land, although the ship's head is kept almost on the one course the entire distance of nearly three thousand miles. The deviation of the compass is a complicated science, embracing so vast a field of causes, that it can be very imperfectly stated in the inquiry column of this paper.—SAILOR.

[64382.]—**Turbine or Waterwheel.**—I, for one, am pleased to see a discussion commenced on this subject at last. A wheel-maker has spoken, and now I hope Mr. J. Brown, Belfast, and others will give their experience. "Millwright," however, speaks of so many cubic feet of water flowing on to the wheel = 13·29H.P. and 17·28H.P., $\therefore$ 13·29 × 33000 ÷ 18 × 62·5 = 5420c.ft. per minute, roughly, for first amount. (I won't be certain of last figures, as it's done by Gravet slide-rule, which does not read very far with certainty.) He then goes on to speak of its doing so much work by driving a certain class of stone, &c., on wheat, &c. This, no doubt, is all right for a milling engineer who is intimate with the power required for different grains and stones, but for ordinary people it gives very little idea of the actual power given off. Could not "Millwright" give us the cubic feet passed through gate and brake power taken off first motion shaft? Also whether it was fitted with internal toothed segments on rim, or with spur wheel on axle? Also its approximate cost and cost of erection? With these data we might be able to compare it with the turbine motor. Of course, in fitting any machinery regard must be had to the work to be done. If you had to drive a corn mill away in the country, and away from skilled workmen, put in a water-wheel; for look how long they run without repairs. On the other hand, in driving, say, a dynamo electric machine, put in a high speed turbine to save countershafting and belts with slip and risk of breakdown. Can anyone say the longest ade by a turbine without repairs? There is er overshot wheel I was examining at the Year at the Frosterley Limestone Quarry, near ngton, 29ft. to 30ft diam., 6½ revolutions per te, 2ft. 6in. or 3ft. face, working under about to 60ft. head, which I was informed had been ng for at least 25 years, and I believe with ly a touch done to it, employed on stone ing, and reckoned to be about 4H.P. I hope subject will be "ventilated" further, as it s.—ENGINEER, Govan.

383.]—**Boiler.**—If the boiler is in good con- it should be safe at 50lb. I should not hesi- o work it at that.—T. C., Bristol.

439.]—**Electric Clocks.**—Would "Acolyte" ow he makes and connects the small commu- to the hour arbor of clock (see answer No.).—LEX.

441.]—**Sherry.**—A peep behind the scenes in merchant's (wholesale) cellars often makes somewhat sceptical. Previous to my clair- oe, one glass of sherry before, during, or dinner always made me "uncommonly queer head." This was owing probably to the ction of an intensely acid state of the ch's contents. According to Dr. Ringer's dbook of Therapeutics," all alkalies—i.e., cids, actually increase the said acidity of the ch; moreover, no alkali can be taken into the ch without robbing the body of its phos- s. In a feeble subject, too, this loss is con- ble, and cannot be replaced by food, as in a person. Moral: There being two classes of in this world, the one eating and drinking er to live, the other living in order to eat drink, to act upon the former, and to banish iscomfort-causing sherry, and thus prolong ife, is the suggestion offered by—THE LYD- DISPENSER.

445.] — **Embossing Note-Paper.** — TO . DOR." AND OTHERS.—I am much obliged reply. Will someone kindly explain the s of embossing in colours?—C. J. P.

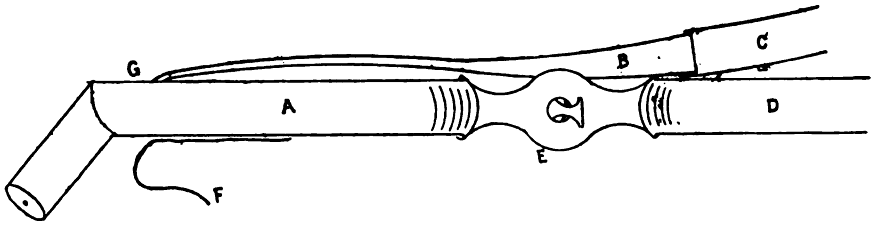
460.]—**Boring Pulleys, &c.**—Do you not that the hole could be easily bored out if a as driven tightly into the key bed and then lush with the inside, and the whole bored out ier.—J. F. LANGHOLM, Dumfriesshire.

461.]—**Altering Bell Circuit.**—ERRATUM. engraver has made an error in the sketch I The wire from the right hand side of the y only goes to the push on the extreme right. s not go across to the wire going down to H B, wn in last issue.—A. I. E. E.

461.]—**Altering Bell Circuit.**—If what ave done is correctly indicated by the m given, then the answer to your question, re am I wrong?" is simply, Everywhere. how the battery in close circuit; two pushes only one wire connected to each; the other are arranged so as to intercept each other, he wires from them lead in both directions same point in a wire from one end of the y; the two bells are connected by a wire passes through each, but avoids the battery erminates in a push at each end; not one t out of the six includes a push, bell, and y; and if the shaded spindle-shaped body at the lower left-hand corner represents a , it is so placed that the practical result is me whether it is turned on or off. You say ant S. B. to ring from any of the six pushes, the requirement is clear. Do you want to ring from all of them also when the is turned on? If so, you will find the method bed and figured in the "E. M." for Jan. 1st, reply 55582. Or do you want some pushes g one bell, and some to ring the other, or o ring both when the switch is turned on? s not the remotest idea whereabouts your nts are located; the one other thing clear to nd is that your desire "that any of them can u by their ringing the H. B. connected up as ," is one which can never be realised. If you r the pushes 1—6, beginning at the top left- and reading left to right in the usual way, it facilitate description. If you will give it replies to the above, adding any material ulars necessary to convey to a stranger exactly you wish to have carried out, it may be le to give you a working diagram.—R. T. S.

70.]—**Pyroxylin.**—I am much obliged to Johnian" for his reply; but HNO_3 is not able in other than very large towns. Can $(NO_2)_3$ be obtained by using N_2O_5 instead O_3? How is the heavy oil separated from H_2O after washing, and will any other ent do besides Hanoverian earth?— NCED STUDENT.

98.]—**Pewterers' Gas Blowpipe.**—If g Tinman" will proceed as described below, l be able to make a gas blowpipe, useful for ring, blowing joints in lead pipe, and many purposes. It is easy to make, and costs little

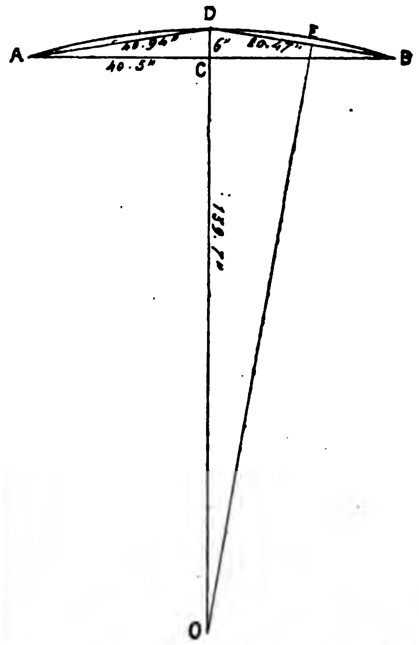


I inclose a sketch, which will perhaps make my remarks clearer. Take two pieces of ⅜ brass or copper tube, cut a thread on one end of each piece. The piece marked A should be 8in. or 9in. long, that marked D 3in. or 4in. long. Procure a ⅜ equal brass cock E, tapped, brass thread, and screw the two pieces of tube into it. At 1¼in. from the end of the largest piece of tube file a mitre, and bend it to the angle shown in sketch (about 120°). This joint must be brazed, and if "Young Tinman" has not had any experience in brazing brass tube, he had better get an "old tinman" to do this for him, or he may spoil two or three pieces before he succeeds. This done, take an ordinary brass blowpipe, B, and bend it to a similar shape; drill a hole at G, and insert the blowpipe, taking care that the end of it does not project through the ⅜ tube; in fact it must be about ⅛ back from the mouth of the tube, and exactly in the centre; it may now be soldered to the tube A. A piece of ⅜ tube (C) should be fixed on the end of B; on this is fixed a piece of flexible tube about 2ft. long, and in the end of this flexible tube there must be a mouthpiece, a piece of ⅜ pure tin pipe, slightly flattened, is as good as anything; flexible tube to whatever length the user requires is fixed on the pipe D; this is for the gas. F is a hook to hang it up while using, that is to say, while the hand holding it is required for something else. By regulating the tap E, a flame can be got as fine and sharp as a needle, and can be increased at will to a large and powerful one.—TINSMITH.

[64476.]—**Age of the Sun.**—What on earth can be known of the sun's past? Is it older or younger than the earth? In either case, is it cooling, by its present emission daily of about 1,200 million times the earth's daily supply of heat? Or do meteors enough fall on it to countervail this loss, and make it grow hotter? It is impossible to suggest a subject more hopelessly out of Sir W. Thomson's or any human ken. If its parts have collided, how many, and whence? and at how many times, and when? The matter is well worthy of "Devil's Hoof," one superstitious enough to ascribe to his master, the Evolver, works beyond the power of any but a creator; and entertain the ridiculous idea that varieties of pigeons are pigeons only "because we know the history of the case." Do we know the history of wolves? These are of the same species with mastiff or terrier, because they not only produce offspring with them, but these offspring are fertile to indefinite generations. A greyhound is not of this species, but of the same kind or genus, because, though breeding with them, the offspring are barren, like mules. If there were no offspring, even of this mule sort, the animals would be of not only two species, but two "kinds" or genera. Our knowledge or ignorance of their past history has nothing whatever to do with identity or difference. If there are 700 varieties of hyacinth, they are all hyacinths, because their ovaries can be fertilised by hyacinth pollen, and not by that of any other flower; and they all produce pollen that will fertilise any hyacinth, but have no more effect than a devil's hoof on anything that is not a hyacinth. Thus the 700 are known to be one kind of flower; and no culture had ever produced a new kind yet of any thing.—E. L. G.

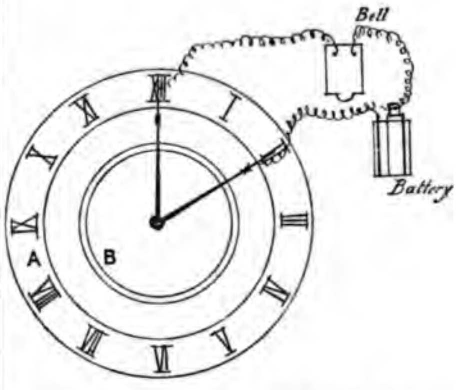
[64483.] — **Varnishing Light Cart.** — Let "X. Y. Z." give his cart two coats of gold size before varnishing.—COACH PAINTER.

[64494.]—**Copper Bottom.**—Our first object will be to get the area of the curved surface of the figure. To do this we must first get the diameter of the sphere of which it is a part. In the figure A B is bisected in C, D C O is perpendicular to A B, D E = E B, and E O is perpendicular to D B; O will obviously be the centre. Now the triangles D C B, D E O are similar; therefore D C : D B : : D E : D O. From this we may calculate the length of D O. We find it = 139·7in., therefore the diameter = 279·4in. We have now got the data necessary to get the area of A D B. It is equal to 6 × 279·4 × π = 5295·6in. Now as regards the rim: This we may treat as the difference between the areas of two cones, one whose base is 85in. diam., and another whose base is 81in. diam., the slant of both being the same. Calculating this out, we get the area of the rim = 1,563sq.in. Now add the two results together, and we get the total area in square inches; 5,296 + 1,563 = 6,859sq.in. Let us take the average thickness as ⅜in., taking into account its circular shape. A more exact method could be taken here, but the work connected with it is very laborious. We now get the volume in cubic inches = 6,859 × ⅜ = 2,578; this equals $\frac{2,578}{1,728}$ = 1·489 = nearly 1½c.ft. Now weight of copper = 556lb. per cubic foot (Rankine);



therefore weight of copper in vessel = 834lb.—GILMORE.

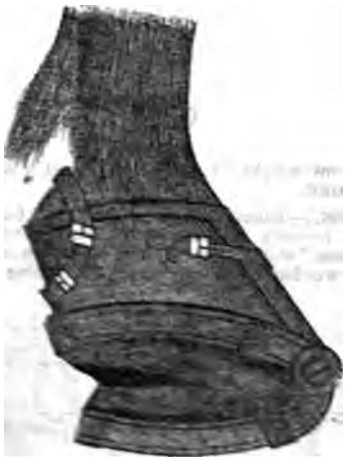
[64496.]—**Electric Alarm Clock.**—I have had quite recently a clock fitted similar to what "Corwen" wants. To the clock face there is fitted a thin wooden or vulcanite circle, as A, going round



the margin where the minute-hand moves, and there is also another circle, or rather channel, B, going round just within the hour-hand's margin; a small piece of platinum fitted with wooden stock, as C, made to slide rather stiffly in the channel B (so as to avoid being moved when the hour-hand comes to it); another piece of platinum, D, is put on the outer circle A just under the XII. The movable stock is put opposite the hour wanted, and connected to bell and battery, as sketch. (The hands of clock, of course, must be raised a little to avoid the possibility of them stopping when they come into contact.) The contact in sketch is set for two o'clock, and the circuit is just completed. Hope this will meet "Corwen's" demands.—F. MASON.

[64501.]—**Liverpool Fire Brigade Horseshoes.**—A few weeks ago the daily papers (at least, some of them) kindly published a letter of mine calling attention to the sufferings of horses in consequence of their continual slipping upon the asphalte and wood-paved streets here in London. In my letter I referred to an improved kind of shoe used by the Manchester Fire Brigade, and the great success attending it. Since then I have learned that this shoe is an adaptation of the "Charlier," which, as "D. G." doubtless knows, is a narrow steel rim pinned on to the hoof, and which allows the frog of the foot to grow naturally and form a perfect non-slipping pad. The publication of my letter resulted in my having several so-called improvements in horseshoes submitted to me, and which I shall be happy to show any of your correspondents who may be interested in the matter. Not owning any horses myself, and having nothing to do with them, I am of course unable to express an opinion, and I have taken up the question purely on the grounds of humanity, hoping that those who are able to do so will carry it on. I may add that a friend of mine has had his horses shod with this narrow steel shoe, and that it is a perfect success, the animals never slipping on any of our asphalted streets or other smooth roadways. —HERBERT WILKINS, 11, Bow-lane, E.C.

[64501.]—**Liverpool Fire Brigade Horseshoe.**—Through the kindness of the superintendent and officials of the Liverpool Fire Brigade, I am enabled to inform "D. G." that when a horse belonging to the above brigade casts a shoe, they fix on a temporary one, which is taken off when they again reach the stables, and the proper one put on. This temporary shoe consists of two pieces of iron, which are jointed together by a strong rivet at the front of the shoe; the joint is loose so that the sides may be moved further from or nearer to each other, making the width greater or less. There are four protuberances on the under side, one on each side of the rivet to preserve it, and one at each end of the shoe. A piece of leather about 5in. long and 4in. high is riveted on each side between a strip of sheet iron and the shoe, so that when the shoe is on the foot the leather embraces the sides of the hoof. To one of these pieces of leather three buckles are attached, and to the other three straps, of which one fastens round the front and top of the hoof, another round the back and lower part, and the third comes in the hollow beneath the fetlock. Perhaps the sketch will aid



in understanding the arrangement. The shoe is [illegible] and for short distances the invention [illegible]. It is the idea of the farrier of [illegible] and as it was only recently introduced, [illegible] be seen anywhere but in Liverpool. The [illegible] with gratitude by him.—BOTANIST.

[illegible]—**Engine.**—Clean the engine thoroughly, and after [illegible] take a clean [illegible] a little boiled linseed oil [illegible] all polished parts. If the [illegible] and the piston taken out [illegible] the inside, it may possibly [illegible] a way to manage [illegible] give it a good clean out [illegible] water, get up steam, then draw the fire [illegible] of the water while the boiler is hot. This [illegible] necessary. [illegible] have never failed [illegible]

[illegible]—**[illegible]**—[illegible]

[illegible]

Dublin" arrived at his numbers; I got m[illegible] out of a table of factors, which gives $1152 = 2^7 \times 3^2$, or 128×9.—J. K. P.

[64505.]—**Screw-Cutting.**—In "Sydenham's" reply last week he states the wheels $\overset{80}{30}—\underset{100}{65}$ will cut the screw required. I fail to see how he does it, because it cannot be done correctly without the 115 wheel. I worked out various trains of wheels, but did not complete them in time for last week's insertion, and the nearest was $\frac{30}{55} \times \frac{35}{110}$, the same as "W. M. I., Dublin," the error being only ·02 in 1in. of screw, or as 576 to 575. Supposing screw to be cut 50in. in length, there would be 576 threads instead of 575 as required.—W. W. C.

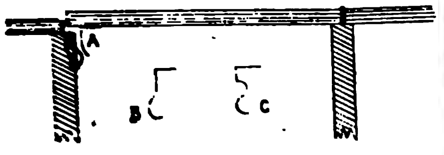
[64511.]—**Re-blacking the Lines in Ivory Scales.**—Mix a little lampblack with gold size and rub in, cleansing the surface at once. When out of lampblack I have used soot and copal varnish, mixing well, wiping off at once, and cleaning the surface of the rule. The latter takes rather longer to dry, but is equally effective. It is just as well to clean the parts thoroughly with warm water and soda before applying the black.—NUN. DOR.

[64526.]—**Telephone.**—In reply to "S. M. S.," I should imagine that the screaming noise he refers to is caused by the pressure between the carbon contacts of his transmitter being too light. In one instrument of this class with which I am acquainted the carbon rods which are spoken to are strung at their top extremities on a horizontal platinum wire, and rest or hang against a horizontal carbon block. The whole is contained in a frame, and the pressure can easily be regulated by altering the angle at which the latter hangs. If care be taken that the pencils can hang freely, and that they do not catch on the bottom of the frame, instruments of this kind work very well. Perhaps "S. M. S." can give further particulars of his instrument? With the rather meagre description to hand, it is difficult to give definite advice.—ENO. H. PELET.

[64531.]—**Enlarging.**—Your ¼-plate portrait lens will suit well enough to enlarge a portrait from carte size, but not a landscape. For that purpose a lens of the rapid rectilinear type is required to give marginal definition. The proper side of the condenser to face the photo slide is the convex. You will find formulæ for calculating what your lens should do in the *British Journal Photo. Almanac for 1888*, price 1s. At page 267 the editor (who is quite an authority on the subject) treats "enlarging" very fully in eleven chapters.—B.SC., Plymouth.

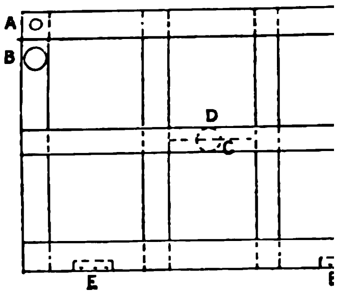
[64533.]—**Two-Tint Writing.**—I have just seen, in an American magazine, the following advertisement:—"The Automatic Shading Pen.—Makes a shaded mark of two colours at a single stroke. Sample set of three sizes, by mail, $1.00. Circular and sample writing free. Ask for them. —J. W. Stoakes, Milan, O." It appears very probable that the pen here described is the one alluded to by "T. J.," and if so, the advertisement does not lead one to think that any special kind of ink is required. More likely a certain method of handling the pen is necessary.—J. DROWLEY.

[64535.]—**Electric Contact under Shop Door.**—Cut the floor board to length required, and hinge it at one end, supporting the other upon a pedal spring sufficiently strong to carry the weight of board and mat. Use a trigger which makes contact when the stud is pressed in; fix it on the joist, as shown above, with striker in form of A screwed [illegible] side of board. A person stepping on the mat will depress the board, and cause the bell to ring until his weight is removed. If you desire the bell to ring only when a person first steps on the mat and not all the time he remains upon it, a striker in form of B should be used; but the trigger should be fixed upon an intermediate joist, or nearer the hinge, so as to obtain a longer period of contact. [illegible] alarm trigger is used, acting as Fig. 40, [illegible] a striker in form of C will be required.—[illegible]



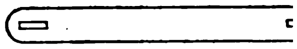
[illegible]—**Electric Contact under Shop Door.**—[illegible] of an apparatus which will, perhaps, suit your purpose. Fig.
made of, say, 3in. slate batten; Fig. 3

FIG. 1



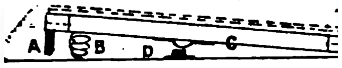
of same; A A are stops o prevent the
pressed down too far when the weight
is placed on the springs B B; C is a

FIG. 2



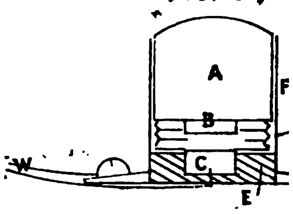
slotted ends, in order to allow it to
pressed down; its object is to relieve t
on the press D, and it is shown in deta
Fig. 4 is the press; it consists of a

FIG. 3.



sliding in a brass tube, F, which is su
the bottom by a flange, G; B is a co
held up by the spiral spring D; while
contact piece, insulated from F by

FIG. 4.



block, E. The tube G F forms, with
is all one piece), one terminal, and the
C is the other, the wires being shown
spring, Fig. 2, must be rather stiff, in
may overcome the resistance of the
D.—PRINCIPIA.

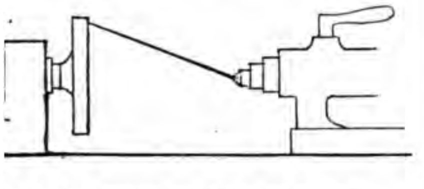
[64538.]—**Cement for Kitchen**
Portland or Keene's cement would b
use. It should be mixed with wate
enough to use. For stopping betwe
work and ironwork, red-lead cement
with advantage, and is mixed from wh
red lead by working the two togethe
C. D.

[64541.]—**Long Focus Rapid L**
retically, the longer focus lens sho
greatest depth; but practically you
reversed, owing to the difference in t
makers of lenses.—B.SC., Plymouth.

[64543.]—**Coated Pills.**—"Botani
the following process the best for
and enamelling pills. Requisites: N
isinglass, 1 drachm; simple syrup,
water to 2oz. Dissolve by gentle h
"The Solution." No. 2. Finely-pow
chalk, 1oz.; white starch, 1 drachm
through fine muslin sieve, and
Powder." No. 3. Gum juniper, 30
sam of tolu, 30 grains; meth. ether, 1
and label "The Varnish." No. 4. A
evaporating dish. No. 5. A small
covered pot. No. 6. A 1lb. or 2lb.
Process: Take your evaporating di
pan) and place the pills in it, taking
are perfectly round, as hard as poss
from adherent powder. Pour about
the solution upon them, moving th
until they are all evenly covered. Th
into your coating tin (No. 5), into w
been introduced a layer (about 1 d
powder), then add about 2 drachms

o the pills, shake freely for three minutes, add more powder if all be taken up. You will now the pills "coated." Expose them for 20 utes, transfer them to polishing pot (No. 6), , with circular and varied movement, rotate il pills assume a glossy appearance. Expose s to the air for a short time, and again rotate No. 6) if not sufficiently glossy. If pills con- iodide of iron, essential oils, &c., they must be varnished (with No. 3); 1 drachm is erally sufficient for 2 gross. The longer the s are shaken, the better the gloss will be.—LEXANDER DEANE.

64546.]—**Testing Lathe Heads.**—If "A. T." es up his largest face-plate, and runs a very fine ove on it, about $\frac{1}{4}$in. from its outer edge, then gets iece of wire $\frac{3}{16}$in. or $\frac{1}{4}$in. thick, 18in. long, centre end of it and point the other, and apply it as wn on sketch, he will find the point will



el in the groove on chuck (if the heads are ect); if not, it will show the direction in which will have to move it to set it true.—D. B. S.

64546.]—**Testing Lathe Heads.**—First you uld ascertain whether the heads are in line h each other and parallel with the bed. amine the movable head first; try whether it l slide freely and without shake over every part the bed. If it is too loose, and you can twist it eways so as to alter the direction of its centre , it is useless to examine further, since its centre has no certain direction. If it fits well, put he dead centre, tighten the fixing screw, and le up the headstock till the centre points meet, l observe whether they do so exactly. This is erally the case. Now draw back the head, sen the fixing screw, screw out the dead centre rel as far as it will go; fix again, slide up the d as before, and observe whether the centres l meet truly. If they do so in both cases, the vable headstock is true. Next examine the d headstock. Loosen the bolt, and try whether can twist it on the bed. If you find it a little e, so that you can alter the position of the run- g-centre $\frac{1}{16}$in. or so, it will not much matter, if know how to set it truly before securing the t. Now we have already compared the running tre with the back centre; but though the centre s of the two headstocks coincided at this point, loes not follow that the headstocks are in line. is is only proved to be the case when we have wn that two points in the centre line of each dstock are in line with a point in the other. have already applied this test to the movable dstock. To apply it to the fixed one, prolong mandrel by fixing a roller of wood into a chuck; the roller project at least a foot further than running centre does; melt some wax upon the of this roller, and mark the centre upon it with ol point while revolving. Now slide up the k centre, and observe whether it exactly enters centre hole in the wax; if it does so, your dstocks are true. This is perhaps the most ly of any test to show the way in which the e has been fitted together. Only the best lathes prove true in this respect, their headstocks ing being bored on the bed.—NO SIG.

54549.]—**St. Paul's Organ and its Organist.** ou will probably get a photograph of Dr. iner at the photo. dealer's at the corner of thampton-street, Strand.—PRINCIPIA.

54549.]—**St. Paul's Organ.**—The specification St. Paul's Cathedral organ has been given in the . M." Search the back numbers. I saw Dr. iner's cabinet photo. in a bookseller's in St. l's Churchyard, corner of Ludgate Hill.—WM. BINSON.

64549.]—**Swell Box.**—Cover the outside of the with boards glued up and planed level, and w them on securely. If the shutters are only thick they will be necessarily too narrow to r. Get a new front of 2in. stuff, and let the tters be kept wide—say, 9in. Narrow shutters not effective. As to the echo organ, I don't k there is any use for it. You say the box is e to the ceiling; how, then, can there be 4ft. for aller front? or what use do you want to make t? If the swell shutters are slightly opened it have the same effect.—WM. ROBINSON.

4550.]—**Meridian.**—The meridian is an ginary circle passing through the poles and the e of observation. There is, therefore, no speci- line which is called the meridian, although we e our measurements of longitude from the idian of Greenwich, and this is looked upon as the meridian. This circle passes, in the heavens, through the zenith and the pole, and from this it is clear how to find it. There being no star which exactly marks the pole, we have to resort to some method to determine its precise position. This we may do by observing the upper and lower culminations of a circumpolar star, and halving the distance between them—or, in other words, finding the centre of the circle in which the star revolves. GILMORE.

[64550.]—**Meridian.**—This is rather vague, and instead of "by day or night," it should rather be told whether with or without chronometry, or what degree of accuracy in time. If you have a ship chronometer, it is enough to mark a shadow at apparent noon, as given in the almanac. The shadow should be that of a parallel bar or rod, at about 110 times its width, at which distance the middle is plainly a mere black line. But you can be quite independent of clocks by day in the week of longest days or that of shortest; and by night at any time of year by noting when a star is at equal altitudes, two or three hours before its transit, and an equal time after it. The cheapest appliance is probably a piece of horizontal arc, fixed level, at nearly the height of your eye, and at its exact centre of curvature a plumb-line hanging into the centre of a basin of treacle. The treacle must not form either a heap or pit round the thread, but be level. Looking down to it from your level arc you can mark where the thread just stops reflection of the star, but the least movement of your eye right or left brings it into view. The interval of your two observations should in no case be less than four hours, and six is better. Hence, the nearer your star to the pole, the less extensive arc will you require. The pole-star itself will do with only one observation if you take care this is within a half-hour of its upper or lower transit. If you use a star of such low declination as to rise and set—Arcturus, for instance—you may fix up two separate bits of arc, and if truly level, the two points on them give an east and west line to which the meridian is perpendicular. All latitudes north of 45° have Capella never setting, and those north of London have also Vega, and these two being on nearly opposite meridians, Vega is well suited for winter and Capella for summer use.—E. L. G.

[64550.]—**Meridian.**—The method to be followed in laying out a meridian line depends very much upon the degree of accuracy aimed at. A transit instrument and a good clock, and astronomical observations made with them, will give the most accurate meridian. An ordinary theodolite, with or without a clock, will give a very good meridian-line which, with care, might not have a larger error than 3ft. in a mile. A very fair meridian line can be laid off by the use of an ordinary pocket watch, if the observer can obtain accurate time (within a second or two), and can get his longitude from the Ordnance Survey map of the district. Supposing he can receive the 10 a.m. time-signal sent out by the General Post Office, or even the signal sent along the railway lines, he would know the correction required to his watch. All he has then to do is to suspend a plummet by a very long string, the bob hanging in a bucket of water. The shadow thrown by the string at apparent noon will be due N. and S. The instant of apparent noon by the watch is found by applying the equation of time and the longitude, thus:—

	h.	m.	s.
Apparent noon	0	0	0
Longitude, west........................	0	2	40
	0	2	40
Equation of time to be added to apparent time	0	13	22
	0	16	2
Watch 40s. slow	0	0	40
Watch time of apparent noon ...	0	15	22

The best way to take advantage of this knowledge of the time is to view the sun and string together through a minute hole in a small piece of metal temporarily fixed to the board or other surface upon which the meridian line is required to be marked. If this be done for a few days, each day with a new watch connection, a very good meridian will ultimately be obtained. Without the aid of time or Ordnance Survey, the operation is more troublesome. By the Sun.—Take an ordinary drawing board, a couple of feet long, and in the middle of one long side erect a stout wire perpendicular to the surface. With a piece of string of the right length to suit the sun's altitude at 9 a.m., say, describe a semicircle on the board with the wire in the centre. The board is placed in full sunshine before 9 a.m., steadied and levelled. Presently the extremity of the shadow of the wire will fall on the circle, and a little mark is to be made there. About 3 p.m. the tip of the shadow, in lengthening, will again touch the circle, when another mark is to be made. The middle point between these two marks will be due south of the wire. By using several circles, greater accuracy will be obtained. The following is an excellent method of obtaining the meridian at night without the use of instruments. At the S.E. or S.W. angle (whichever is preferable) of the house nail up a board as high as possible with one edge 3 or 4ft. long, projecting beyond the brickwork, and truly vertical. With a long plumb line, determine a point near the ground immediately beneath the edge above mentioned, and fix up another board with its edge touching the plumb-line. On a rough tripod fix a piece of metal with a small hole in it, and place this tripod just so far south of the corner of the house that the Pole-star is seen near the edge of the upper board. Almost any almanac will give the time of the Pole star being on the meridian (and remembering that it is also on the meridian 12 hours afterwards, that a few minutes will not signify), it will be easy to place the tripod so that the Pole-star, seen through the little hole, is exactly on the edge of the upper board at the right time. The hole will then be due south of the edge of the lower board, and distant marks can be set up to mark the meridian. The degree of accuracy obtainable by these methods depends very much upon the skill of the operator. I have, for brevity, omitted all details that his ingenuity should supply.—DYNAMITE'S BROTHER.

[64551.]—**Ordnance Datum.**—The first base line taken in England was that measured just outside London on Hounslow Heath, in 1784, by General Roy, for the purpose of triangulating the short stretch of country between Greenwich and Dover in order to establish a connection between the observatories of Greenwich and Paris. Its length was about five miles, and so skilfully was its exact value ascertained by Gen. Roy that, upon re-measurement some years later, a length differing from it only by some two or three inches was obtained. The real base-line of England, however, is that measured on Salisbury Plain. In the English triangulation, a base of verification was measured when the work had proceeded as far as Masterton Carr, in Yorkshire. Another was taken at Ridland's Marsh, in Wales. In Ireland a base of some eight miles was measured on the shores of Lough Foyle by Colly.—GILMORE.

[64553.]—**Dibdin and his Songs.**—Dibdin was both writer and composer of the song, "Blow high, blow low." As to the date, I could not enlighten you.—W. PERREN-MAYCOCK.

[64558.]—**Steam Boilers.**—Bafflers have been tried. The objection to them is that, while they may direct the flame against the sides, they get burned out very soon. Mr. Longridge has lately revived an old notion of heat pegs, but the principle is different—the pegs stand into the interior of the boiler as well as projecting into the furnace or flue.—W. M. I., Dublin.

[64560.]—**Indian Cheroots.**—As a smoker of half a century, I will give you the result of experience. Nearly all cigars, particularly Indian cheroots, are too crude, being freshly manufactured and rapidly sold. The clubs and military messes in India, when obtaining a large stock (even their "Manillas"), put up 256 to 500 cigars in new tin cases; these are soldered up and labelled with name and date of inclosure. When so treated for two to four years they acquire great aroma, besides being protected from the tobacco weevil, which perforates them when exposed to the air. There was a great smoker at Madras who declared the weeviled tobacco was always the best (being aged). He was ever on the look-out for the so-damaged article, and consumed them by putting on a wrapper of tissue-paper, which he tore off as he burnt the weed. I followed his example, and got many presents of damaged cheroots; in spite of the holes, the tobacco was A 1. Trichinopoly is in the Madras Presidency; the genuine cheroots are sent for sale to Madras Town. I prefer the "Lankas," manufactured at Coconada on the Madras coast. The "Leisure Hour" is the best brand; more than one Englishman has made a fortune in that form of weed. Bombay has its good cheroots, too—notably the "Elephant" brand. I used to get this and others from a German firm in that city. Preferably, I admire the large Havannah-shaped No. 1 cheroot made in Burmah, which I used to get from Rangoon in quantity, where female labour, being very cheap, is solely employed in their manufacture. I consider this kind, when put away as above described, a perfect cheroot. Calcutta makes bad imitations, the 'cute Bengalee delighting in fabrications, however pernicious to the consumer. Some men like fancy flavours, and pack their cheroots in dried rose-leaves, &c.; but I like pure tobacco. If cheroots become too dry, put a few slices of apple or carrot in the box for use.—EOS.

[64562.]—**Rudder.**—The book is wrong. "C. C's." own idea is right. Beaufoy proved, by numerous experiments, that the resistance of planes is approximately as the sines of the angles of stream obliquity. The resistance does not run exactly as the sine; because the skin-resistance of the plane modifies the result. The modification is perceptible at angles of less than 15°; but at larger angles it is so small as to be of no practical moment.—FRANK CAWS, Sunderland.

[64566.]—**Dynamo.**—This is a very unpractical way of running a dynamo. However, by the help of gearing, it could be run for a few minutes. How long do you want it to work at a time? It is a mere question of gearing, weight, and height. —W. PERREN-MAYCOCK.

[64566.]—**Dynamo.**—Taking 20c.p. as 6 watts, we get, as the power necessary to drive the dynamo, $\frac{1}{124}$ of a horse-power—that is, 269ft.-lb. per minute. You will therefore have to raise a weight of 2·4cwt. one foot for every minute the dynamo runs. If you think it worth the trouble and labour, it would be a very simple matter to arrange an apparatus to fulfil your requirements. —GILMORE.

[64567.]—**Electro-Magnet.**—The magnet is to be a horseshoe, of course. Make the cores of 2in. round iron, and wind 60lb. or 70lb. No. 12 or 14 c.c. copper wire on each leg. Resistance of wire:—No. 12 per lb. = ·025 ohm, No. 16 per lb. = ·075 ohm. The cores should be of the softest iron annealed by being made red-hot and allowed to cool in the ashes. Such a magnet will lift over a ton at its greatest power. Don't wear your watch whilst experimenting.—CHAS. PROVIS.

[64567.]—**Electro-Magnet.**—You have first to consider the resistance of the rest of the circuit—i.e. of the battery and lead wires; the resistance of your magnet should equal this (say) x^{w}. The dia. of cores should be about one-third length—i.e., 4in., and they should be of Swedish or Norwegian iron, carefully annealed. Calculate the volume of wire you have room for, which will depend on length of yoke. Let vol. = V; the resistance x should $= \frac{l}{s}$ where l = length of wire and s its cross-section; also $V = l \times s$.—W. PERREN-MAYCOCK.

[64567.]—**Electro-Magnet.**—Use a core about 1¼in. in diameter, and wind sufficient wire on to treble the diameter of each limb—i.e., so that each wound limb should measure 3¾in. in diameter. The exact weight of wire will depend on the closeness with which you are able to lay the wire on—probably from 20lb. to 25lb. The gauge will depend on the amount of current you are able to drive through. If you have a large current of low E.M.F., use No. 14 wire; but if you have a higher tension, but not a large current, use a finer gauge—say, 16, 18, or 20. See my book, "Electrical Instruments for Amateurs," for further information.—S. BOTTONE.

[64568.]—**Oscillating Cylinder.**—This is large enough to drive the boat slowly. Supposing the cylinder is vertical, the steam block face has first a centre pin on which cylinder oscillates, and cylinder is kept against the face by a centre screw on other side of cylinder. If the size of the port-holes in cylinder is ⅛in., then face of block has four holes in it—two at top and two at bottom, and placed ⅛in. each side of a vertical line. The two holes in one side are connected to steam, and the other two to exhaust. Solder a new face on cylinder.—T. C., Bristol.

[64569.]—**Lightning Conductor.**—You must attach a copper or zinc plate of at least three or four square feet, descending well into the damp earth below your "mortar and brick rubbish." I believe all iron masses about the forge ought also to be connected with the conductor; but this is less important, and disputed by some.—E. L. G.

[64569.]—**Lightning Conductor.**—The best thing you can do with this is to dig a hole a few feet deep at the bottom of the rod, and add a piece of iron to the conductor, and bury it in the hole with about a bushel of wet coke at the bottom. This will act as an earth plate. As it is at present it is rather dangerous; but if it is treated as above, and the ground kept damp by pouring an occasional bucket on it, it will be quite safe.—PRINCIPIA.

[64569.] — **Lightning Conductor.** — The chimney would probably be safer without such a conductor. If you have no water main near to which you could attach the earth end of lightning conductor by means of a metallic wire or rope equal in conducting power to the lightning conductor itself, you had better bury a plate of galvanised iron or copper in a few bushels of coke well watered, and solder the end of conductor to the plate. A wood casing would be of no use whatever.—C. PROVIS, Emsworth.

[64569.]—**Lightning Conductor.**—Dig down and continue your conductor much deeper until you get into damp soil. It is essential that the conductor should have a moist termination. If you cannot reach damp earth, arrange a cesspit filled with breeze, earth, and small broken rubbish, and lead into this a small inlet for occasional water percolation. In this moist bed bury a square yard *of sheet copper,* and connect your conductor to *same. Then trust in Providence; but it will be* wise to have your whole conductor tested, and, if it be a flimsy one of iron, put up a copper one.—A. C. G.

[64569.] — **Lightning Conductor.** — Your lightning conductor, as it at present stands, is really dangerous instead of being a protection, and must have been erected by a grossly ignorant person. It should terminate in a plate of copper or zinc, at the very least 3ft. square, and embedded well down into the damp subsoil, surrounded by lumps of coke and cinders; besides which, a branch wire should be soldered on to the water-main. If the plate can be put direct into water, such as a pond or well, so much the better. There is no need to encase it. If these conditions are satisfied, you may work by it with perfect safety.—W. PERREN-MAYCOCK.

[64569.]—**Lightning Conductor.**—In any case the loose end of your conductor is highly dangerous, for, instead of conducting the electricity to the earth direct, it would conduct it to your cellar, and thence make contact through the remaining distance with the earth, with more or less disastrous effects, setting fire to any combustible in its way. The only safe way to proceed is to bury a plate (or mass of metal) in the wettest place you can find in the earth, and join it to the broken end with wire of the same size as the original. But as a lightning conductor would certainly never be put up without a connection with the earth, if you look you will most likely find the other end, and so save yourself much trouble. A casing of wood would only add to the danger of the thing, as explained above.—LEWIS.

[64569.]—**Lightning Conductor.**—I think it is fortunate that "G. J." has drawn attention to the earth communication of his lightning conductor, as a better arrangement for having the foundations of his chimney torn up by a violent flash could hardly be devised. He should dig a hole about 6ft. deep, about 3ft. square, two or three yards from the outside of the chimney; at the bottom let him put an old 56lb. weight, attaching one end of a good copper rope to its ring, and firmly uniting the other end to the end of his present conductor. The hole should then be filled up nearly to the top with lumps of coke and covered in. If his conductor is of good size (say ¾in. copper rope), I think he will be pretty safe at his forge; but I should not work there in a heavy thunderstorm if it can be avoided. A good wood casing over the conductor in the cellar would prevent parties touching it; but a good earth connection is the main thing to obtain for a conductor.—B. HARCOURT.

[64570.]—**Packing.**—Asbestos paper with red lead is best for your purpose, and would be dry in a few hours sufficiently to work your engine.—LEWIS.

[64570.]—**Packing.**—Soak a thin piece of brown paper in linseed oil, cut it to size of joints, and lay it between, and screw; or use simply putty made of equal parts of red and white lead. Use either joint the following day.—T. C., Bristol.

[64570.]—**Re Dynamo Brushes.**—I venture to reply to this query, as I have two "Manchester" dynamos under my charge about the size of querist's, of 300 and 220 ampères respectively, which have been running now nearly three years at Leeds Coliseum, giving great satisfaction, being especially free from the vice mentioned—viz., sparking at the brushes. Of course machines of this size, giving large currents, require a little attention to get the best results. I always smooth up my commutators after every two or three runs, with a fine file and slow speed, finishing off with flour emery cloth, and cleaning off with waste. The brushes as supplied are about the right angle, and should be kept bevelled off nearly ⅛in. at nose, and slightly rounded off at heel to prevent cutting, and must not cover more than the width of one commutator bar at the end. Care should be taken to get them to bed well all over, and to set them exactly opposite on the commutator; the rocker must be set to position of least sparking, and will require moving whenever the load is much varied. The main point being to prevent sparking, which soon gets from bad to worse, oil should not be used unless the brushes cut, which will be shown by bright rings; these may be touched with the slightest trace of oil on tip of finger. My machines often run the entire evening without any perceptible sparking at the brushes. I would suggest that querist should have his commutator turned up true in lathe, and make a fresh start with a new set of brushes.—F. W. DICKINSON.

[64571.]—**Shaking Hands.**—The modern habit is derived from the custom of shaking or striking hands in confirmation of a bargain, or on becoming surety for another, and has been common to all nations and all ages. See Proverbs vi. 1, xvii. 18, xxii. 26.—CHRONOS.

[64571.]—**Shaking Hands.**—This is one of those customs which cannot be said to have had any one local origin, being found in use in various ages, and among many nations. Its meaning is that of alliance, or friendship. The following, from Taylor's "Early History of Mankind," is to the point. "We could scarcely find a better illustration of the meaning of the gesture of joining hands than in its use as a sign of the marriage contract. One of the ceremonies of a Moslem wedding consists in the bridegroom and the bride's proxy sitting upon the ground, face to face, with one knee on the ground, and grasping each other's right hands, raising the thumbs, and pressing them against each other; or in the almost identical ceremony in the Pacific Islands, in which the bride and bridegroom are placed on a large white cloth, spread on the pavement of a marae, and join hands. This as evidently means that the man and wife are joined together, as the corresponding ceremony in the ancient Mexican and the modern Hindoo wedding, in which the clothes of the parties are tied together in a knot. Among our own Aryan race, the taking hands was a usual ceremony in marriage in the Vedic period."—J. H.

[64573.]—**Organ Swell.**—In reply to "Organist," I find from my own experience that to use felt for lining swell-boxes is detrimental, as it deadens the sound very much when the swell shutters are open. I should prefer some boards an inch in thickness screwed across the ends and top of the box, and the back also, provided it does not touch the wall; half an inch is too thin for any swell-box. I have known a capital effect to be produced from a box only an inch thick, and I used to play upon an organ myself a few years ago which had its swell-box constructed upon the very best principles, with 2in. shutters, with hardly any effect at all; but position has a very great deal to do with the effect of swells generally. "Organist's" idea to carry a trunk or tube through the ceiling is very good, as I have known it to be used with very good results; it not only gives a more brilliant crescendo, but makes the crescendo more gradual. You will find in some organs that you get all swell effect from the first inch and a half travel of the swell pedal, the remaining part of the travel being of little or no use. Should you have a tube put to your organ, you should see that great care is taken that the valve or shutters to the trunk work perfectly with the front shutters.—BACH.

[64573.]—**Organ Swell.**—To deaden the vibrations of your swell-box you should commence by covering the top and sides, also back if practicable, with the thickest brown paper; after which, put on a layer of thick woollen felt, and tack it down. Over this you should now nail stout pine lining or flooring, if you wish the best results, making the box about 2in. thick. If the expense of the felt is an objection, you could cover with the pine, leaving a space between it and the present sides of the box. This air-space would act well as a deadener. See that your swell shutters close perfectly. I would advise you not to take the trouble of carrying a tube through the ceiling for the purpose of securing an echo effect. It is obvious that, whatever faint sounds might penetrate the ceiling, they would be effectually drowned by the much louder sounds from the swell-box. It might be possible to plant a stop of pipes above the ceiling, and convey the wind by means of tubes, if the game were thought worth the candle; but they would never keep in tune with the rest of the organ, owing to the difference of temperature.—JOHN MCLAREN.

[64574.]—**Boehm Flute.**—You cannot do better than get a Carte's 1867 model. I much prefer vulcanite to cocus wood; it is so much lighter, and at the same time easier to blow. I do not agree with you that professionals prefer the wood; my experience points the other way. A fall is much more likely to damage the mechanism than to injure the vulcanite, but if you are in the habit of dropping things in such a casual way, I should not advise you to invest 28 guineas in a flute. Perhaps you would prefer a silver instrument—they are all the same price. By advertising, you may pick up a second-hand flute for £17 to £20. I have frequently seen them offered in *Exchange and Mart.* The only Collard I ever saw had very large holes; it was loud close at hand, but had no carrying power. I did not think much of it.—SM.

[64576.]—**Ink for Type-Writer.**—This is made with a saturated solution of aniline violet mixed with glycerol.—SM.

[64576.]—**Ink for Type-Writer.**—The ink for type-writer is composed of red or purple aniline dye, thickened with gum and a small pinch of sugar, —TECH.

[64576.]—**Ink for Type-Writer.**—To 2oz. to 3oz. of ordinary ink add a (table?) spoonful of thick gum and a teaspoonful of brown sugar; warm, and saturate the ribbon; dry, spread on board, and brush with glycerine. If there is too much colour, iron between two papers; if too little, re-brush with glycerine.—A. W.

[64577.]—**Engine and Boiler.**—Boiler safe up to 200lb. if the ends are dished, and is quite too small for the engine unless the cut-off is about ½ stroke or earlier. The boiler is not capable of evaporating more than about 1c.ft. of water per hour, or about 70 revs. per min. at 100lb. pres. = about 1¾H.P.—T. C., Bristol.

[64578.]—**Boiler.**—The following dimensions will suit you, but I do not know about being "proper." I did not know such a dimension was to be found. I would advise 1½in. external diameter thin iron tubes. You can then get in about 14 or so in a firebox 12in. diameter, which can be 18in. deep. The smoke-box is usually a conical hood with chimney at top. Make hood a foot high, and chimney 5in. diameter. Engine will give about ½H.P. at 300 revs. at 40lb., but I should work it at 50lb. or 60lb. Make shell and firebox, &c., of ¼in. plate, and it will be safe at 80lb., if workmanship is good.—T. C., Bristol.

[64579.]—**Testing the Compass.**—One of the reasons why a ship's compass requires to be tested is that the ship itself becomes a magnet, and exerts an influence on the compass, by which it is deflected from its correct position. In good compasses—notably Sir William Thomson's—large masses of iron are part of the instrument, and compensate effects of this description.—GILMORE.

[64579.]—**Testing the Compass.**—As most ships are built of iron, or consist very largely of iron, and as iron by hammering, vibration, or even lying in a certain position with regard to the earth's magnetic poles, acquires a certain amount of magnetism, subject to variation, it follows that the ships exert a very powerful influence on the readings of the compasses. For this reason it is absolutely necessary to check the errors, and this is done by swinging the ship and noting the deviational error in every position. A chart of errors is compiled, to be referred to in every position of the ship. But as this "sub-permanent magnetism" of the ship is continually varying, it is necessary to be continually taking note or "testing the compass."—S. BOTTONE.

[64579.]—**Testing the Compass.**—Ships' compasses are affected by the magnetism induced in the iron and steel of the ship, caused first by the hammering any steel receives during the building, whilst under the induction of terrestrial magnetism. All vertical masses of iron are similarly affected. The effect on the compass is—1. Semicircular variation, which is *nil* when the disturbing mass is in the magnetic meridian, and causes westerly and easterly variations of the needle when it is W. or E. 2. Quadrantal variation caused by horizontal masses, such as guns and plates. This vanishes at the four cardinal points, causes a westerly deflection when in a N.W. quadrant, easterly in S.W. quadrant, westerly in S.E., and easterly in N.E. quadrant. This is corrected by neuralisation with permanent magnets placed on deck. The semicircular variation is neutralised in a somewhat similar manner by a vertical magnet. The errors are found by "swinging the ship," for which consult works on magnetism and navigation.—SM.

[64580.]—**Electric Lighting.**—You could not do better than use a secondary cell; and you could charge it well with the batteries you have. The length of time it will work the lamp depends entirely on the number and size of the plates you use. Full information is given in previous numbers.—W. PERREN-MAYCOCK.

[64580.]—**Electric Lighting.**—If George Eastlake will kindly refer to No. 1186 of the "E. M.," reply No. 63875, he will find a very excellent description of mode of making and charging an accumulator just such as he requires. If he cannot procure this number, he will find a full account in my new book, "Electrical Instruments for Amateurs" (see "Sale Column"); or, lastly, if none of these serve, I will write a short reply specially for him.—S. BOTTONE.

[64581.]—**Sundial.**—Being only 3° 5½' W. of Greenwich, say 1/116th of 360°, your time of noon is but 1/116th of the way between the almanac's March 1 and its March 2. No matter for what latitude a dial was made, it will suit any other, if you do but set its gnomon or shadow-casting edges parallel with the earth's axis, and its XII. hour line in the meridian.—E. L. G.

[64581.]—**Sundial.**—You do not say whether it is a horizontal or vertical dial. If the former, the 12 o'clock hour-line (or meridian, as it is called) must be due north and south. The plane of the dial must, of course, be perfectly horizontal. The longitude of a place has nothing to do with a sundial. The latitude only is taken into consideration in determining the hour-lines and the height of the style, or rather its angle, which is equal to the latitude of the place for which the dial is constructed, if a horizontal dial; but if a vertical, then the complement of the latitude.—ILIAD.

[64581.]—**Sundial.**—TO "PORTOBELLO."—You do not say that 56° is your own latitude. It is probably near enough, however; but if your latitude differs much from 56° you must tilt the base a little. The dial should indicate 12h. 0m., when the clock regulated to Greenwich time shows 12h. 24m. 47s., because the clock should be 12m. 25s. ahead of the sun, and Greenwich time is 12m. 22s. ahead of your time. Before finally fixing the dial, be sure that it always shows the correct time, allowing longitude as above.—DYNAMITE'S BROTHER.

[64581.]—**Sundial.**—You do not say what latitude you are in; evidently it is not 56°, for lat. 56 and lon. 3° 5½' W., is in the Firth of Forth, about eight miles north of Musselburgh. However, place the stile of sundial in the meridian (see 64581)—i.e., north and south; then, if a horizontal dial, tilt it either backwards or forwards till in the same plane as the latitude for which it was constructed; then, to save the trouble of applying longitude, tilt it up sideways towards the east the same number of degrees as you are west longitude. If you omit this latter, at Greenwich Mean Noon your dial will show 11h. 35m. 15s. on March 1st.—DADDY.

[64582.]—**Chemical.**—First pass air through solution of quicklime contained in a big test-tube, and then through a U-tube containing lumps of solid caustic soda. The air must be passed through the former first, which removes the carbon dioxide, the latter removing the moisture.—R. H. A.

[64582.]—**Chemical.**—Draw the air through a solution of caustic soda to deprive it of carbon dioxide and to deprive it of moisture any one of the following substances will do it: (1) Dry caustic soda. (2) Dry, freshly burnt quicklime. (3) Pumicestone soaked in sulphuric acid.—SATINE.

[64582.]—**Chemical.**—Break up your caustic soda, and put it into a U-shaped tube furnished with corks, through which you bore holes and insert bent tubes to conduct the air; join by indiarubber tube to a similar apparatus containing quicklime. The latter absorbs moisture—the former both moisture and CO_2; so it matters not in what order you join them up.—GILMORE.

[64582.]—**Chemical.**—Fill a wide glass tube with fragments of the caustic soda. Adapt tubes and corks (as required) to the ends, and slowly pass the air through it. This will deprive the air of both carbonic acid and water vapour, forming sodium carbonate with the carbonic acid, and absorbing the water vapour by reason of its deliquescence. Lime will do the same, but it is not so convenient or powerful.—PRINCIPIA.

[64582.]—**Chemical.**—The apparatus required is as follows: Two U tubes filled with dry caustic soda, a Liebig's bulb filled with lime-water, and two more tubes filled with dry caustic soda are connected together, and an aspirator connected at one end to draw the air through. The caustic soda absorbs the moisture, and the lime-water the carbonic acid. Pumice-stone with sulphuric acid would make a better absorbent for the moisture, and a strong solution of caustic potash for the carbonic acid.—T. O. D.

[64582.]—**Chemical.**—Take a moderately wide tube, straight or U-shaped, preferably of glass, and fill it with the caustic soda, NaHO, in pieces about as large as peas, and quicklime in coarse powder. The air should be forced in at one end, and will be completely freed from moisture and carbon dioxide when it reaches the other. Of course, the materials will require renewing. The soda might be used alone; but it would become liquid very soon and obstruct the tube. The lime is not open to this objection, but it is not so active as the soda; it is best, therefore, to use them together.—YOUNG ANALYST.

[64582.]—**Chemical.**—Caustic soda is used to absorb the carbon dioxide; sulphuric acid, calcium chloride, and phosphorus pentoxide for removing the moisture. Not only must you have a separate wash-bottle or U-tube for each reagent, but you must have several of each. It is by no means easy to thoroughly purify the air. You should first pass it through five or six U-tubes containing small fragments of caustic soda, then through a couple of wash-bottles filled with fragments of pumice-stone saturated with a solution of the same; next through a wash-bottle containing sulphuric acid, which serves to show the rate of flow; next through more U-tubes containing pumice and sulphuric acid, and finally over calcium chloride or phosphorus pentoxide. The air must be passed slowly.—SM.

[64583.]—**Strength of Material.**—As shafts vary directly as the cube of their diameters, all you have to do is to deduct the cube of hole from the cube of shaft, and there you are. Thus, $4^3 = 64$, and $3^3 = 27$; $\therefore 64 - 27 = 37$ is the strength of hollow shaft in torsion, compared with a solid one $= 64$. If used as a beam (as your query reads), then the strength varies to $4{\cdot}7\,R^4$ for a solid round beam to $4{\cdot}7\left(\frac{R^4 - r^4}{R}\right)$ for a hollow beam, R being larger radius and r being smaller radius. This formula is used instead of BD^2 as applied to rectangular beams.—T. C., Bristol.

[64583.]—**Strength of Material.**—The strength of a 4in. round bar as a beam, supported at the ends and loaded in the centre, compared with a 3in. bore-tube ½in. thick similarly loaded, would be as 37·6 is to 20·3, or a loss by boring of 46 per cent.; but the percentage of the area of the bored-out piece to the whole area of the solid bar is 55 per cent., so that there is a saving or gain of a little over 9 per cent. at the above dimensions and section. But a solid bar of equal area to the tube will be about 2⅝in. diam., and as a beam similarly loaded, its strength would be represented by 12·2; while the tube's strength is represented by the figures 20·3, showing the gain of 66 per cent. in favour of the tubular section.—W. M. I., Dublin.

[64584.]—**The Best Kind of Small Boiler.**—Has "F. A. M." seen the little "Shipman" engine actually working? Churchill had one set up some time ago. The boiler is made on Alban's principle; tubes closed at one end, screwed into a box (water space) at their other end. Water regulated automatically, by a float; fuel, simply kerosene injected by the steam, in the form of spray—raising a furious heat, but regulating its intensity as the steam rises and falls; and if the engine is stopped, and steam rises to 102lb. (usual working press.), the fire goes out, and lights itself again from a taper or oil-lamp directly the steam gets down to 100lb. This engine ought to be better known. The only objection to it is the noise the burning spray makes. Then there is Merryweather's "Crinoline" boiler, which raises steam in seven minutes. It consists of a low cylindrical steam and water chamber, into the bottom of which are fixed numerous Field's tubes, which are so laid together round the circumference that they form the "water-space" casing for the firebox. I had a small Field's boiler, with the top bolted on for inspection, which I worked at 150lb. press.—T. F. S. T.

[64585.]—**Model Electro Loco.**—You certainly could not carry your power on board; all the room would be wanted for the motor itself. The motor can pick up its energy from an insulated wire running between the rails, the rails being utilised to carry current back to battery.—W. PERREN-MAYCOCK.

[64585.]—**Model Electro Loco.**—Make the motor fully as large as your space will allow, and gear it down by a small strap. It will not work, being so small, at the same speed as the driving wheel of the engine. You could have large cells, and conduct the current to the engine along the rails, insulating the wheels from the axle and frame, so as to cause no short circuit between the rails. Take the current to the motor by leads from small brushes rubbing on the rims of two opposite wheels. A simpler method, but not so good in appearance, would be to put down a central rail and allow brushes to rub on it. This would obviate the necessity of insulating the hubs of the wheels.—GILMORE.

[64586.]—**Electro-Magnets.**—TO MR. BOTTONE.—Approximately, each magnet would sustain 4lb., if connected separately to the 12-celled Daniell battery. I should think that if connected in series the falling-off in power would be directly as the number of electros added on, say 2lb. each for 2, or ½lb. each for 8. But if the magnets were connected in parallel, the resistance in the outer circuit being less, you would probably get a better effect, more especially if the battery were now arranged in 2 in series, 6 in parallel.—S. BOTTONE.

[64587.]—**Lunar Eclipse.**—I cannot find any record of the eclipse in the year 1830, as referred to by "B. R."; but I can give him the dates of several other occasions when the lunar eclipse has occurred under similar circumstances. The *Illustrated London Almanac* for 1864 specifies the dates of July 17th, 1590, and Nov. 3rd, 1648, and June 16th, 1666, and May 26th, 1668, when the moon was eclipsed when the sun was seen at the same time above the horizon. Again, Carey's "Astronomy," p. 105, says: "The eclipse was seen at Paris when the sun was distinctly observed above the horizon on the 19th of July, 1750." MacCulloch's "Geography," p. 85, "the moon appeared to rise eclipsed before the sun had set on the 20th of Sept., 1717, and on the 20th of April, 1837." Again on the 17th of Jan., 1870, this curious phenomenon occurred, and also in July of the same year (see *Daily Telegraph*, 16th July, 1870). The astronomers evade these damaging facts by the suggestion or assertion that these undeniable phenomena are caused by refraction. But objects by refraction are always bent upwards, but *shadows* are invariably bent downwards; but the so-called earth's shadow is never thus seen. In March, 1848, an observer near Collumpton, in Devon, saw the moon during the eclipse with as perfect a light as if there had been no eclipse at all. For the astronomers to tell us that all these undeniable facts are to be argued away, and we are not to see what we do see unless science can explain it, is a slavery of the soul which I trust will soon cease to enthral us.—JOHN HAMPDEN.

[64588.]—**Lathe.**—Do not bolt uprights to lathe, as there is always more or less vibration caused. You could put an A framing to straddle the lathe to carry overhead. Size of shaft 1¾in. diam., or even 1½in. diam., and pulleys coned and of same size as cone pulley on mandrel is usual. The fast-and-loose pulley must be of such a size as to give desired speed.—T. C., Bristol.

[64588.]—**Lathe.**—It is not usual to erect uprights against any portion of a lathe. Better to erect columns of wood as far behind the lathe as possible and as high as convenient; brace them together, and put good raking timber struts in at least two directions, spiking down their ground ends to astout sleeper 3ft. below the ground; tamp them flush. When spiked, one of the raking struts should go to your engine, and if well secured it will serve two purposes—one to resist the pull of the belt, and the other to steady the uprights.—W. M. I., Dublin.

[64589.]—**Surface Condenser.** — You must have 80sq.ft. of tube surface, and pass nearly 2cu.ft. of water through the tubes per minute. Arrange the length of tubes to suit yourself, but you must have above surface. Use plain iron, not galvanised. You must have an air-pump twice the size of your feed-pump at least.—T. C., Bristol.

[64590.]—**Dynamo Brushes.**—I don't expect it is the brushes that are in fault. In a cylinder machine the brushes should be so thick that on the coil connected with any plate or plates reaching the brush which is set on the neutral diameter (or points of least sparking), the current in such coil has time to just fall to zero, and start again in the opposite direction; for I suppose you are aware that the current in any coil is reversed on its passing under the brush. The brush should therefore be so thick in its contact with the collector, not commutator, that it presses on the last quarter of one plate, all the next plate, and the first quarter of the plate just approaching neutral line; this is, of course, only approximate, it is impossible to give a fixed rule for this point; you must experiment. Suppose the ends of brushes are frayed and torn, in that case lay them flat on a block of lead or hard wood, and with an old plane iron and hammer chop the ends off square with sides. Next, we must consider at what angle the brushes must press on the collector; this depends on the thickness of the brush and diameter of collector, and number of plates. If the brushes press on nearly radially, then violent vibration will be set up which will cause sparking, while if you set brushes nearly approaching a tangent with collector then they will require frequent trimming to keep them making the proper amount of contact as described above. Probably you will find about 35° with the tangent line about right. To trim the brush ends, get two pieces of smooth, flat board, and clamp brushes between them, with about ¼in. or ⅜in. of brush projecting, then file or grind off to required angle, taking care to file from heel to point of brush, and to raise file off brush when drawing back for a fresh stroke, and just touch off about ⅛in. of point, and clear the burr, if any, off back. Then look on standard by collector for two marks at opposite ends of a diameter; these are for setting the brushes by; set the brush points exactly to these lines or marks, then approach brushes on to collector, and rotate bodily round till you find a point at which sparking is a minimum. You need not use a block and tackle to set up brush springs; it only wears the collector, and does not in the least improve the machine; nor need you use a pail to lubricate the collector, a touch with an oily finger is enough, if done every few hours—that is, if collector is true, and brushes not pressing too hard. I have found that the best lard oil acts well; but use as little as possible, and it is excellent for severe scorches if skin is not broken. If brushes press too hard, then two things occur. First, the collector wears into ruts, and brushes gimp, making matters still worse by sparking; secondly, the metal of collector plates is "trailed" over from plate to plate, causing partial short circuiting, and the machine is said to "fire." Again, if you examine collector carefully, you will, perhaps, find the insulation spaces partially filled by a mixture of charred oil or grease and copper dust and dirt. Clean out, see that collector runs true, and has a slight endlong play under the brushes, which tends to prevent rutting, and, if you like, try French chalk instead of oil on collector. I have heard it is good, but have never tried it myself. Invest 2s. in Crompton's "Price-List Pocket-Book," where you will find useful hints on starting their make of machine, which, of course, apply generally to all cylinder armature machines. I should be glad to hear how you get on. The broader brushes are the better.—ENGINEER, Govan.

[64593.]—**Induction Coil.**—Yes, I think the *result is fairly good*; and when you have a proper break and make arrangement, I have no doubt you will get a longer spark.—S. BOTTONE.

[64593.]—**Induction Coil.** — What is your ultimate object? If to get a longer spark, put on as much more secondary as possible, and treble battery power.—W. PERREN-MAYCOCK.

[64593.]—**Induction Coil.**—If you get only a thin spark with such stout wire for secondary (No. 36 or 38 is generally used) it must be very bad wire indeed. You ought to get a thick spark, which, of course, would be shorter than if you had used the same weight of a finer wire. I find I can easily obtain a 1in. spark from 1lb. No. 38, and if you require a long spark, I should recommend this size. Get the softest wire, and do not stretch it whilst winding, or you will increase its resistance. The primary should be silk-covered to save space. 1lb. No. 28 would probably give about a $\frac{3}{16}$in. spark with condenser.—CHAS. PROVIS, Emsworth.

[64593.]—**Induction Coil.**—"Volo" must give this coil up, as it will never be worth anything. No. 28 is too large for secondary use; he should have taken No. 36. Old wire is generally deficient either in continuity, insulation, or conducting power; it never pays to use it. Thirty-four layers of secondary seems a large number; the last 14 must be too far from the core to be anything but a hindrance to the effect. He speaks of its being "well insulated"; this frequently means over-insulation. The "file-break" is, of course, not a favourable adjunct; but a proper one would make little difference to this coil. I would advise his looking through the numerous instructions for coil-making in back numbers, and trying a fresh one with new wire.—B. HARCOURT.

[64594.]—**Steel in Australia.**—Some years ago iron was being rolled near Sydney, and, I suppose, it is still being done. But if "Canadian" wants much material, he would have to import it in *some* form, and why not have it shipped ready rolled to requirement?—T. F. S. T.

[64595.]—**Drying Air.**—Would not pans of dried calcic chloride do? It would be more expensive at first than lime, but the moisture could be drawn off, when saturated, far more easily than from lime.—YOUNG ANALYST.

[64595.]—**Drying Air.**—"Quis Est" seems to be on the wrong track. If the air is loaded with moisture, that air wants drawing off, and a supply of drier air put in its place. It is a mistake to suppose that it is the heat only that causes drying. A very small heat supply with a good fan to draw off the air as soon as it has "picked up" so much moisture will do an astonishing deal of drying, compared with a stewing heat and no ventilation.—T. F. S. T.

[64596.]—**Cupolas.** — The Herbertz cupola, made by Tangyes of Birmingham, is operated with steam jet. As an average of several months' working, it is said that the total weight of fuel is only 6½ per cent. that of the metal.—J. H.

[64598.]—**C. and C. Motor.**—I don't know efficiency of this small motor, but you can count on not getting more than about 30 or 40 per cent. from any small motor. As to your second question, it is simple enough; 746 watts per second = 550ft.lb. per second, since both equal 1H.P. ∴ ft.lb. = W × $\frac{550}{746}$; where W = work in watts, and 1 watt = 1 volt × 1 ampere.—ENGINEER, Govan.

[64598.]—**C. and C. Motor.**—I do not know the percentage efficiency of this type. Given efficiency of a motor = 90 per cent., power being supplied at 10v. 20 amp., then work given out in foot-pounds $= \frac{10 \times 20 \times 33000 \times 9}{746 \times 10}$.—W. PERREN-MAYCOCK.

[64600.]—**Brass Casting.**—"Rex" would find by the time he had his plaster mould heated up enough (to allow of the brass running properly) it would warp and break up. The pattern must be cast in the sand in the usual way, with gates, and a good head of metal. Better have it cast by a professional; it would cost little, and be properly done.—DENS.

[64600.]—**Brass Casting.**—For a competitive prize among some boys who were pistol shooting, I once tried to cast a bullet of silver in plaster of Paris. I made the mould all right, and melted the silver, but had to pour it over and over again—only a small drop of the silver would enter the mould. The sixth time the mould filled; but I found it was only because each attempt had burnt part of the inside of the mould to a soft powdery state. When it was all charred, the hot metal went in and settled. Hence, I presume, "Rex" will have to dry and char (?) his plaster mould before he can cast in it. I should think fine facing sand would be better.—T. F. S. T.

[64601.]—**Wood Bearings.**—In some situations I find wood far preferable to metal, as it gets soaked with the grease, and so remains lubricated in position where metal becomes dry; as, for example, where a great quantity of dust is about. They cause a little more friction, doubtless; the harder the wood the better. Grease and blacklead is good, with a little oil to keep it soft.—T. C., Bristol.

[64602.]—**Evolution.**—Neither food, surroundings, nor habits, but the process of Natural Selection, using the second term in its more literal sense. (In view of a possible objection, I might mention that "habits" must refer to the male bird, since the plumage of the other sex is anything but "gorgeous.")—YOUNG ANALYST.

[64602.] — **Evolution.** — It is not that the whiskers are "grown"; but that they are permitted to remain, while the hairy covering of other portions of the body has been lost, during our advancement to civilisation. The peacock's gorgeous plumage probably owes its development to sexual selection.—J. H.

[64602.] — **Evolution.** — An old book says, "Answer a fool according to his folly." Your correspondent is either jesting, or something else. I protest against these columns being used for such silly conundrums. I retort, and it is only worthy of such a reply, Which of our ancestors hit upon the idea of growing wisdom teeth? I consider it a capital notion; but should like to know to whom the credit for its (their) introduction belongs. They are purely ornamental—so with great toenails. If your correspondent will only take the trouble to read Darwin's "Descent of Man,"—which is the only one of Darwin's works I have read completely through—"the peacock's gorgeous plumage" will cease to be a mystery to him. One half of these silly queries would be annihilated if men only read the evidences of evolution for themselves.—DEVIL'S HOOF.

[64603.]—**Attaching Engine to Lathe.**—I saw a lathe in Liverpool, on the end standard of which a cylinder was fixed (upside down), working direct on to the projecting crank-shaft of the fly-wheel. It looked very compact and neat; but I should think would be hot for the leg and face in working.—T. F. S. T.

[64603.] — **Attaching Engine to Lathe.**—"F. A. M.'s" query reminds me of an idea I had when a lad—viz., to have an oscillating engine working on the usual crank of lathe. Of course, the engige could be cased in. But if you are an amateur, stick to your legs, or else go in for a gas-engine with the usual overhead shafting; nothing beats it. Or, if you are fond of "fads," why not go in for a motor?—T. C., Bristol.

[64603.]—**Attaching Engine to Lathe.**—The great objection I consider to these arrangements is the difficulty of stopping the lathe suddenly. The engine of the self-contained type would have a speed of about 200 revs. per min., so that to pull it up sharp would be impossible. To overcome this difficulty, a friction clutch is placed on the driving pulley and a brake on the engine fly-wheel. For intermittent work, such as turning a number of cylinder covers, it is found inconvenient to be always stopping and starting the motor, so the friction clutch is introduced; but in making screws with a screw-plate the lathe is required to run backwards, also consequently to stop the motor a brake worked by foot is applied. The use of such a combination, however, involves a waste of time. The motor would preferably stand on the floor (not touching the lathe) in the position now occupied by the crank-shaft. Gas, or a spray of petroleum, would heat the boiler.—A. F. SHAKESPEAR, Luttichau-strasse 14, Dresden.

[64604.]—**Heating Small Boiler by Gas or Paraffin.**—When I asked Mr. Fletcher for a gas-burner for my air-engine, he told me it would pay better to have a boy all day putting coke on to keep a fire up! The Shipman engine is said to give 1H.P. for ten hours on about two gallons of kerosene. See reply to 64584.—T. F. S. T.

[64606.]—**Belts and Pulleys.**—You can put 70lb. per inch of width on a double belt—300I.H.P. = 300 × 33,000 = 9,900,000ft.-lb. per minute, and as speed of belt is 65 × 18 × 3¼ = 3,680ft. per minute nearly, we require 9,900,000 divided by 3,680 = 2,690lb. pull on the strap, which should have a belt 36in. wide. If only 30in. wide, the pull will shorten the life of the belt considerably.—T. C., Bristol.

[64607.]—**Storage Battery.**—TO MR. BOTTONE OR OTHERS. — See also reply to 64580. If "Amateur" can refer to Vol. XL. of the "E. M.," p. 28, he will find a very full and exhaustive account of exactly such an accumulator as he requires. Should he not be able to procure, and will ask again, I will, with the Editor's permission, condense the said article and send it in for publication.—S. BOTTONE.

[64609.]—**Electro-Magnet.**—It is usual to use bobbins for bell work. Of course, a little powder is gained by winding directly on the cores; but this is counterbalanced by the greater neatness and closeness with which the wire can be wound on the bobbin.—S. BOTTONE.

9.]—**Electro-Magnet.**—You may do as y; but take care that your bobbins fit on the ends of the cores, or your magnet t be so strong. Bobbins are always wound they are put on the cores.—LEWIS.

11.]—**Pacinotti Rings.**—Makers stock two punchings for these armatures—viz., 4⅞in. er to run in a tunnel 5in. in diameter. have 10 teeth. The next size is 6in. in er, with 13 teeth. Both these are punched $\frac{1}{10}$in. charcoal iron, so about 80 are required in. armature. If you like to write to me, aving looked up my advertisement in the umn, I shall be happy to quote prices.—S. NE.

12.]—**Brass and Zinc.**—I do not know r "W. J. B." would prefer the results of Thurston's experiments to the opinion of nker, or "we in the trade," but if he refers 838, p. 183, he will find an article on "How ke the Strongest Brass," and he may rest that the best proportions are approximately 55, zinc 43, tin 2. The last named can be l for the majority of purposes. Prof. on's experiments are set out at length somein a back number. The querist also asks r pure zinc sheet is durable exposed to the he will tell me where such a thing as a f "pure" zinc has been exposed to the here, I shall perhaps be able to answer him. ommercial zinc sheet has a life of from seven teen years according to environments.—DOR.

2.]—**Brass.**—The following are some of ys of copper and zinc:—

	Copper.	Zinc.
eim gold or bath metal	16	4
brass	16	6
ry brass (most durable alloy)	16	8
sheathing metal	16	10⅔
solder for copper and iron ...	16	12
solder for brass work	16	16
gold	16	16½
metal	16	1—1¼

very durable exposed to air, and the purer he more durable, for the impurities, when ed by water, with a little acid (carbonic or ric) in it, tend to set up a galvanic current, as waste the zinc.—SATINE.

14.]—**Coal-Dust Bricks.**—In reply to lsior," I have known brown Barbary gum sed for the purpose. The "Sixpenny Sale n" will tell him where he could get it.—

14.]—**Coal-Dust Bricks.**—According to a tus which I have, these are composed of d pitch, incorporated at a high temperature, echanically compressed with great force, y they are compacted and solidified.—PRIN-

4.]—**Coal-Dust Bricks.**—Lime and pitch substances employed to render small coal e in the manufacture of these bricks. 10 per cent. of lime is added in the one case. case of pitch being used from 5 to 10 per added, according to the nature of the coal hardness of the brick required.—T. O. D.

14.] — **Coal-Dust Bricks.** — Warlich's fuel is made by mixing a ton of small coal 2 gallons of tar, which, when formed into is baked at a temperature of 800° F. for hours. Wylam's fuel is made by mixing 7 or 8 per cent. of its weight of pitch with all coal. It is passed through a retort at a d heat to soften it, when it is moulded into under pressure.—J. H.

14.]—**Coal-Dust Bricks.**—I went pretty ghly into this some time ago. The ground disintegrated in Carr's machine) is mixed per cent. of pitch, then heated and pressed ricks. Mr. Samuel Butler, of the Crown ved Coal Company, Cardiff, was some years think, in 1884) making about 50 tons a day ours, with a 15H.P. engine and four men oy.—T. F. S. T.

16.]—**Mill-Bills.**—The whole art or mystery king mill-bills consists in a knowledge of crets of tempering, and they are to be obonly by practice. Now and then someone round to the shop and offers to sell you a recipe for preparing some hardening soluwhich may be of no particular value, but sometimes is like the famous recipe for cold ng, a deliberate hoax. However, to the Heat your steel to a cherry red when at in the dark; don't hit it hard, but put ntity of blows rather than sledgers, and re soon as it begins to turn black. Having it to the desired shape, finishing if necessary e file, heat once more to a cherry red, and n water (old smithy water for preference, does not really matter), and rub the edge ight on a stone. Now heat again (preferably t plate), and when the blue is seen, cool at once by dropping into the water. An expert smith tempers at once by dipping the steel in the water when red, withdrawing, and watching the colours come and go; but practice is required. Never heat too high; never hit too hard; never be afraid of reheating or of repeating your blows; don't attempt to do it all at once, and try again—you are sure to succeed. If you can't master it, write again; say what you have done, where you failed, and I will at least try to help you.—NUN. DOR.

[64619.]—**Chemical Balance.** — Short-beam balances are much quicker in their oscillations, and hence weighing can be more rapidly done. They can also carry a heavier load than a long-beam balance, given equal weights of beams. Long beams are said to be more sensitive; but much depends on the construction. I have an Oertling long-beam which will indicate $\frac{1}{10}$ milligram, but the oscillations are exceedingly slow. I much prefer the short beam.—SM.

[64621.]—**Peculiar Dates on Tombstones.**—Previous to 1752 the legal year commenced on the 25th of March, while the popular reckoning was as at present; therefore, on January 22nd, in one example given, the year 1713 would have commenced as far as the latter reckoning went, while it would legally still be the end of the year 1712. In order to reckon anniversaries the first date should be taken, while to compare with legal records, &c., the second is necessary. I might mention that there seem to be three misprints or mistakes in the query. I think that the first example should be 17$\frac{10}{11}$, the next 17$\frac{12}{13}$, and the third Jan. 22nd.—YOUNG ANALYST.

[Not misprints.—ED.]

[64621.]—**Peculiar Dates on Tombstones.**—The "old style" is the method of reckoning time anterior to the Gregorian reformation of the calendar, and the "new style" is that adopted since. The "new style" was introduced into England in 1751, when it was determined that the year 1752 should begin on the 1st of January instead of the 25th of March, which was then the legal commencement, and that the 3rd day of September, 1752, should be called the 14th, or that the days from the 3rd to the 13th inclusive should have no nominal existence. It was at one time the fashion to express dates in both styles, of which those quoted are examples.—CHRONOS.

[64621.]—**Peculiar Dates on Tombstones.**—Formerly the year began on March 1. September, October, November, December mean the 7th, 8th, 9th, and 10th month. When people began to reckon January 1 as the beginning of the year (for which there was no sufficient reason) all dates involving January and February had both years attached. The date 16 January, 1640, on a tombstone or anywhere else would certainly mean 1641 of our present mode of reckoning years. The practice of making the year begin on the 1st January came in about the beginning of the 18th century. Surely T. D. Friend is not correct in stating the existence of June 22nd, 17$\frac{12}{13}$. If such a date really exists, it is to be explained as due to ignorance on the part of the mason who engraved the tomb, or of the relatives of the defunct, who have undoubtedly carried on the double numbering of the year four months too long.—DYNAMITE'S BROTHER.

[64622.]—**Screw-Cutting.**—Two threads in 1in. = four-eighths in one revolution of the screw. And as the groove to be cut in one revolution of the lathe mandrel is to be 106⅞in., it follows that the revolutions of the screw is the number of times one half-inch or four-eighths goes into 106⅞in. = 213¾ times, or, expressed as a fraction, $\frac{1}{213\frac{3}{4}}$ or $\frac{4}{855}$, or, as the querist puts it, $\frac{8}{1,710}$. Reduce $\frac{4}{855}$ to two factors first. This becomes (1) $\frac{2 \times 2}{95 \times 9}$. Secondly, add two units to both sides; (2) $\frac{2 \times 2 \times 1 \times 1}{95 \times 9 \times 1 \times 1}$. Then, thirdly, affix three ciphers to both sides; (3) $\frac{20 \times 20 \times 10 \times 1}{95 \times 90 \times 10 \times 10}$. Fourthly, add one cipher to both sides; (4) $\frac{20 \times 20 \times 10 \times 10}{95 \times 90 \times 100 \times 10}$. Fifthly, multiply both sides by 5; (5) $\frac{20 \times 20 \times 25 \times 20}{95 \times 90 \times 100 \times 50}$. But as there may not be three 20's available, add half of 50 to 50, and half of 20 to 20; and the train becomes $= \frac{20 \times 30 \times 25 \times 20}{95 \times 90 \times 100 \times 75}$; or other combinations. Practically, the train is of little value, applied in the ordinary way, as it is not likely they can be mounted without special arrangements; and one of such necessities is that the belt should be applied to the end of the screw, making the pinions drivers, and so getting up a good speed on the belt. But the other practical objection is that the stress on the last pinion is considerable, and out of all proportion to the belt power and the cut to be taken. Another way to make rifling easier (as a good makeshift), would be to utilise the back gear of the lathe, if its ratio was some convenient multiple or sub-multiple of 5. Of course a special stud and pinion (in this case amply strong) would be required to transmit the motion from the back-gear motion to the train.—W. M. L., Dublin.

[64622.]—**Screw-Cutting.** — Plainly 1710 = 171 × 10, and, also as plainly, 171 will divide by 9, because its digits added together make 9. And dividing 171 by 9 gives 19, so the wheels to be used will be 9, 10, and 19, or multiples of the same. The way to work it out is thus—

viz.,
$$\frac{1710}{8} = \frac{855}{4} = \frac{9 \times 19 \times 5 \times 1}{2 \times 2 \times 1 \times 1}$$
$$= \frac{90 \times 95 \times 125 \times 1}{20 \times 10 \times 25 \times 1} = \frac{90}{20} \times \frac{95}{30} \times \frac{125}{25} \times \frac{3}{1}$$
$$= \frac{90}{20} \times \frac{95}{30} \times \frac{125}{25} \times \frac{105}{35}$$

In order to see whether a nearer approximation could not be effected by going to the next place of decimals, I took out the following numbers—viz.

11495 = 55 × 11 × 19
11496 = 24 × prime
11497 A prime
11498 = 2 × prime
11499 = 3 × prime
11500 = 500 × 23
11501 = 7 × 31 × 53
11502 = 2 × 81 × 71
11503 A prime
11504 = 16 × prime
11505 = 15 × 13 × 59

The first of which alone is to be managed with an ordinary set of wheels. In my own set I have 53, 59, and 71, so I could accomplish three of the others as well. The train for 11·495 stands thus—$\frac{40 \times 50 \times 50}{55 \times 95 \times 110}$.—J. K. P.

[64622.] — **Screw-Cutting.** — The ratio is $\frac{1710}{8}$ as you state. Put it in the form of—

$$\frac{19 \times 90}{8} = \frac{19 \times 90 \times 10}{2 \times 2 \times 20},$$
or—
$$\frac{95 \times 90 \times 10}{2 \times 10 \times 20} = \frac{95 \times 90 \times 100}{20 \times 10 \times 20}$$
$$= \frac{95 \times 90 \times 100 \times 60}{20 \times 20 \times 20 \times 30}.$$

Above shows the various steps; but why use eight wheels?—T. C., Bristol.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

64061. Forging Cranks, p. 400.
64066. Gold Working, 400.
64067. Instantaneous Water Heater, 400.
64068. Grease Box, 400.
64071. Limestone, 400.

64233. Paper Bottles, p. 492.
64246. Boring Longitudinal Holes through Wood, 492.
64255. Vertical Coil, 493.
64257. Magnesium, 493.
64259. Printing on Wood, 493.
64263. Bearing Springs, 493.
64265. Silver and Nickel Specula, 493.
64266. Reflecting Telescope, 493.
64267. Drum Armature, 493.
64274. Shocking Coil, 493.
64279. Model Boiler, 493.
64281. Elevators, 493.
64286. Spongy Aluminium Castings, 493.
64288. Nitrous Acid, 494.
64289. Oval Chuck, 494.
64292. Xylophone, 494.
64293. Electric Lighting, 494.

THE gasworks of the Birmingham Corporation have produced a net profit on the last year's working of £25,772, upon a gross profit of £126,258, and this net amount has been appropriated to the credit of the improvement rate of the borough. The increased consumption for the year was 2¾ per cent., and there has been a decrease in the value of residuals of £5,000. This is less than half the estimate of the Committee at the beginning of the year. There has been an increased consumption of coke, while sulphate of ammonia, in the manufacture of which the Corporation find a great customer for their ammoniacal liquor, is worth £2 per ton more than when the Committee made their estimate. The expenditure for the year under the head of maintenance of works has been £69,000, it being the aim of the Committee to keep the works in the highest state of efficiency.

QUERIES.

[64623.]—**Bee Hives.**—Would "Silke" kindly help me? I have studied his remarks and also sketches and description of his hive in number of Oct. 14th last, and have made drawings to scale of ¼ as far as I can. I made out his sketch in Figs. 2 and 3 to be 1-16 scale, and Fig 5 ¼ scale, and from these the following dimensions:—Hive body. (*a*) Short side, outside wall 9⅞in.; inside wall 7⅞in.; plus strip under air space ⅜in. thick; plus strip over air space ⅝in. thick—equal in all 8⅞in., which makes outside wall ⅞in. higher than the strip over air space. (*b*) Long side, outside wall 9⅞in.; inside wall 8⅛in.; plus strip under air space ⅜in.—equal 8½in. in all. Above this the thickness of top of frame—viz. ⅜, brings frame top level with top of strip over air space on short side, and, therefore, 8⅞in. from top of frame to floor board. I make side of roof, shown in Fig 5, 11in.; air spaces (inside walls) I make 1½in. Have I calculated the above measurements correctly? How much should inner wall in Fig. 5 be bevelled to allow bee space under the top bar of frame? In *British Bee Journal*, of 9th Feb, "Silke" says air space in front of his frames in 12in. during winter. Does this imply that the frames only occupy about 6in. in centre of hive, leaving 12in. on each side from frames to outside walls in a hive 30in. long? Would "Silke" also kindly say what is the smallest sum required for bees and all accessories, as smoker, &c., with particulars, for starting with one hive of bees, not counting the cost of hive? Would an extractor be necessary the first year.—INDIAN.

[64624.]—**Crown Wheels.**—Would some reader kindly give me the following information? I want to use a 6in. diam. crown wheel, geared to a 1½in. crown wheel. What I want to know is will crown wheels of different sizes run together?—NO. SIG.

[64625.]—**Coil.**—I am making an induction coil and wished to use an old primary, but I find it does not work the break properly: it goes slowly and gets fused together. Does age have any effect on the wire? There are 50yds. of No. 12 on it. It used to go all right about 10 years ago.—T. G.

[64626.]—**Model Loco. Boiler.**—Will anyone tell me what thickness of copper is necessary for a model loco. boiler to be worked at 80lb.? Also a good way of laying down lines 100yds. long, for a locomotive 6in. gauge, on a level hard mould surface. Must be capable of bearing a weight of 250lb. on every 2ft. of their length.—COPPER.

[64627.]—**Detector.**—I have an ordinary detector, square pattern, with three terminals on top. When I put the end of wires from a No. 2 Leclanché on the terminal on the left, and on the middle one, the needle deflects to 70; but when putting the wires on two outside terminals it only deflects to 30. It used to deflect to 40 outside terminals. Does the needle want magnetising or should it be magnetised? I was thawing some porous pots in bichromate cells last week, which were frozen, with a hot poker. When I put the poker in the pot it commenced to blaze for about a minute. What is the cause of this?—CARNARVON.

[64628.]—**Screw-Cutting**—Will any reader tell me what wheels will cut 14½ threads per inch? I have change wheels beginning at 20, 25, 30, 35, and so on up to 120. Guide screw ¼in. pitch.—IN A FIX.

[64629.]—**Fresnel's Rhomb.**—How is the best way to use this with the microscope, and are the two Nicols prisms to be used at the same time?—P. N. Z.

[64630.]—**Curling Stones.**—Could any reader describe the mode of mounting curling stones for polishing, and name the kind of powders used, and way to use them?—CURLING STONE.

[64631.]—**Polishing Marble**—Will some kind reader please give me a few instructions to polish marble? The marble came from Italy, is very hard, and is, I believe, called Corsican marble. What I want is a few hints how to produce the polish seen on marble washstands, &c.—CAEN STONE.

[64632.]—**Copper Boiler.**—Would any reader kindly tell me what size and thickness are required to make a vertical boiler, for a horizontal engine, 1in. bore by 2in. stroke? I wish it to be made of copper, riveted, no tubes, to burn charcoal, with water gauge, safety valves, taps, &c. I also should like a few hints as to riveting and making the ends. Also what pressure it would stand. A sketch would greatly oblige.—R. A. B.

[64633.]—**Scotch Putty.**—I have looked through the different recipes for making cement for iron joints, which are each very good, but there is one made which is very useful where joints are required to be subjected to heat. It is known as Scotch putty. I should feel grateful to any of the readers of your paper who would kindly inform me how this is made. I have seen it used generally when in a state like putty.—FERRO.

[64634.]—**Greenhouse Pipes.**—Last summer I fitted my small greenhouse with new 4in. hot water pipes and foolishly coated them with black varnish, or a kind of stove varnish; but when the pipes got warm I discovered my mistake. The tar fumes began to rise and would soon have destroyed all my plants. Then I tried to get it off again, and scraped and scoured them, but with no effect. Then I washed them with caustic soda, but with no better result. Then I coated them with a good coat of paint, thinking to cover the tar, but when the house gets to about 60° of heat the fumes are still there and attack the plants directly. If any reader can kindly help me out of my difficulty I shall be greatly obliged.—J. A.

[64635.]—**Dynamo.**—Will some kind reader please give me dimensions and quantity of wire for a dynamo to light a 5c.p. Swan incandescent lamp, and power required to drive it? Also can I wind or connect the above so as to get a steady light while the dynamo is driven at an irregular speed? If not, at what speed must it be driven, and how much may it vary?—W. E. L'ESTRANGE.

[64636.]—**Steam Chest.**—I want to make a steam chest to stand a pressure of 150lb.; sizes are 6ft. long at top, bottom length 5ft; 2ft. 2in. wide at top, 1ft. 8in. at bottom. The cover will be domed about 3in. and bracketed every 3in., brackets being 3in. high at outside of cover flange and tapered off to the crown. The flanges of the chest and cover will extend 12in. beyond steam joint. The bolts will be at the outside of flanges. Would any of your correspondents give me an idea of the thickness of best cast-iron required for same? Also the number of 1in. bolts to hold down cover.—JOHN KIRKWOOD.

[64637.]—**Test for Mystery Gold.**—A few weeks since a paragraph appeared under the heading of "Scientific News" stating that the nitric-acid test could no longer be relied upon for gold, as mystery gold would also stand it. Can any correspondent mention an easily applied test that is reliable?—GIMEL.

[64638.]—**Didymium.**—Can any chemical reader give me an account of the elements neo. and praseo-dymium (mentioned in pp. 450 and 451 of last Vol.), which have been found to compose didymium, or tell me where I can find an account of them?—R. H. A.

[64639.]—**Piccolo.**—I am desirous of learning the piccolo. Can any reader of this paper who is a player of this instrument inform me which is the best and easiest to finger—one of four, five, or six keys? Where can I get the best tutor and scale of fingering? If having learnt the piccolo, could I play a flute with the same fingering?—FLAUTO.

[64640.]—**Test for Gold.**—Some gravel was brought to me from a drift said to contain gold. When examined, I found some minute particles of a glittering metal. Will some one kindly inform me how I can test it? The particles do not combine readily with mercury, and dissolve sparingly in acid nit. mur. In the drift were two pebbles, quite hollow, and very black inside—sparkling in light. One contained a small quantity of what appears to be wet clay. Will some one kindly give information?—ABERGWAUN.

[64641.]—**Lacquer or Enamel for Castings.**—Can any of our readers inform me of a lacquer or a kind of enamel paint (suitable for light castings) of a consistency that will effectually prevent rust, without destroying the character, sharpness, or cleanness of design, and admit of a hue or colour similar to graphite or ordinary black-lead? It should not crack easily, rub off, nor peel. Is there any process of firing or burning colour on?—HANDSWORTH.

[64642.]—**Hot-Water Fittings.**—I have a four-story house to fit up with hot water to bath, lavatory, and sink. Have got a 200gal. galvanised iron cistern in roof. Should feel obliged for information as to connecting pipes to circulating cistern. Also to high-pressure boiler in kitchener. Must the cold be connected to circulating cistern below the level of feed cistern?—A NEW SUBSCRIBER.

[64643.]—**Making Cycle Wheels.**—To "A.M.M.A."—1. What sort of drill do you propose to use in drilling rims? Have not a horizontal drill. Could not a lathe be used? 2. Kind of steel used for axle—i.e. mild or cast. 3. Is it necessary to harden ball hubs? If so, how is it managed without hardening the flanges? Are they cast or forged? What material used? 4. What is the best form of head for spokes, half round, conical, or flat?—A. F. SHAKESPEAR, Dresden.

[64644.]—**Cleaning Gloves.**—How can I clean a pair of thick wash-leather gloves without shrinking them?—A. F. SHAKESPEAR, Dresden.

[64645.]—**Egg Problem.**—A lady buying eggs was told by the saleswoman "For every shilling you spend I will give you two eggs in." How many eggs, and at what price, must be bought to yield a saving to the lady of one penny per dozen? Answer has been found by trial. How is it to be solved by arithmetic or algebra?—A. C. G

[64646.]—**Reservoir.**—Will someone kindly tell me the name of the largest reservoir in Great Britain, its area, depth, and the engineer by whom it was constructed, and for what purpose it is used?—C. E.

[64647.]—**Delivery of Water from a Pipe.**—A sprinkler is to be fixed over the stage of a theatre, which will contain 7,500 ⅛in holes, drilled in the top side of the tubes. The lower ones being 3in. and the upper ones, near the roof, 2in. diam. The sprinkler will be filled by a 5in. pipe, 40ft. in height, in direct communication with a 13in. main in the street. 47yds. distant, by a 5in. pipe, newly laid for the purpose. The 13in. main has a head-pressure of 130ft., and the pressure of water in it is found to be 50lb. per square inch, tested by a gauge. How many gallons of water will the 5in. pipe, 40ft. in height from the street, rain down from the sprinkler in one minute? Under what pressure will the water issue from the holes? Is it likely to spread like water from the rose of a degging can? From the formula in Molesworth's "Engineer's Pocket Book," I make it out that 3,892gal. will be discharged in a minute. Others make it very much different. I shall therefore feel greatly obliged if any of the expert calculators who contribute to your paper will kindly favour me with a solution of the problem.—IRWELL.

[64648.]—**Tricycles.**—Being a rider myself, I cannot understand what "K." means (letter 28436, p. 602) by fitting a second set of foot-rests to his tricycle. I am always anxious to learn any new wrinkle to make riding easy. If this should meet the eye of "K.," I hope he will kindly explain the kind of foot-rests he means.—J. R.

[64649.]—**The "E M." Telephone.**—If Mr. Bottone or the inventor—with our Editor's kind permission—would give full particulars with drawings for fitting up these instruments they would be gladly received by scores of amateurs besides myself. I understand full descriptions, with drawings, were given in Nos. 846 and 953 of the "E. M." I was not in the country at that time. I have tried several times to get these back numbers, but, sorry to say, I have not been successful. I should be glad to see the descriptions and drawings repeated once more. I am a fairly good workman in woodwork and metal, and I can fit up most kinds of electrical apparatus, but know nothing whatever of telephones. Good practical instructions, with drawings, if possible, would prove a boon to a large number of more recent subscribers.—J. R.

[64650.]—**Designing-Machine.**—At a recent conversazione I saw a machine by which most beautiful designs were produced. It consisted of a tripod stand supporting a wooden platform, to opposite ends of which were hinged two levers, to the top ends of which again was hinged another platform. One of these levers was prolonged downwards, and carried a weight, by swinging which a horizontal motion was given to the upper platform. At right angles to this motion another weighted lever was jointed to the supporting platform, and carrying at its upper extremity a rod carrying a small glass tube drawn to a fine point and filled with ink. The point of the tube rested on a piece of paper placed on the moving platform. By the combination of these movements the tube drew designs on the paper, but on making an instrument myself, I found it impossible to exceed a few simple curves. Can anyone tell me if there is another motion overlooked, or any other part of mechanism required?—ALPHARD.

[64651.]—**Convection Currents—An Optical Delusion.**—I had pointed out to me the other day by a friend, a curious fact in connection with the cardboard horses one frequently sees about Christmas time, suspended over the gas jets in shop-windows. Though perhaps not new to many readers of "Ours," it may yet interest those who have not had their attention drawn to it before. On gazing at the revolving horses for a few seconds, and then closing one eye the horses will soon appear to be going in the contrary direction. To some people the effect is the same with both eyes open, but it seems to take longer. How is this explained? Is it more difficult to keep both eyes fixed than one?—G. E. H.

[64652.]—**Musical Watch.**—We have in our family a curious gold watch. It is a repeater, and there is also a musical part attached. By adjusting a small lever the music can be made to play every hour, or to keep silent as one likes. The musical train takes about 15 minutes to run quite down. The face is gilt, and the hour numbers are painted on small white enamel discs, which are fastened on to the face. Have any of our readers skilled in matters horological ever come across a watch of this kind, and can they say the probable age of it, and what country it most likely hails from?—G. E. H.

[64653.]—**Steam Valve.**—Can any reader say if there is any kind of steam valve in use that accurately answers a given pressure of steam reduced from that of the working pressure of the steam boilers—say the pressure of steam for driving engine required to be from 40lb., 45lb., or 50lb. adjustable to either of those, while at times the boiler pressure varies from 55lb. to 70lb.? Having at present in use what is known as a reducing valve, but which does not seem to accomplish the desired object, as the rising of the steam overpowers the controlling capacity of the governors and throttle-valve of engine.—S. T.

[64654.]—**Defective Coil.**—TO MR. BOTTONE.—Please advise as to probable cause of defect. I have made coil on your plan given (p. 52, No. 1,121) core ⅝in. diam., 6in. long. Primary four layers 24 s.c., paraffined paper between each layer, last layer covered with silk glued on to prevent abrasion by secondary tube. Secondary 37 layers 35 s.c. (old), well basted and paper between each, with 4 cells bichromate, plates 7in. by 2in. It gives 5-16in. spark only. Would the silk cover to primary, or using too thick a paper for insulation, be the cause?—G. H. BARBER.

[64655.]—**Pianoforte Repairing and Regulating.**—I have recently repaired my cottage piano sticker action, covering hammers, and putting in a new set of levers. On putting in the action I find that the hammers do not come down to the rail anything like even in consequence of the lever leather being rather thicker than before. The ends are nearly right, and as I cannot raise the action any higher, I wish to know how to get over the difficulty. Perhaps some practical hand will say how this is to be done and oblige.—SET FAST.

[64656.]—**Joints for Slate Cistern.**—Can some of our readers oblige me with a recipe for making the joints of slate cisterns? I have one that has been taken down from the basement of a school, and have fixed the same in the tower, but now it is together, it leaks very badly. The joints were all scraped and put together with red and white lead, with a little litharge and gold size. Cistern contains 600gal., and in a very awkward place. I have been told that shellac and marble dust is sometimes used. If so, how is it applied, or is there any other better material?—PLUMBER.

[64657.]—**Hot-Air Engine.**—Will Mr. Sutcliffe oblige me with the correct dimensions for a ½-man power hot-air engine, which I propose to make on the plan of the model described in the "E. M." for Jan. 1, 1886? I should like to know of what material the heating cylinder should be made. Would tin do, or could a cast-iron water pipe be utilised in any way?—CHELTENHAM.

[64658.]—**Furnace.**—Will some reader tell me what heat ordinary drain pipes will stand without burning away? Also if there is any material made into pipes which will stand a greater heat. Some sort of terracotta, perhaps. The firebricks over our heating furnace crack with the heat. What could be used as a substitute? Cast iron burns away.—QUIS EST.

[64659.]—**Model.**—I have a brass cylinder, about 3½in. by ⅞in. diam., with piston and piston rod, which were part of an old-fashioned enema syringe. I want, if possible, to utilise these as corresponding parts of a model beam-engine; but the packing of the piston is gone, and I should be glad if some reader would tell me how to replace it, and what material to use.—PONTESBURY.

[64660.]—**To Mr. Bottone.**—A friend of mine has one of Grigg's large medical coils. I notice an electro-magnet by the side of the coil, horseshoe form, with hammer and contact breaker working on its poles. How is the wire of this magnet connected to the coil, and what advantage is there in having this magnet? I also notice the coil is conical shape the narrow end; the core draws in and out. What advantage is there in this form of coil?—J. R.

[64661.]—**Harp.**—Could any reader tell me how to make one? I have a carved pillar I wish to work in, but cannot find out what is in the sounding board to attach to the pedals or whether the pillar is hollow. Any hints I shall be obliged for.—BANCO.

[64662.]—**Collotype.**—Will some one kindly give particulars of collotype printing, describing how the plate should be prepared and saying what sort of ink is used for rolling up? Is there any book printed in English on the subject? What is the best work on photo. mechanical printing processes in general?—J. S. B.

[64663.]—**Deceptive Boiler.**—I have a 4H.P. engine tical boiler which sometimes deceives me, in the of water. The gauge and taps indicating full is nearly empty, causing a great noise and shaking. y kind reader inform me how I may remedy ve consulted an engineer, but fail to do any good. EUR.

.]—**Magneto Machine Sparks.**—Will S. please say whether electric sparks should be seen nall contact spring, when the latter is properly , the machine being turned rather fast, or do arks mean so much power lost?—G. E. H.

.]—**Fireproof Floor.**—Being a small builder, ing had no experience in fireproof work, and as I ebuilding my workshop, I shall be obliged if any ndent will give me a sketch or description of a floor for a room 30ft. by 60ft. which is to hold benches and light machinery.—W.

.]—**Joining Thick Wood.**—I am about a carpenter's bench, and wish some of your ex- d readers would inform me how to join the top, onsists of two 11in. boards, 2in. thick, and 6ft. MATEUR.

.]—**Compound.**—Will any reader show how m is discharged from out of one cylinder into the linders of a triple expansion engine?—ONE IN A

.]—**Shock Coil.**—Will Mr. Bottone and pia" or some other kind reader, give me some de- n of a shock coil for a 3-cell Leclanché battery? l be very glad of a sketch and number and length for bobbins.—TRAMLER.

.]—**Sight Feed Lubricator.**—Will some kindly give a sketch of the new sight feed lubri- howing the chambers for oil and water respect- ad the working actions? Is any of the water to pass with the oil? If not, how is it pre- ?—J. H. MILLS.

.]—**Stain from Oak.**—Can any colourless applied to oak where used in half-timbered work unpainted so as to prevent the water when off it from staining black the brick and stone- ider?—S. W.

.]—**Oxy-hydrogen Microscope.**—Will ntributor kindly say in what way objects should nted for use, and in what situations larvæ and for exhibitions in the water tank may be likely to d?—O. S.

2.]—**Tortoiseshell.**—How is this article d?—O. S.

.]—**Closed Circuit Bell Ringing.**—Can give an explanation of the closed circuit system ric bells often used in America?—E. R.

.]—**Hardening Leather.**—Is there any method of hardening leather by impregnating it olution or solutions which will produce in its deposit of silica or some other hard substance?—Q.

5.]—**Reversing Gear.**—I have a horizontal lve engine, and want to put reversing gear to same me slide-valve and eccentric. Will some reader how I can do it?—MAPLE.

6.]—**Polishing Artificial Eyes.**—Will some lend tell me how to polish artificial eyes? They ave a high polish or they are painful to wear.— ER.

7.]—**Cleaning Scale from Castings.**—What best and easiest way of cleaning off the hard sandy om castings before putting them in the lathe?— ROSE.

8.]—**Blast Furnace.**—An iron ore in found to e following composition:—

rous carbonate	58·48
nganous carbonate	0·71
gnesium carbonate	21·90
cium carbonate	10·68
ica	7·93
er constituents and loss	0·30
	100·00

uch silica would you add as a flux in blast furnace nt for pig iron? Is there any chemical rule em- in working out this? If so, please state what it HY. THOMAS.

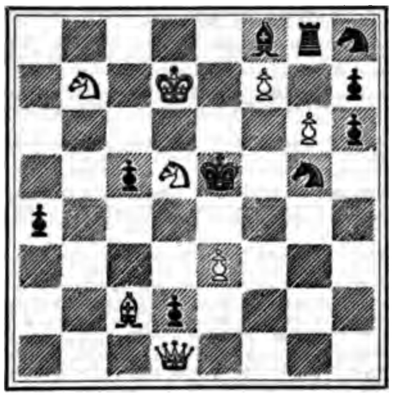
umens.—In his researches on normal and logical albumens, M. Joseph Béchamp, a guished biologist, has brought to light two The first, which interests the physiologist l as the philosopher, is that, by the attentive of the nitrogenous matters of the eggs of res, the author has been led to this remarkable sion—viz.: *Even chemically an animal is what the egg from which it proceeds*, not only as is its organised elements, but by the different e of its albumens, its other albuminoid rs, and its zymoses (fermentiscible prin-). The second fact, which interests patho- l physiology, and particularly diagnosis, is in effusions, there never exists one albumen , which would be that of the serum of the ; but there would be several, which differ it individually and profoundly, among which e zymoses. In submitting these researches Academy of Sciences, M. Béchamp has, ver, established the fact that there exists a on of cause and effect between the membrane morbid tissue, through which the transuda- s produced, and the albumens of the effusion, are always the same, variable only in quantity e same tissue that has been traversed. In words, the membrane or the morbid tissue ises a profound chemical action on the albu- of the blood.—*Lancet*.

CHESS.

ALL communications for this department must be addressed to J. PIERCE, Langley House, Dorking.

PROBLEM MLXXXV.—BY G. J. SLATER.

Black.



White. [8 + 10

White to play and mate in three moves.

SOLUTION TO 1,083.

White.	*Black.*
1. R-Q B sq.	1. Anything.
2. Q, B, or Kt mates.	

(Three variations.)

NOTICES TO CORRESPONDENTS.

CORRECT solutions to 1,083 by Quilter, T. H. Billington, Sorrel (Q sq put for Q B sq, first move), G. T. Stringfellow, and Black Pawn.

SOLUTIONS to 1,084 acknowledged in our next.

TOURNEY problems received from T. H. Billington.

J. KEEBLE.—Thanks for problem. It shall be examined.

SORREL, W. JAY, N. BROWN, AND T. H. BILLINGTON.—Names entered for Solution Tourney. No entrance fee is needed this time.

WE must congratulate our correspondent Mr. W. Jay on having the only clean score in the present Solving Tourney in *Pen and Pencil*.

IN Mr. Fraser's correspondence Tourney, the present score is:—England, won 18, drawn 2, lost 14; Ireland, won 17, drawn 1, lost 20; Scotland, won 13, drawn 3, lost 14.

A MATCH was played between the Nottingham and Leeds Clubs on Saturday, when Nottingham won by six games to five.

MR. R. W. BARNETT is champion of the Belfast Chess Club.

MR. BURN has been presented by the Liverpool Club with a magnificent set of chessmen and board, in commemoration of his recent victories.

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ANSWERS TO CORRESPONDENTS.

◆

. *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand*, *W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

. Attention is especially drawn to Hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

BACK NUMBERS.

WE receive so many queries asking for directions how to make many instruments and appliances which have been fully described in back volumes, that we have compiled a list, which we shall insert in this column at intervals, of those most frequently sent, and as the numbers are still in stock, new subscribers should consult the list before sending their questions.

Bookbinding: No. 613.
Electric machines: Nos. 1,009, 1,026.
Electro-magnets: Nos. 772.
Lacquers: No. 866.
Pattern Making: Nos. 938, 941, 943, 945, 948, 950, 952, 954, 955, 956, 958, 959, 962, 963, 969, 974, 978, 986, 989, 993, 995, 998, 1,000, 1,001, 1,003, 1,004, 1,006, 1,009, 1,010.
Silver-plating: Nos. 1,009, 1,010.
Varnishes: Nos. 478, 619, 675, 723, 775.

The following are the initials, &c., of letters to hand up to Wednesday evening, Feb. 29, and unacknowledged elsewhere:—

C. RABACHE.—S. E Peal.—T. McClelland.—W. F. Stanley.—D R.—C. H. M.—J. and H. Grace.—J. Alexander.—A. J. Adams.—F. Holmes.—Beer.—E. J. P.—A. S. T. E.—Chromo.—W. H. S. S.—Meter Maker.—J. E. W. J.—Pewter Gill.—L. Sidney.—W. W. D.—S. Read.—A. J. P.—One Puzzled.—Vegetus.—Photomaniac.—Bijli.—Solar Radiance.—Chronos.—Jonathan.—W. Donald.

ANXIOUS. (There are many questions of a medical character which can be answered without seeing the patient, when the symptoms are described; but yours looks like a case which can be answered only by a surgeon after examining the weak foot. Send the particulars to Dr. Allinson, at the *Weekly Times and Echo*, 332, Strand, W.C., and he will tell you whether anything can be done by writing.)—AURELIUS. (Try whole-meal bread, wheat-meal porridge, and leave condiments alone. 2. Yes the snow on Ben Nevis is often deep enough to imprison the observers, so far as their windows and doors are concerned; but they can get out at the top of the observatory. 3. Three, as a rule.)—J. M. (The answer referred to a question put by a correspondent whose little boy had swallowed a large number of pilules labelled "Aconite," or something as poisonous, much to the alarm of his parents. He, however, suffered no ill effects. Thanks for the offer; but we should have no use for them, though they might contain the drugs.)—C. WALTERS. (Do you mean make the iron parts? If so, it will cost you as much for the patterns as to buy the finished castings, if not more. Procure lists from our advertisers, and see what they have to offer you.)—F. DAWSON. (The query has been answered many times, with illustrations of the batteries, &c. See indices, including that to be published March 16.)—WEDNESBURY. (What is the clock to do—ring a bell or be worked by electricity? Both questions have occupied some space in the numbers published in the last month.)—M. P. M. S. (You can try sulphate of cuprammonium; but we do not think you will be successful in producing stencils by the method suggested. It has been tried by many.)—R. THOMAS. (The dust is mixed with tar, creosote, or any cheap cementing material, and the blocks are moulded under pressure. See the indices, under headings of "Artificial Fuel," "Utilising Waste Coal," &c.)—EXCELSIOR. (Some books on California are issued by Mr. W. Kingsbury, 41, Finsbury-pavement, E.C.; but see the answer to Rob. Harris last week, p. 612.)—ITALICUS. (It is a sort of lithographic process which can be worked cheaply and expeditiously. You can get a descriptive circular from the company.)—RIOGE KOE. (Holtzapffel's works are in English, and are published by the firm at 64, Charing-cross. They can also be obtained of "all booksellers." Evans's work can be had of the author, 159, Wardour-street, W.)—F. T. W. (Probably due to dusting the mould more thoroughly. See No. 1137, p. 404, for an illustrated paper on brass casting.)—TOM FOSTER. (Mix in the usual way, but use some gold size instead of a portion of the boiled oil.)—EPICURE. (Try about equal parts of the vinegar in which walnuts have been pickled and of mushroom ketchup, flavouring and spicing to taste; or mix walnut ketchup and vinegar.)—J. P., Belfast. (There is an article with illustrations of wood-working attachments for lathes in No. 834, p. 32 See also the indices of many back volumes.)—LAMPS. (They are troublesome. You must keep as cool as possible by giving free ventilation in the lamp chamber, and ret im occasionally. Have you tried a little camphor in the oil?)—PETROLEUM. (Presumably you mean Prof. Abel's lecture on "Explosions Produced by Non-Explosive Liquids" at the Royal Institution, an abstract of which appeared in No. 1043. You would have found that under Lamps—"Explosions in Paraffin-oil Lamps.")—A NEW SUBSCRIBER. (Powers of 40 up to 90 might be employed;

but as you cannot well make the eyepieces, why not apply to the optician to fit the instrument with suitable eyepieces?)—T. R. L. (No, certainly not. You will find a good deal about mesmerism on searching the indices.)—EMERSONIAN. (Dyeing sheepskin mats, No. 892. 2. The abbreviations mean 7 degrees Beaumé's hydrometer, 15 Twaddell's hydrometer.)—J. T. (A yearly tenancy is terminated by giving six months' notice, so that the tenancy expires on the same quarter-day as it commenced.)—Q. Q. (A good thing is to wear flannel.)—X. Y. Z. (You have seen the articles on Electric Bell-Fitting, we presume. Why not try your suggested "improvements," and let us know the result?)—ACIER. (Why not apply to the patentees, or look up the specification at the Patent Office?)—J. O. (Will not the present series of articles on Electric Bell-Fitting suit you? If not, you will find answers to your queries in many back volumes.)—A. H. MENEFY. (The electric light for such a purpose is much more convenient than candles, but not so cheap. Surely you know King, Mendham, and Co., of your city. They could show you suitable devices.)—NOVIST. (Answered many times, even in recent numbers.)—J. S. B. (See indices. There is something about the subject in nearly every other number.)—DYNAMO. (See previous answer. Why not try it? You do not say how much wire is on it.)—R. E. B. (For browning gun-barrels see pp. 237, 327 of the volume just completed, and the indices of back volumes. 2. Any of those advertised in our columns would do.)—J. M. JONES. (Some telephones are protected by patents, others are not. Try those advertised in these columns.)—SIRIUS. (You certainly will not be able to "scan the surface of Uranus" with your 3½in. non-achromatic telescope. It would be worth the extra cost to make it achromatic. Try Lancaster and Son, Birmingham: we think they publish simple directions for making such telescopes.)—LOCO. (Get the illustrated sheets showing the history of the locomotive in England and America, drawn by Mr. West, Princes-terrace, Darlington.)—MYRMIDON. (If the query was received it was, no doubt, answered in this column, as freckles are not very interesting subjects to our readers at this time of the year. A good recipe for all kinds of freckles is—Elder-flower ointment, 1oz.; levigated sulphate of zinc, 20 grains. Apply night and morning. You will find several recipes in back volumes by consulting the indices.)—WATCH JOBBING—WITHOUT A SIGNATURE. (If you cannot refer to the many articles on the subject published in back volumes, you should procure Mr. Britten's "Dictionary and Guide," from the author at the Horological Institute, Northampton-square, Clerkenwell.)—INQUIRER. (Better procure some of the cheap handbooks on the subjects named, as you will need them for reference. Any bookseller can procure them.)—H. L. M. (Mercury expands ·018153 for each degree between 32° and 212° F.—that is, approximately. See Ganot's "Physics" for further information. The query would involve a lengthy calculation.)—T. CASSON. (Not easily done; but you can imagine a number of ordinary forms placed on a ring. There would be spaces between each at the front, which could be filled up with wood, &c. The better way is to make them vertical. 2. Do not know of such an ink. It would take as much time to wash it off as the book would be worth, and, besides, the paper would be spoiled.)—ANXIETY. (In such a case no useful advice can be given without personal examination; but you can try the effect of rubbing in paraffin oil.)—GARFIELD. (Do not understand you. A mould is taken in plaster, guttapercha, or special wax, and the copper is deposited on that, not cast in paper.)—R. C. C. (Hardly, we think. Show it to some firm which introduces such novelties.)—H. H. (A. is now a yearly tenant, and must give six months' notice, terminable at the time at which he took the house, or pay six months' rent to B.)—F. E. FRANKS. (The asbestos is not unwholesome, but it gets decidedly nasty: Mr. Parker Smith's self-cleaning pipe is far the best pipe we have seen.)—J. D. H. (In type).

Don't go to London without visiting the Electropathic Establishment of the Medical Battery Company, Limited, 52 Oxford-street, London, W. (corner of Rathbone-place), where Mr. C. B. Harness, the eminent Medical Electrician, gives advice free of charge on all matters relating to health and the application of Curative Electricity. His world-famed Electropathic Belt (price 21s. post free) should be worn by all Nervous and Rheumatic Sufferers. Pamphlet Free.

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Advertisements must reach the office by 1 p.m. on Wednesday to insure insertion in the following Friday's number.

WANTED, a SITUATION as FITTER. [illegible] Engine Work, having 3 years' experience. [illegible] A. W. GRIFFITHS, [illegible], Chiswick, London, W.

ORGAN BUILDING.—Amateurs [illegible] Soundboards, Keys, Pedals, [illegible] Front Pipes, Back Falls, and every requisite.—[illegible] and Co., Organ Builders, Limes-road, Croydon.

OUR EXCHANGE COLUMN.

The charge for Exchange Notices is 3d. for the first 24 words, and 3d. for every succeeding 8 words.

Good Value Offered (cash or instruments) for all kinds of Scientific Appliances.—CAPLATZI, Science Depot, Chenies-street, near British Museum. Estab. 1862.

To Microscopists.—For any mounted slide received will send two samples of Scotch and German Infusorial Earth.—E. W. DRURY, 125, Coltman-street, Hull.

Lathe, excellent, £30, B.G. Screw-cutting, treadle, compound slide-rest, set change wheels, &c. Offers.—18, Gertrude-road, Liverpool.

Robinson's Patent **Hot Air Engine**, 2 man-power, only 2d. day for fuel, equal to new, thoroughly reliable. What offers in exchange?—12, Pittville-street, Cheltenham.

Shares wanted, small lots, Appalachian, Balkes, Astor Oscar, Chile, Kaboonga, Spitzsof, Valley, Augustin. Exchange BOOKS, Telescope, Microscope, Coil.—COLLIER, Plymouth-place, Leamington.

Safety Bicycle, perfectly new, genuine high class, rear-driving Safety, never ridden. Exchange Tricycle or Bicycle in part payment.—T. GOSNEY, Castle Cary, Somerset.

Models, Scientific Apparatus, Tools, or Machinery taken in exchange for NEW GOODS or Work done to order.—BUTLER BROS., 44, Elsden-road, Tottenham, London.

Splendid Six-string Rosewood **Banjo**, best silver mounts, 15 bolts, splendid tone, best make; offers exchange.—No. 9, Gloster-street, Hackney-road, E.

Bicycle, 52in., will exchange for anything useful.—W. B., 5, Claro-terrace, Richmond-road, Earl's-court, S.W.

"**English Mechanics**," from 591 to 1042. Offers wanted in exchange.—ROBINSON, Catherine-street, Sheffield.

Good Treadle **Sewing Machine**. Wanted Smith's anvil or cylinder, about 7in. by 3½in.—H. MANN, Engineer, 14, New Crown-terrace, Lillie-road, Fulham.

Manchester Dynamo, with about 300 watts output; will sell or exchange for part cash. New and well made.—MAC, 24, Cleveland-road, Islington, London.

A 12H.P. **Gas Engine**, nearly new, Clerk's patent, with starting gear, two flywheels, exhaust pipes, &c. Exchange Shipbuilder's Tools.—H. LYON, 697, Duke-street, Glasgow.

Lathe, 6in., 4ft. 6in. bed, 3-speed wheel. 120lb., 30 steel Bicycle Rims, 3½in. Steam Gauge. Exchange. Reply, stamp.—W. SMITH, Bilston-road, Wolverhampton.

Cooking Apparatus, containing 4 steam boiling pans, 2 pans jacketted, all fittings complete. Exchange for Boiler, vertical or horizontal, or offers.—LOWE, Wallis-road, Hackney Wick.

Large **Screw**, 30 inches long, 3 inches dia., with nut, suitable for heavy press; also about 3cwt. steel Drills, Punches, Chisels. Exchange offers only.—Below.

Aquarium, 36 by 18, plate glass, iron frame, ornamental top, ebonised stand, equal new; also quantity of Fretwoods. Exchange only.—PORRETT & CO., Sunderland.

Tricycle, two 56in., front wheels, all roller bearings, cowhorn handles, excellent rubber tyres, &c. Offers, musical.—18, Gertrude-road, Liverpool.

Launch Boiler, 3ft. by 20in., vertical, ½ plate, 26 1½ steel tubes, all mountings and fire-bars complete; work at 100lb. Exchange.—Below.

English **Concertina**, 48 keys, by Murdoch and Co., London; never been used. Want Safety parts or Humber Tricycle, or offers.—HOY, 5, Kingsley-street, Sunderland.

Large **Intensity Coil**, in polished box, 24in. by 9in. = 14in., 3 batteries, all fittings of ivory, including discharger, rubbers, and handles, switches, water regulator, commutator, and Lot of other Fittings, all in good order, £2 10s., or exchange Tools, Safety Bicycle, Cyclometer, &c.—BROOKS, 4, Myrtle-terrace, Kingston-road, Wimbledon.

Wanted, a good Silver Stop Watch, or model Locomotive with slide-valve cylinders. No rubbish. Exchange.—Below.

A good **Brass Stand**, a Roasting Jack, good Gyroscope, and Model Engine, fitted with governors. Stamp, reply.—CLIMPSON, 10, Queen-street, Hill Top, West Bromwich.

Schäffer and Budenburg patent steel tube **Steam** GAUGE, in leather case, used for testing boilers, 4in. dial, up to 200lb., only used twice. Wanted, offers. Lathe appliances would be useful.—WILSON, 89, Shrewsbury-street, Brook's Bar, Manchester.

In exchange for not less than half-plate good Portrait Lens, grand MEDICAL COIL, Bells, Cylinder Machine, all of best workmanship and finish; also Lowe's Violin, suit lady.—BYWATER, North-road, Wolverhampton.

Required, ½-plate Camera, with long focus, reversible frame, &c. Exchange splendid 8 by 5 CAMERA, or 9-carat Gold Albert.—EDWARD HUGHES, Graigue, Kilkenny.

Microscope, mahogany lock-up, handled case, ¼in. and other objectives, eyepieces, &c., mechanical stage, polarising prisms, slides, &c. Offers.—18, Gertrude-road, Liverpool.

Wanted, good Concert Flute. Exchange 12 months' "CARPENTER and BUILDER," 1887, unbound, clean, and part cash.—JOHN S. GREEN, Flaxmoss-road, Haslingden.

Wanted, 6in. Screw-cutting Slide-rest, 6ft. gap bed Lathe. Exchange "BLACKIE'S POPULAR ENCYCLOPÆDIA," "Nicholson's Dictionary of Architecture," &c.—WILLAN, junior, Evenwood, Darlington.

"**English Mechanic**," Vols. I. to X., XIV. to XXI., XXIII. to XXVII., all inclusive, unbound. Tool offers for whole or part.—Below.

6in. **Lathe Heads**, socket and T-rest, heavy flywheel, 5ft. double crank, treadle, links, &c. Exchange for smaller Lathe, complete with iron bed and standards.—W. MILES, 29, Rayne-street, Leicester.

Barometer, Standard Mercurial, suit gent's hall or laboratory. Offers.—18, Gertrude-road, Liverpool.

Cyclostyle, Gestetner's patent, complete. Exchange for Carbons, 2½ by 5½, bichromate of potash, and terminal screws.—F. BLANKS, 36, Star-street, Paddington, London.

2 Splendid Folding **Music Stands**, brass fittings, value 15s. each. Wanted, good leather Cornet Case, and leather Violin Case.—J. S., Oak-street, Radcliffe, Manchester.

Several small **Engines**, Castings, &c., &c. Large Books on Ship Building. Must be cleared at once. Exchange.—53, Oxford-street, Manchester.

"**English Mechanic**," last 3½ years for 15s. worth provisions, or useful exchange.—PRINCIPAL, Grammar School, Tuxford, Notts.

Treadle Singer **Sewing Machine**, good order, cost £6 10s. Will exchange for good Singer or Jones' Hand Machine.—PRINCIPAL, Grammar School, Tuxford, Notts.

Hume and Smollett's "**History of England**," handsomely bound in 12 volumes, cost £3 12s., pages uncut. Offers.—SMALL, Cavour-terrace, Sheerness.

Wanted, Model Cutter Yacht, length 4 or 5ft., with or without spars. Good exchange given.—Care of H., 50, Bow-street, Landport, Portsmouth.

Small **Dynamo**, by Sledge, Wyatt and Co., Clapham, 10c.p. Wanted, good Magneto Machine or Medical Coil, or offers.—SPENCER, No. 1, Whittaker-street, Burnley.

50 candle-power **Dynamo**, with hand wheel, laminated drum armature, wrought field magnets, shunt wound, value £4. Exchange offers only. Photo.—WM. WALTON, London-road, Gloucester.

Electric **Scarf Pin**, 3-cell pocket battery, in case, cord and presselle, brilliant light, perfect order, value 14s. Exchange offers only.—WM. WALTON, London-road, Gloucester.

Plated **Revolver**, central fire, cost 14s. 6d., used twice only, good condition. What offers?—E. W. DRURY, 125, Coltman-street, Hull.

Small collection of Ancient Roman **Copper Coins**. Will exchange for a collection of Foreign Stamps, or offers.—E. W. DRURY, 125, Coltman-street, Hull.

Good exchange for small Scraps of Platinum, suitable for electric work; must be good.—SMITH, 70, Hardres-street, Ramsgate.

Six **Incandescent Lamps**, Lane-Fox, of 13 and 20c.p., high resistance. Will exchange for Chemical or Electrical Apparatus.—R., 18, West Kensington-gardens, W.

Wanted, Glass Stoppered Bottles, also Gramme Weights 500 to ·001, in box, must be in good order. Offers.—See above.

Exchange **Scribing Block**, suitable for fitters or turners, for Books on Electricity or Engineering, or something useful to value 5s.—C. HARCOURT, Zeals, Wilts.

"**English Mechanic**," last 8 vols., perfect. 2 Vols. "Architect," 2 do. "Building News," bound in cloth, gilt lettered. Exchange whole or part for Model Boiler Fittings, Model Engine Parts, or offers.—F. ROBINSON, 65, Fernhead-road, Paddington.

Cross-bred **Deerhound-Greyhound**, 24in. shoulder, retrieve, catch hare. Exchange anything useful to value of 25s. Lathe castings preferred.—E. LAWRENCE, Chipper-lane, Salisbury.

Photographic Apparatus, ¼-plate, or 3 vols. "Ward and Lock's Universal Instructor," for small Printing Press, type, and accessories, or offers.—EMSLIE, 9, Chapel-street, Aberdeen.

1 dozen **Slide-rest Tools**, ⅜ square, good quality. New cross-cut Saw, cost 13s. Mincing Machine, cost 8s. Large Drilling Cramp, ½ cwt., worth £1.—Below.

Wanted for the above, Set of Castings for compound Launch or Model with link motion, any size. Stamp reply.—SEDGLEY, Witton-lane, West Bromwich.

Cremona Moulds, Building Frame, and Tracings; also Water Motor, value 15s. Will exchange for Theodolite or what offers.—CHARLES EWEN, Forest of Glentana, Aboyne.

Exchange, "**Life and Travels of David** LIVINGSTONE," beautifully bound and illustrated, cost £2 10s., for "Newland's Carpenter and Joiner."—H. JAY, 1, Bridlington-street, Alfreton-road, Nottingham.

Small Collection of **Foreign Stamps** in album, good condition. Exchange Drawing or Painting Materials, Haydon Cutter Bar, Chucks, anything Engineering.—PERCY CLARK, Stamford.

12in. **Circular Saw** and Bench Top rises, complete, with pulley. Exchange Electrical, Photography, Lathe Tools, Cycle Fittings, Musical, or offers.—PERCY CLARK, Stamford.

Hydraulic Press, 500 tons, steel cylinder, steel columns, 18in. ram, 12in. stroke, 30in. square platen, new. Exchange for Machine Tools.—CAM and SON, Worcester.

High-class Special **Launch Engine**, 6I.H.P., high speed and silent, highly finished. Offers. Photo., 6 stamps.—CAM and SON, Excelsior Works, Worcester.

"Grosvenor" **Sociable Convertible**, in perfect condition, balls throughout, pedals included. Offers to value of over £10.—CAM, 50, New-street, Worcester.

Wanted, small iron Printing Press and Type. Exchange new 2½ LATHE, all iron.—GEORGE CATER, Priory-street, Colchester.

Thomas's Circular Feed **Sewing Machine** (for leather work), quite new. Will exchange for anything useful.—GEORGE CATER, Priory-street, Colchester.

3in. **Lathe**, all iron, planed bed, faceplate, rests, &c., also several volumes "Engineer." Exchange good Bicycle Frame, Screwing or other Tools, or offer to value of 40s.—J. M., 14, Alliance-street, Stafford.

Model horizontal **Engine**, 1¼in. bore, 2¼in. stroke, spring piston, 15 inches long, and Vertical Copper Boiler, 15 inches high, 6 tubes, all fittings, 40 pounds pressure; new. Exchange for Rear-driving Safety Bicycle.—G. ROBINSON, 45, Stone-street, Newcastle-on-Tyne.

Good **Duck Gun**, 7 bore, warranted good, single; will exchange for a pair of Field Glasses to the value of 55s. to G. GOS BOULD, Brand Creek, Southery, Downham.

Safety, balls to all parts, equal to new. Also Lathe 4½ centre, all iron. Wanted, Gas Engine.—10, Pitlake Bridge, Croydon.

Gas Engine, model, or hot-air, wanted. Offer oi Silver Repeater, two Pocket Batteries, two Cameras.—P., Box 5, Stirling.

"**Burgh's Marine Engineering and Com**POUND ENGINES," condition good as new. Wanted, Browning's Rainband Spectroscope, with adjustable slit, or offers.—J. ADAMS, Skelwith Bridge, Ambleside.

A quantity of **Theological Books**. Exchange for Photographic Lens, Printing Press, or Type. List sent. Offers requested.—H., 4, Folly-lane, Swinton, Manchester.

Vertical **Engine**, 2¼in. bore, 3½in. stroke, steel shaft, not quite finished. Wanted, 6in. Lathe. Offers.—VERTICAL, 44, Wilkin-street, Kentish Town.

"**Knowledge**," 10 Vols. complete, unbound. Want high-power Micro Objectives, Micro Apparatus.—W. J. CHAFFEY, 249, Wyndham-road, Bournemouth, Hants.

Violin, sweet tone, ¾ size, suit beginner. Exchange for Photographic or Electrical Apparatus (former preferred), or offers.—PHILIP ARBLASTER, Five Ways, Birmingham.

Leather Belting, best English oak-bark tanned, 3in., 1s.; 4in., 1s. 3d.; 5in., 1s. 6d. per lb.—GILBERT, Oxford-road, Sheffield.

Three oxyhydrogen **Blowpipes** for liquid fuel. Also about one cwt. Ground Glass. Exchange. Sample, stamp.—G. ISHERWOOD, 7, Strand-road, Bootle, Liverpool.

Small **Dynamo Armature**, Galvanometer, Mr Bottone's Book, Battery, and Lamp. Wanted, good Book on Th Dynamo, or offers.—Particulars, &c., DEW, Peterhouse College, Cambridge.

Want Gas Stocks and Dies and cash for 2½ **Lath** HEADS and Appliances, and Scribing Block.—Particulars, T NEALE, 4, Silver-street, Kettering.

(*Continued on page* VI.)

The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, MARCH 9, 1888.

PRACTICAL ELECTRIC BELL-FITTING.—VII.

Connecting-up.

THE following diagrams show the various ways of connecting-up bells, indicators, &c., and, though the most usual methods are shown, nearly every building may require some little modification of the arrangements here described.

Fig. 49 shows a simple circuit consisting of push, battery, and bell. The cover of the push P has been removed, showing the connections to the contact-springs, one of which, for the purpose of distinction, is shown darker than the other. The bell B (shown in detail in Figs. 17 and 18, page 524) has its cover on; thus none of the movement is visible. Z and C are the respective poles of the battery D. On the two springs of the push being pressed, together the current flows from the positive pole C of the battery to the terminal L, through the bell to terminal E, and thence by the wire and push-springs to the negative pole Z. Both in this and the following figures the Z or return wire is shown thicker, in order to make the diagrams clearer.

Fig. 50 is a simple bell circuit with earth connections, the circuit being completed between the two plates E E by the earth. The wire from the zinc of the battery, and one of the wires from the push, are fastened to the water-pipe in the manner described on page 335.

Fig. 51 shows the method of connecting two or more pushes so as to ring the same bell. The pushes are here shown with their covers on, the buttons being represented by the black dots. Pressing the button of either of the pushes *a, b, c, d* completes the circuit causing the bell B to ring.

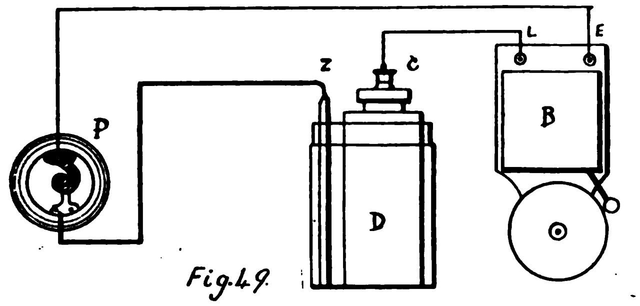


Fig. 49.

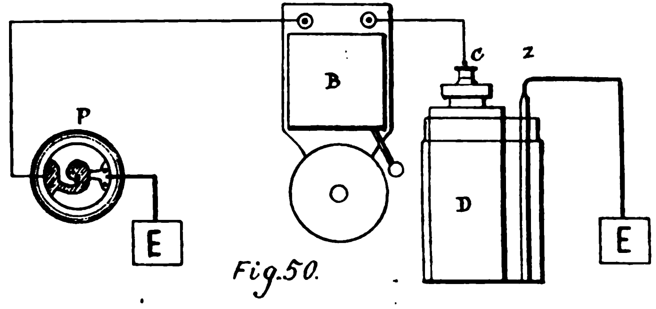


Fig. 50.

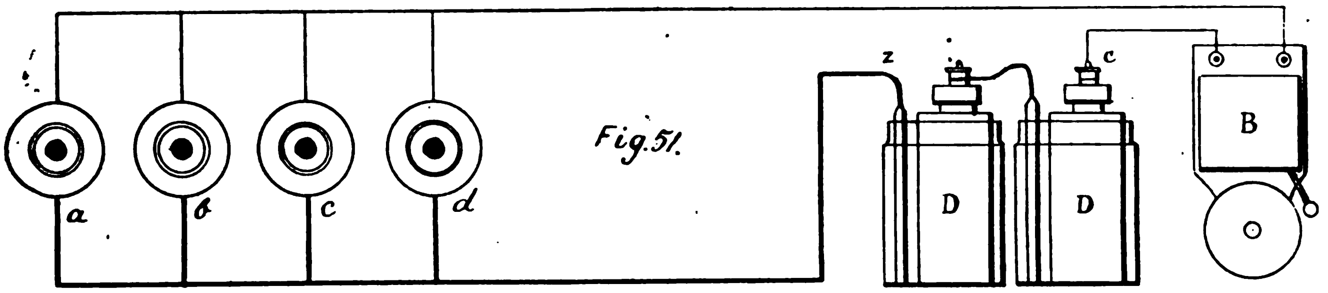


Fig. 51.

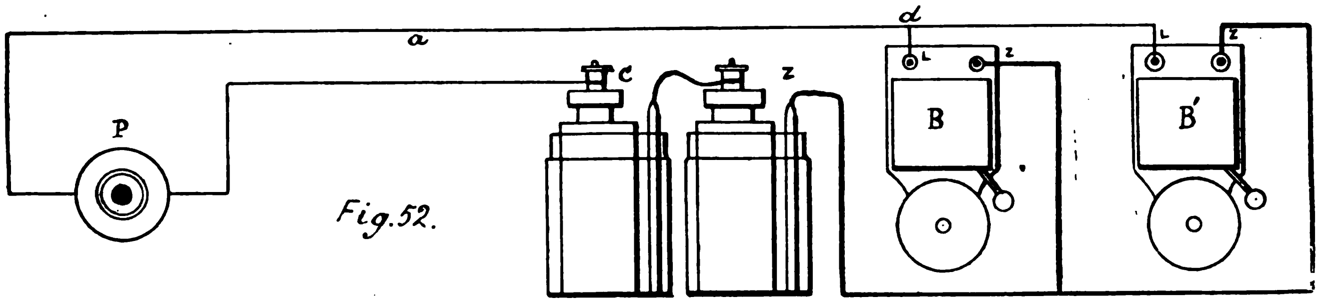


Fig. 52.

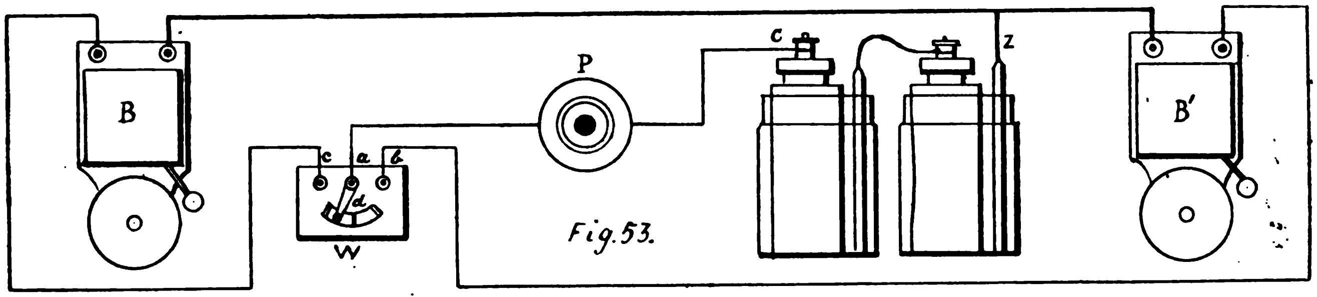


Fig. 53.

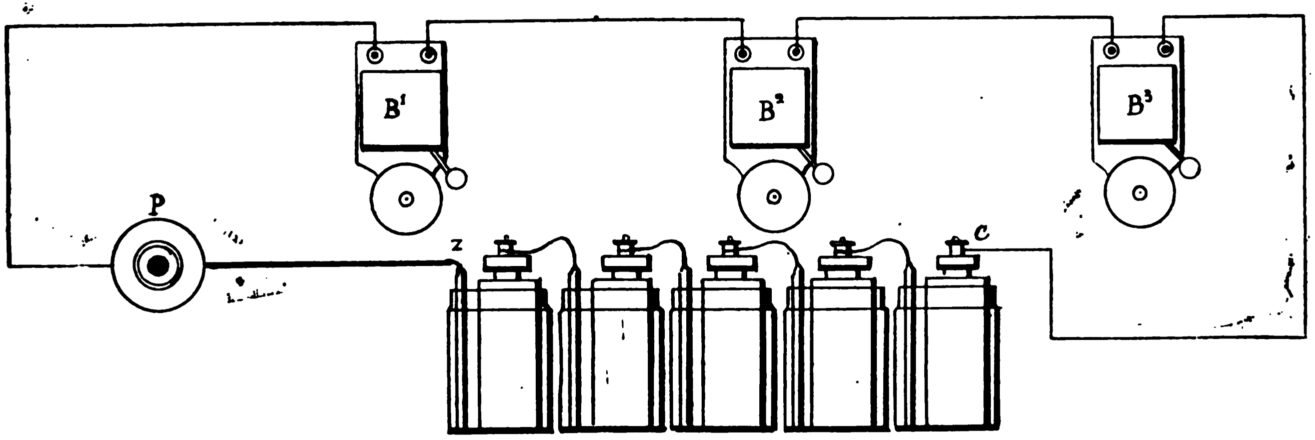


Fig. 52 shows an arrangement by means of which two bells can be rung simultaneously from one push, the bells being some distance apart, as in separate rooms. On the button of the push P being pressed in, the current flows from the positive pole C of the battery through the push, and along the wire *a* to *d*, where it divides, half (if the bells are of equal resistance) passing through the bell B, and half through the bell B'. When bells are arranged parallel like this, care should be taken to insure the resistance of the coils of each bell being as near alike as possible, or else to put the bell with the lowest resistance the farthest from the battery, so that the resistance of the line compensates for its lower resistance. If there are many bells, care must also be taken to provide sufficient battery power, the largest sized cells being used. The practice of splitting up a battery of smaller cells into two halves, and connecting the halves parallel, is not advocated unless absolutely necessary, it being far preferable to employ larger size cells.

Fig. 53 shows a similar arrangement to that in the previous figure, only each bell is rung singly, the bells being, as before, in separate rooms. A three-point switch, W, of the form shown in Fig. 47, is used, being fixed near the push P. If the button of the push is pressed while the arm D of the switch W is in the position shown, the terminal *a* is connected to *c*, and the bell B will ring; but if the arm of the switch is moved over to the opposite side, the terminal *a* is connected to *b*, and if the push is now pressed the bell B' will ring instead.

Fig. 54 shows how bells are connected in series, so that by pressing the push P the bells B^1, B^2, and B^3 can be rung simultaneously. The bells, to ring satisfactorily, must be either single-stroke or of the form shown in Fig. 19, p. 425. The cells of the battery for this purpose (the size of which cells will vary according to the size and construction of the bells used) must be of sufficient number, connected in series, so as to obtain the E.M.F. necessary to force the required current through the high resistance necessitated by placing the bells in series.

F. C. A.

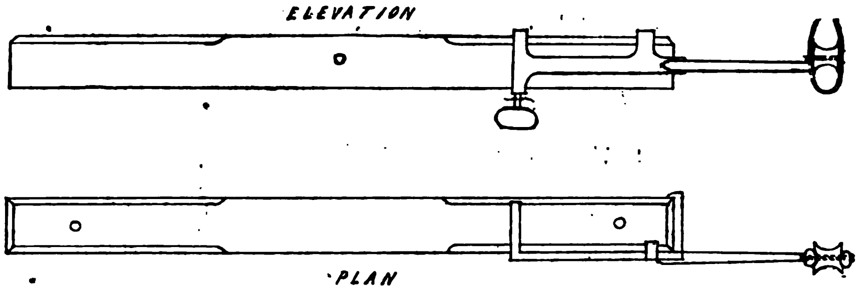
(*To be continued.*)

RENEWING TELEGRAPH AND TELEPHONE WIRES.

THE frequent interruptions caused by earths and contacts during renewal operations have at all times been a source of much annoyance to telegraph engineers. Considerable attention seems, however, to have been given to the matter lately, and various appliances have been designed to avoid stoppages from this cause, and to maintain uninterrupted communication while new wires are being run. Particulars have been furnished of another appliance designed and patented some time ago by the Caledonian Railway Company's engineer, Mr. Dunn. Practically perfect results are said to have been obtained by means of this tool; while the use of it, instead of retarding work, as might seem at first sight to be the case, facilitates it to such an extent that at least 20 per cent. more can be done.

The runner, as shown in the sketch, is attached to the arm by transverse jaws and an under-pinching screw, and the outer end carries a free pulley, over which the new wire is run. The pulley is a special feature of the tool, as it offers little or no resistance to the wire, and in drawing out enables one man to do the work hitherto done by two.

The "scouring" and "skinning" which take place when wire is drawn over rough ground or over arms against insulator bolts or other rigid surfaces are also completely obviated, and the wire is got into position without the zinc coating being broken or in any way impaired.



The method of using is as follows:—One runner is attached to a long arm on each pole along the section over which a coil of new wire will run; the wire is then drawn out over the runners, and, as those project, keeps clear of the standing wires on the poles. When drawn out the wire is viced up on the runners and exchanged with the old wires, after which the latter are cut down. The whole process is gone through without the new or old wire getting foul of any other wire on the poles, and as this result is obtained not only without prejudice to the speed of work, but with very considerable acceleration to it, it is expected that the tool will be generally introduced.

It will be apparent that it is much easier to lift the bight of the wire on to the runners as it is being drawn out than to thread the wire over the arm between the insulator and the pole, as is done under the old system.

A number of appliances had been designed and tested by Mr. Dunn; but it was found, after considerable experience, that the one now described is most suitable for the work. Its advantages are that it is light and portable, and can be quickly and securely attached without boring or cutting the arm. It provides complete immunity from interruptions, and facilitates the work. It prevents injury to the anti-corrosive coating of the wire, and adapts itself to the system of drawing wires out.

BRIN'S IMPROVEMENTS IN BLEACHING.

THE Brin process of manufacturing oxygen is gradually finding many fields of usefulness in the industries, one of the latest being the bleaching of fibrous substances by chlor-ozone in the manufacture of paper. This process has been recently patented by the Messrs. Brin themselves, and is thus described: The pulp of the fibrous materials is thoroughly washed before or after it leaves the breaking engine, and after having been mixed with a quantity of water, if necessary, to make it of the proper consistency, it is run into a churn or vessel fitted with revolving beaters or paddles, or with other suitable means for agitating the pulp. This churn or vessel should be so constructed as to be readily closed to prevent escape of the gases used in the treatment. The pulp is violently agitated in the churn or vessel by the beaters or their equivalents, and whilst agitated the pulp is subjected to the action of a mixture of chlorine and oxygen gases which have been electrified and are admitted into the churn or vessel, which may be most conveniently effected by means of a perforated pipe situated at the bottom of the churn or vessel. The electrifying of the chlorine and oxygen may be done in an apparatus such as is used for producing ozone from oxygen, and the electrified mixture of chlorine and oxygen is called chlor-ozone. After the pulp has been treated by agitation in the presence of chlor-ozone, the pulp may be thoroughly washed and be then used in the ordinary manner in the manufacture of paper. Any chlorine and oxygen which escapes from the churn or vessel and has not been absorbed as chlor-ozone by the pulp during the agitating or churning operation may be re-electrified so as to be reconverted to chlor-ozone, and be used again in the process, or the oxygen may be employed to revivify the oxide of manganese or other metallic oxide used in the manufacture of the chlorine used in the process. Illustrations of the apparatus are not necessary; but there is a container of oxygen gas, and a retort partly immersed in water contained in a vessel or boiler which can be heated by any suitable means. Into the retort are placed the matters from which the chlorine is produced—for example, black oxide of manganese and hydrochloric acid. Oxygen in sufficient quantity to form the required mixture of chlorine and oxygen, and at the same time to revivify the black oxide of manganese, is admitted to the retort from the container by a pipe leading down into the black oxide of manganese in the retort. The oxygen and chlorine pass by a pipe from the retort into a wash bottle, and therefrom into a gasometer, to effect which the bell of the gasometer may be caused to rise by adding weights so as to withdraw the gases from the retort and wash-bottle. When the bell is full the weights are removed, and the gases by the descent of the bell are expelled through a pipe into an ozone generator, in which they are highly electrified and converted into chlor-ozone. The electrified gases (chlor-ozone) pass from the generator by a pipe into a vessel in which the pulp is placed and agitated by a stirrer. The pulp thus treated is removed and used for paper-making, which may be performed in the usual manner. The oxygen and chlorine which arise from the pulp are drawn back by a pipe into another gasometer by the bell thereof being made to rise by adding weights, and after it has become filled, by removing these weights the gases are by the descent of the bell forced back into the retort to be again used in the process. The pipes are furnished with valves and cocks to control the supply and direction of flow of the gases.

GEARING.—XI.

Screw-Gears.—(*Continued.*)

IN our last we went through the mode of construction of a pair of screw-wheels designed for mutual and equal gear, determining the relations which subsist between the different dimensions by the graphic method of the laying down of lines. In this I shall show how the same result can be obtained by simple calculations based on the functions of triangles. I shall also describe how in various ways the relations of screw-gears can be conveniently modified, so that although they are not employed to anything like the extent of the other gears previously described, they have the advantage of a great range of *adaptability*, and afford in the lighter-running mechanisms a simple means of transmitting power between shafts too inconveniently situated in relation to each other for the utilisation of common gear.

Suppose a screw-wheel is brought us, and we are required to make another to gear with it, either at right or at any other angles. We want to determine the pitches, the angles, and relations depending thereon. Take, for example, the following:—Counting the teeth in the wheel brought, we find they are eight in number; we find the circumferential pitch (see last article, Fig. 67, p. 593) taken on the pitch circle to be $1\frac{3}{16}$in., the normal pitch $\frac{15}{16}$in., the divided axial pitch about $1\frac{1}{2}$in., and the angle of teeth, measured on a short section of the same, 38°, all these dimensions being taken on the plane of the pitch circle. These measurements may all lack strict accuracy, owing to the difficulty of taking them on twist gears; but they are near enough for our purpose. We can plot these dimensions down in the form of a right-angled triangle as described in the last, Fig. 68 p. 593, or we can calculate them all one from the others, and take the *mean* of the results which will then be very accurate, and afterwards design and make our new wheel thereto, to work at any angle, or having any diameter required.

The circumferential pitch = $1\frac{3}{16}$in., which, multiplied by 8 = $9\frac{1}{2}$in. circumference, or 3in. full, pitch diam. The angle of teeth is 38° with the wheel face. Make a right-angled triangle (Fig. 76) to represent these relations. Its hypothenuse A P (= the screw-thread) makes gle θ of 38° with the base A M (= the the axial pitch), and the height of the dicular P M = 9½in. (= the total circrential pitch). Now $\frac{\text{P M}}{\tan.\,\theta}$ = the base, tal axial pitch. The tangent of the θ, of 38° = ·781. Hence $\frac{9\cdot5\text{in.}}{\cdot781} = 12\cdot17$ d, the axial pitch. Our measurement he divided axial pitch as 1½in., and 1½in.

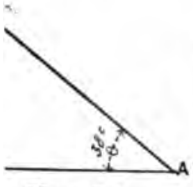


FIG. 76

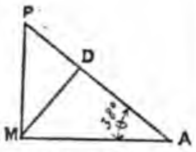


FIG. 77

12in., which corresponds very nearly. way we are tolerably sure that our s a portion of a multiple threaded true f 12in. primary pitch, and 38° of angle. we measure that primary axial pitch y, which is impossible, we might find it hat greater, or less, than our calculation because its determination rests mainly accuracy of the angle of 38°, which is rily taken on a short length of the and therefore liable to error. The ement of the divided axial pitch will y be out a little also. The measuref the circumferential pitch should be , being most easily obtained on the face wheel.

ow proceed to calculate the normal pitch

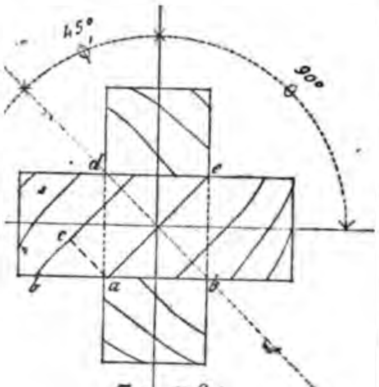


FIG. 78

r data, and see if it coincides with the measurement. From the properties of gled triangles we have the relation 7) A M × sin. θ = M D, and P M = M D. We measured the divided tch as 1½in., and the circumferential $1^3/_{16}$in. Let the first coincide with the in Fig. 77, the base of the triangle and hypothenuse of the triangle nd the second coincide with the line perpendicular of the triangle M A P, othenuse of the triangle P M D. Then of 38° being ·61566, we have A M = 1½in. × ·61566 = ·923490in. = M D,

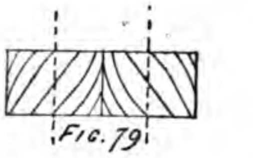


FIG. 79

al pitch. Also the circumferential ing $1^3/_{16}$in., the cosine of 38° being e have 1·1875in. × ·78801 = ·934761in. = normal pitch. Each result is so that we can accept this dimensufficiently close to the normal r all practical purposes. From mensions, therefore, of eight screw-threads of 12in. primary pitch, $\frac{15}{16}$in. normal pitch, and 38° of angle, we can at once make other wheels for mutual gear. The diagram, Fig. 77, is merely introduced to render these relations or functions more clear to the student. But the advantage of a simple means of calculation is that it enables one to verify at once the approximate dimensions taken from the wheel itself, and to detect inaccuracies mathematically minute.

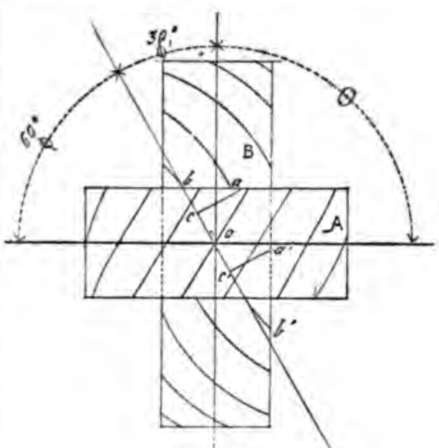


FIG. 80

In our last article, page 593, we supposed two screw wheels in mutual gear, having the same number of teeth and being of the same angle, and hand of thread. To obtain the relations of such wheels by calculation: in Fig. 78 let θ = the angle between the axes of the wheels, ϕ and ϕ' = the angles between the wheel teeth, and their transverse planes, or the planes perpendicular to their axes, on which the circumferential pitches are measured. Evidently in Fig. 78, $\phi + \phi' + \theta = 180°$, and are therefore complementary to each other, a point to be noted in succeeding figures. Let *a c* represent the normal pitch, and *a b* the circumferential ditto. The angle *a b c* is equal to the angle ϕ. Then, $a\,b = \frac{a\,c}{\sin.\,\phi}$. Let $a\,c$ = 1in., then $\frac{1\text{in.}}{\sin.\,45°} = a\,b$. The sine of 45° is ·70710, hence $\frac{1\text{in.}}{\cdot70710} = 1\cdot41\text{in.} = a\,b$. Conversely $a\,b \times \sin.\,45° = a\,c$.

We can also calculate the tooth length. The angle $b\,d\,e$ = the angle ϕ. Then $b\,d = \frac{b\,e}{\sin.\,\phi}$ Call $b\,e$=3in., then $b\,d$ will equal $\frac{3\text{in.}}{\cdot70710} = 4\cdot24\text{in.}$ the tooth length.

Lastly, if there are 12 teeth in the wheel, then, since $a\,b = 1\cdot41$in., $a\,b \times 12 = 16\cdot9$in. circ., = 5⅜in. pitch diam.

The relative numbers of teeth in these gears, the angles, and the "handing" of the tooth-threads may vary, and yet the wheels work truly. In a pair the threads may be both right-handed, or both left-handed, and in each case the axes of the wheels must cross each other at some angle greater than the angle of repose, which is 10° for iron and iron; and the angle at which these axes cross will be equal to the *sum* of the angles of their spirals. In Fig. 78 those angles make 45° with the axes, hence the latter cross at 45° + 45° = 90° of angle. But suppose the two wheels of a pair were made, the one with a right, the other with a left-handed spiral, then the angle of their axes would be equal to the *difference* in these angles—thus, 45° + 45° = 0; in other words, their axes would be parallel (Fig. 79).

The angle of 45° in Fig. 78 is the exact bisection of the angle 90° of the axes, and this is the most advantageous relation. But suppose the tooth angles ϕ and ϕ' were 30° and 60° respectively. This would alter every relation except the normal pitch, which alone must remain equal in wheels gearing together. Thus in Fig. 80 the line of 30° and 60° represents the tangent passing through the pitch point O, common to the helices of both wheels, and coincides, therefore, with the tooth diagonals at that point. The angles of the tooth on wheel A are 60°; those on wheel B 30°. A and B have, therefore, helices of different primary pitches, though the number of the helices, and their normal pitches are alike. The circumferential pitch of A is less than that of B, and therefore its diameter is less. ϕ represents the tooth angle of A, ϕ' that of B. Then $\frac{a\,c}{\sin.\,\phi} = a\,b$. As before, let $a\,c$ = 1in. The sine of 60° is ·86602. $\frac{1\text{in.}}{\sin.\,\phi} = \frac{1\text{in.}}{\cdot86602} = 1\cdot15\text{in.}$ Then 1·15in. × 12 teeth = 13·80in. circ. = 4⅜in., full pitch diameter of A.

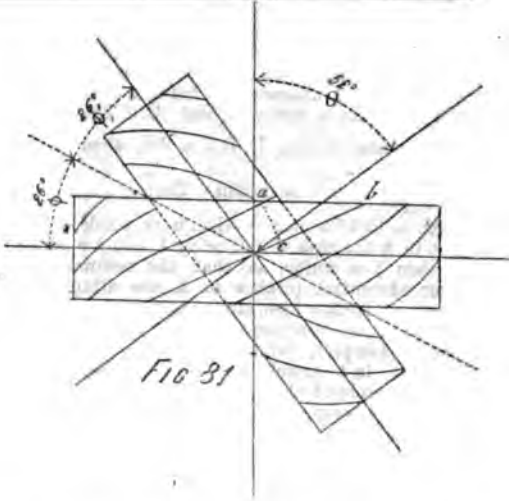


FIG. 81

Again, the sine of 30° is ·5000, $\frac{a\,c}{\sin.\,\phi'} = \frac{1\text{in.}}{\cdot5000}$ = 2in. Then 2in. × 12 teeth = 24in. circ. = 7⅝in. full, pitch diam. of B.

So that though we have the same number of teeth of the same normal pitch as in Fig. 78, yet the difference in tooth angle makes the circumferential pitches and diameters very unequal in the two wheels A and B. Hence the diameters of such gears are not proportioned to their normal, but to their circumferential pitches.

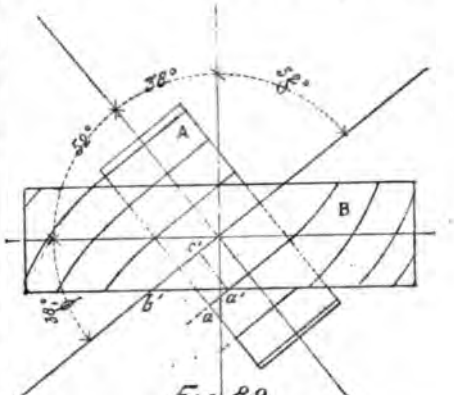


FIG. 82

It is sometimes convenient to gear together shafts which cross at other angles than 90°. In Fig. 81, let the angle θ between the axes equal 52°, and the teeth have the same obliquity on both wheels, or $\frac{52°}{2} = 26° = \phi$ and ϕ'. Then in these the circumferential pitches will be alike, as in Fig. 78. Again, let the normal pitch $a\,c$ = 1in. Then $\frac{a\,c}{\sin.\,\phi} = a\,b = \frac{1\text{in.}}{\cdot43837}$ = 2·28in. We see again how the diameter is governed by the angle of obliquity of the teeth. In this case $a\,b = 2\cdot28\text{in.} \times 12 = 27\cdot36$in. circ. = 8⅝in. pitch diam., against 5⅜in. p.d. in Fig. 78. Yet each wheel has the same number of teeth, and the same normal pitch *a c*. But in Fig. 81 the friction due to sliding is excessive.

The angle of the common tangent to the teeth may vary between ϕ and ϕ' until in certain cases, where the axes cross diagonally, the tangent line *coincides* with one of the axes, and then its wheel is no longer a screw, but a *spur* wheel gearing into a helical wheel. In such cases, though the normal pitch is the same the circumferential pitch of the helical wheel is largely in excess of that of the spur wheel, while in the latter the two pitches are absolutely coincident. Fig. 82 represents a gear of this mixed character, A being a spur wheel gearing into a screw wheel B. The same calculations obtain. In B $\varphi = 38°$, then $\frac{a\,c}{\sin.\,\varphi} = \frac{1\text{in.}}{\cdot 61566} = a\,b = 1\cdot 62$in. Then 1·62in. × 12 teeth = 19·44in. circ. = 6¼in. bare, pitch diam. But in A the sine of 90° being 1, and *a b* being 1, then $\frac{1}{1}$ = unity, so that the normal and circumferential pitches in A are alike, and 1in. × 12 teeth = 12in. circ. = 3⅞in. bare, p. diam.

Again, we can see, bearing in mind the paper templet, whose use was illustrated in the last article, Fig. 72, p. 594, that the principle of the gear cannot be affected, if instead of wrapping the diagonal lines which represent the tooth centres around a circular block, we spread them out upon a plane surface, so making a *rack*. The rack will then be a screw gear of infinite radius, and a screw pinion will drive it. And the angle of the rack teeth may be identical with that of the teeth of the screw pinion, or the common tangent line may be such that the tooth angles shall be unequal, as in Fig. 80, so long as their *sums* make up the required angle between the axes. In Figs. 83, 84, are shown screw wheels gearing into racks. As we have had wheels with equal angles, so in Fig. 83 we have a rack and wheel with equal angles. As also we have in Fig. 82 a screw wheel working with a spur wheel, so in Fig. 84 we have a screw wheel working with a spur rack. In Fig. 83 the normal and the circumferential pitches of the teeth would be alike, in Fig. 84 they would be the same in A and B respectively as in A and B of Fig. 82, the angles being alike.

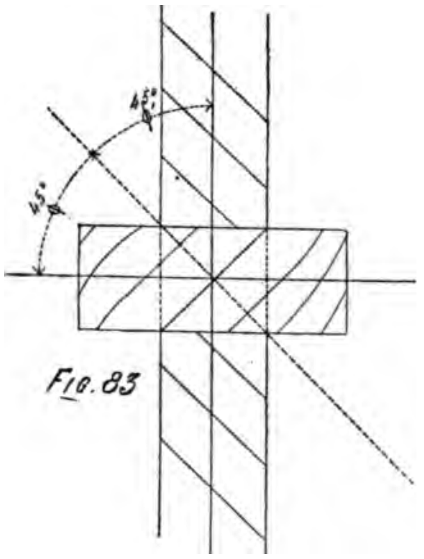


Fig. 83

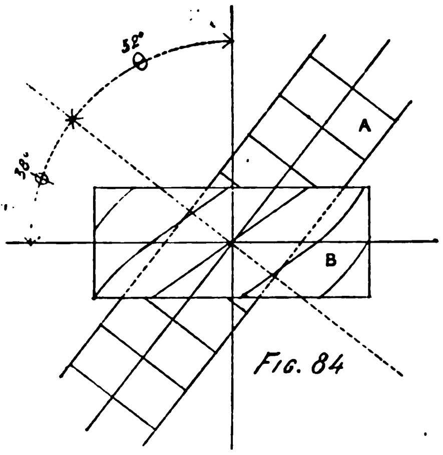


Fig. 84

Since the direction of the common tangent line to a pair of gears governs the angles of their teeth, the tooth angles at the point of tangency must be equal, and where the tangent line bisects the directions of the axes of a pair of equal gears, as in Fig. 78, ϕ and ϕ' are alike, and the primary pitch is the same in each. But wheels of unequal size, for different velocity ratios are often required to gear together two to one, three to one, &c., and then, though the tooth angles to the common tangent are the same, the difference in diameter alters the primary pitch. So that in Fig. 85, geared two to one, where the angles ϕ and ϕ' are equal, and the normal and circumferential pitches respectively alike, the primary pitch of A would be twice that of B. If the tangent line were such that φ and ϕ' were unequal, as in Fig. 80, then the primary pitches would be modified thereby, and not be strictly proportional to diameters.

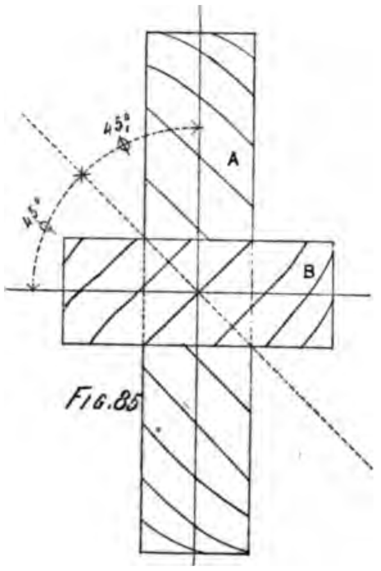


Fig. 85

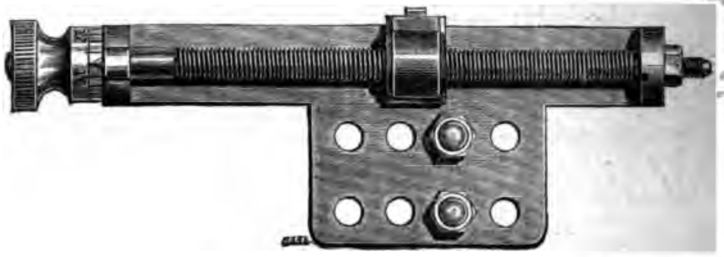
In screw-gears there is no rolling contact, but sliding only, contact between teeth taking place (in theory) at a mathematical point, at the point of common tangency to the pairs in gear. Contact begins at one edge, and passes from one side of the teeth to the other. The friction is excessive, being most of all when the angle of the common tangent to the teeth divides the direction of their axes unequally, making the teeth of one wheel longer than those of the other, least of all when it bisects the axes.

I have been somewhat precise in explaining the designing of these screw gears, both by graphic methods and by calculation, because a clear understanding of these fundamental constructions will enable us the better to pursue the study of the kindred forms to follow, which will form the subject matter of succeeding articles.

J. H.

THE BRITANNIA COMPANY'S REGISTERED SCREW-CUTTING GUIDE.

THIS appliance, which has just been introduced by the Britannia Company, of Colchester, can be used on any lathe. By its use the workman can regulate the depth of cut to the greatest nicety, and the use of the chalk mark or any such expedient is unnecessary. It can be used for inside or outside screw-cutting, or other work requiring uniformity. It saves time from insufficiency of cut. It prevents the breaking of tools or the work being torn out from the centres. It is a reliable stop for ornamental drilling and fluting. While the lathe is cutting this can be adjusted for the following cut. It only requires to be bolted upon the saddle of a screw-cutting lathe, and a projecting stud or screw fixed in the middle slide engages the stop. It can also be used on ordinary lathes with slide-rest; in this case it must be fixed to the bed. It is, in our opinion, a cheap, handy tool which has long been wanted by engineers, and will also be appreciated by amateurs.



ON THE CHANGES PRODUCED BY MAGNETISATION IN THE DIMENSIONS OF RINGS AND RODS OF IRON AND OF SOME OTHER METALS.*

By SHELFORD BIDWELL, M.A., F.R.S.

IN a paper communicated to the Royal Society in 1885 ["Roy. Soc. Proc.," Vol. XL., 1886, No. 242, p. 109], the author has shown that the elongation which an iron rod undergoes when magnetised does not, as had been generally believed, remain unchanged at a maximum when the magnetising force exceeds that which is sufficient to produce so-called saturation. On the contrary, he finds that when the magnetising force is continually increased beyond this limit, the elongation becomes gradually less and less, until the rod, after first returning to its original length, ultimately becomes actually *shorter* than when in the unmagnetised condition.

The experiments described in that paper are, however, open to objection, on the following grounds:—(1) The field due to the magnetising solenoid was not quite uniform; (2) the effect of the ends of the rods was uncertain, and might have played some material part in the production of the phenomena in question; (3) all the rods used in the experiments retained a certain amount of permanent magnetism; (4) the experiments might with advantage have been carried further. The paper now offered to the Society contains an account of some new experiments which were designed to meet the above objections.

Objections (1) and (2) were met by using rings instead of rods of iron, observations being made of the changes which occurred in their diameters under the influence of various magnetising forces obtained by passing currents of electricity through coils of wire encircling the rings. To remove the third objection the rings were demagnetised before every observation, by a modification of the method described by Prof. Ewing in the "Phil. Trans," Vol. 176, p. 537. And lastly, the battery employed was increased from seven Grove's cells to thirty.

After an explanation of the precautions taken to guard against the effects of current heating, an account is given of some experiments with three rings arranged in slightly different ways, and the results are compared with those of an experiment made under similar conditions with a straight rod. It was found that in their general character the phenomena of elongation and retraction were just the same in both cases, and were in close agreement with those of the former paper. The differences in mere details were not greater than would probably be found to occur in different specimens of iron of the same form.

Being satisfied that these curious effects of magnetism were practically independent of the form of the iron, and having regard to the fact that it was much easier to obtain intense fields with straight than with circular solenoids, the author thought it worth while to make some further experiments with straight rods. The metals used in addition to iron were cobalt, nickel, manganese steel, and bismuth; and the highest magnetising force reached about 840 C.G.S. units, the maximum in the old experiments having been 290.

It was found that the retraction of the iron continued to increase with higher forces until it was finally as much as 45 ten-millionths of the length of the rod, when there were indications that a limit was being approached. The retraction of the nickel reached 113 ten-millionths, when it also was evidently not far from its limit.

The behaviour of the cobalt rod was exceedingly and interesting. No evidence of any change th appeared until the magnetising force d 30 or 40 units. Then the length of the an to diminish, and continued diminishing e force was about 400, when the retraction ed to 50 ten-millionths. But beyond this ne rod gradually became longer again, and action with the highest force of 800 units y three-fifths of its maximum amount. It ertained that the maximum retraction did cide with a maximum of magnetisation, as have been suspected to be the case. It is d that iron and nickel might possibly in a similar manner under sufficiently high ising forces.

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* A paper read before the Royal Society.

also suggested that some specimens of and nickel might, like iron, begin with a reliminary elongation, thus accounting for arrett's observation that cobalt undergoes on when magnetised.—*Nature*, Vol. XXVI.

s and curves are given showing the relation magnetising force and changes of length metal.

nth was found to be slightly elongated in ields, though no change could be detected rces of less than about 500. The greatest on observed was about 1·5 ten-millionths h.

anese steel was almost unaffected. The on in a field of 850 was estimated to be ne fifty-millionths of the length.

ly, it is shown that the mechanical stress d in iron by magnetism does not account than one-fifth part of the observed magtraction.

pendix to the paper contains evidence of h degree of accuracy obtainable by the of observation employed. In the very ajority of the measurements of elongation raction, the probable error was less than -and-a-half-millionth part of an inch, or one l-thousandth of a millimètre; and the reexperiments made upon different days (the ns having been in the meantime dismantled), currents of ascending and of descending , were strikingly concordant. This degree sion is attributed to the perfection of the arrangements, which rendered it possible to the image of a wire with such sharpness, er reflection from a mirror its position upon 24ft. (732c.m.) distant could be read to a of a scale division, each whole division qual to $\frac{1}{40}$in. (0·64mm.). The magnifying was such that a change of one two-and-alionth part of an inch (or one hundreddth of a millimètre) in the length of the ler examination caused the image of the move through about three-quarters of a vision. More accurately, a scale division nds to 0·000018mm.

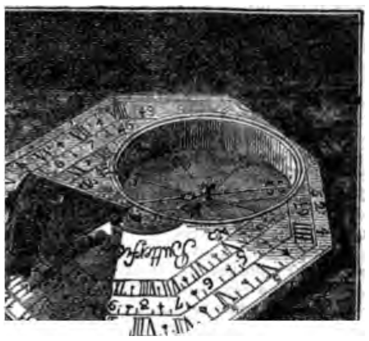
currents used were measured by one of and Perry's commutator ammeters, and the with which the magnetising forces were d, though quite sufficient for the purpose xperiments, does not claim to be very high.

IALS—HISTORICAL, THEORETICAL, AND PRACTICAL.

following notes on sundials are given in a cent number of *La Nature*:—

History.

eed of fixing the division of time graphiust have been felt from the beginning of d. It is certain that the Egyptians found f doing it in the apparent motion of the . No sundial, however, has been found in the antiquities of Egypt; but it is supposed that the inhabitants of that country observed the length of the shadow of the obelisks that were scattered throughout the land, and that they calculated the hour from that. They likewise used clepsydras. We are certain that the sundial was known in Judea, since Isaiah (750 B.C.) asserts that God set Ahaz's dial back. Diogenes Laertius attributes the invention of sundials to Anaximander, and Pliny gives the honour of it to Anaximenes of Miletus (600 B.C.). Herodotus says that the Greeks received this invention from the Babylonians, and Plutarch asserts that the Egyptians measured the height of the pole with a tablet in the form of a tile, making a sharp angle with the plane of the level, whence we must conclude that the invention of the equinoctial dial belongs to them, because it is a natural consequence of the knowledge of the obliquity of the Ecliptic.



1,—Sundial of the Seventeenth Century.

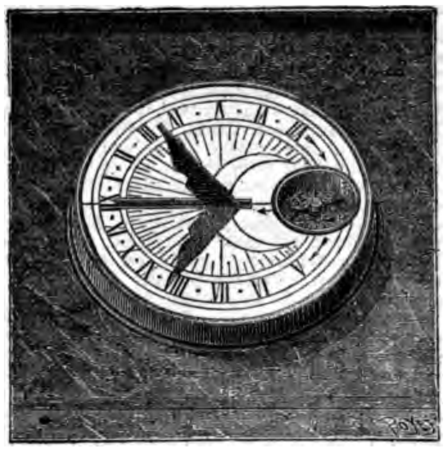


FIG. 2.—Pocket Sundial.

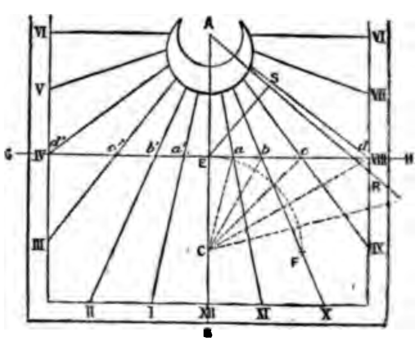


FIG. 3.—Method of Making a Sundial.

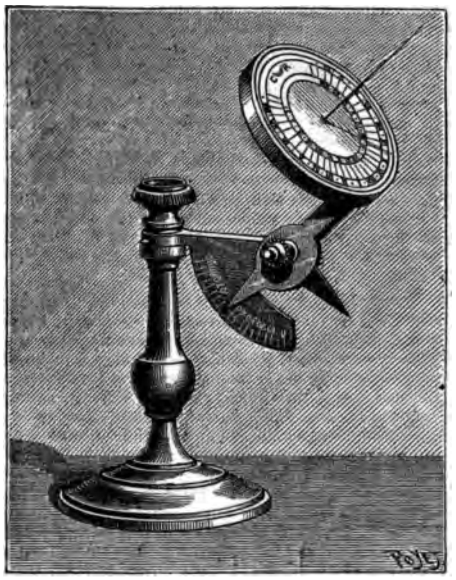


FIG. 4.—Universal Sundial.

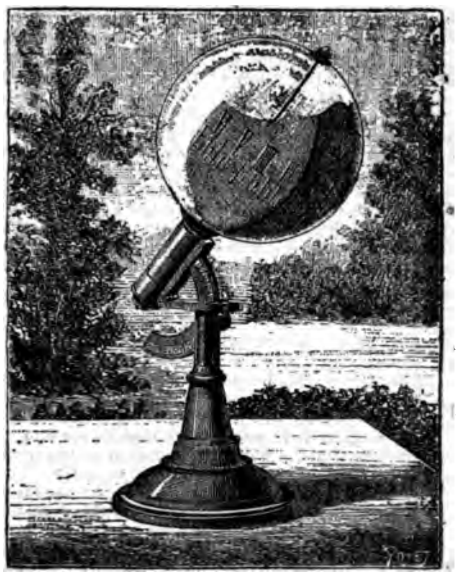


FIG. 5.—Universal Solar Clock.

The Romans did not know of the sundial till the time of Cicero, Cæsar, and Cato. Valerius Messala brought one from Catana. This was placed upon the rostrum; but it could not have been accurate, as it was constructed for a latitude less by 4° 30′ than that of Rome. The Romans also made use of the gnomon; but this could have been no more correct than obelisks, on account of the penumbra. Moreover, it could indicate the hour approximately only at noon, the moment at which the shadow, being shortest, remains immovable for an instant. For this reason slaves were charged with the duty of making this time known.

To Eratosthenes is attributed the invention of a hollow sphere, or hemisphere, called a skaphe, and provided with a straight style in the centre. The plane in a line with the sun and the style that was held vertically intersected the concavity according to a semicircle, which, receiving the projection of the shadows, marked on it the sun's height. From this description it will be seen that this kind of a dial could not have been of very great utility, and that the property of all gnomons resides in the simple process at present employed for finding the meridian of any place, as we shall show further along.

Despite the efforts of so many men of genius (whose names have been preserved in history) to discover a method of fixing a knowledge of the time, the sundial was not invented till the day on which the shadow of the gnomon was able to lie upon the surface or wall carrying the hours. One of the oldest of this sort of apparatus known comes to us from Phenicia. It is in the form of a hollow ellipsoid, with a horizontal style, and has been reconstructed by the present learned director of the Conservatoire des Arts et Métiers at Paris, where it may be seen.

Since the time of Vitruvius (100 B.C.), and especially since the sixteenth century of our era, the art of tracing sundials has been enriched with all the data of geometry and mathematics.

To-day, this branch of science—gnomonics—is established in theory upon an infallible basis. The neglect of this valuable object for regulating watches could not be explained did we not know that up to the present the most serious obstacle to the use of it has been the difficulty of finding a system of simple management that will render the use of it convenient and comprehensible to all.

Sundials, more or less ornamented, have been constructed in all times. In Fig. 1 is shown a curious dial of the seventeenth century. In Fig. 2 is shown a pocket apparatus got up by Mr. Rimbaud. It suffices to orient this little dial with the compass with which it is provided to obtain the hour through the shadow of the style, which latter, after the reading has been done, is made to enter a slot in the face.

Sundials can be consulted only for the latitude for which they have been constructed, and, as the hour is read in reverse order, according as we are on one or the other hemisphere, it will be seen that in order to know the true hour exactly, by means of these instruments, we should have to have 180 of them. The same is not the case with the equinoctial dial, and especially with the universal solar clock recently invented by Mr. Rimbaud.

Hereafter we shall give the theory of the sundial of the equinoctial type, and in the mean time we shall make known the method of laying off simple mural and portable dials.

Draw the line A B (Fig. 3), which will be the central line of the dial. At A make the angle, B A R equal to the latitude of the place, and prolong A R indefinitely. From any point, S, selected upon A R, draw S E at right angles with A R, and at E draw G E H at right angles with A B. On A B make E C = E S, and from the point C as a centre describe the quarter circle E F, which divide into arcs of 15°, in starting from the point E. Through the points of division draw the radii Ca, Cb, Cc, &c., and lay off the distances Ea, Eb, Ec, &c., towards G at Ea', Eb', Ec', &c. From the point A draw the lines Aa, Ab, Ac, &c., Aa', Ab', Ac', &c., which will be the lines of the hours, and inclose the whole in a circle or a square.

The line of 6 o'clock is the perpendicular raised upon A B at A. The hours before 6 in the morning and after 6 in the afternoon are given by the prolongation of the lines V^h and VII^h beyond A.

The dial is to be placed upon a horizontal surface and so oriented that the point A is directed towards the south. As for the style, that is given by raising in the vertical plane, A B, the triangle, E A S, the upper side, A R, of which may be prolonged to the extent desired.

If the half and quarter-hours are desired, it will be necessary to divide each of the arcs from E to F in two to four parts, thus giving new points on E H.

Theory of Sundials.

Let us in imagination divide the globe that we inhabit, remove a section in the plane of its equator, and allow it to retain its ideal axis, which will be our gnomon. From the foot of the axis, at the circumference of our terrestrial disc, let us draw twenty-four radii of equal length, and inscribe one of the hours of the day upon each of them. If no disturbance has taken place in its natural orientation, this band of earth will effect its double rotary and forward motion on the Ecliptic. An observer situated externally to it would have before his eyes the equinoctial sundial, its principle and its theory. For six months only the traced surface would be illuminated, and in the next six months the hour would be read on the opposite surface, but in inverse order.

Now, in imagination again, let us repeat this object, as shown in Fig. 4, and let us put it upon our globe, which, we will say, has been reconstructed by a miracle. If we desire to make good use of this dial, let us give it the same position that it had when we traced it, that is to say, at every spot on the earth where we chance to be, let us place it in such a way that its southern line shall be parallel with the meridian of the locality, and its plane parallel with the Equator. Under such circumstances, its style, at right angles with its surface, will be naturally at right angles with the axis of the world, and its elevated extremity will be directed toward the Pole-star. Let us state, in passing, that it will not mark before six o'clock in the morning, nor after six in the evening, and that at the time of the Equinoxes, the sun, being at the Equator, will illuminate its edge only. This dial, of which all others are merely projections, may be used in all countries; its construction is very simple, but everybody cannot effect the orientation of it. Several systems have been devised with a view of rendering the use of it convenient, and, among these there is one due to Mr. Rimbaud which we may mention as a new and interesting invention (Fig. 4).

Universal Solar Clock.

This instrument (Fig. 5) seems to us to be the happiest realisation of the theory that we have just explained. In fact, our planet itself is a clock that regulates our civil customs. If we suppose it to be transparent and provided with a material axis, the shadow of the latter will be seen to fall upon the side away from the sun and traverse its equator in twenty-four hours, at the rate of fifteen degrees each. Its slight variations with respect to our clockwork instruments, are compensated for at the end of its revolution on its orbit. Moreover, tables are given that permit of establishing the equation of the minutes every day. The apparatus shown in Fig. 5, then, is a faithful image of the earth. Oriented once for all, like our planet, by a system as simple as it is rational, carried along by the earth in its revolution and shifting, it receiving, like the latter, the central ray of the sun at the same relative points. Its advantages over the equinoctial dial are that it marks the hour as long as the sun is upon the horizon, even during the Equinoxes, and at the same time is an ornament to the garden.

THE EFFECTS OF MODERATE DRINKING ON THE HUMAN CONSTITUTION.

By GEORGE HARLEY, M.D., F.R.S.*

ALTHOUGH all persons who indulge in alcoholic stimulants well within the margin of actual drunkenness speak of themselves as "moderate drinkers," there are two special classes of them which bear no resemblance to each other, except in the one solitary circumstance that they never at any time take sufficient to intoxicate themselves. The one class is that which only partakes of stimulants while eating, the other indulges in them between meal-times. To the latter habit is applied in this country the title of "nipping," while in the East it is spoken of as "pegging." And this is the most pernicious of all forms of drinking, from the fact that stimulants taken without at the same time partaking of food, though only imbibed in small quantities at a time, have most deleterious effects on the internal organs. A man who habitually indulges in a single glass of sherry in the forenoon, a brandy-and-soda in the afternoon, and a glass of whisky-and-water in the course of the evening —for reasons presently to be explained—does far more injury to his constitution than one who partakes of a larger quantity of alcoholic stimulants at meal-times. That this is not a mere ideal opinion evolved from the realms of fancy, but one founded upon an indisputable basis, I shall show by reference to the tables of mortality furnished by the Registrar-General in his Annual Reports. As there, unfortunately, exist no especial tables of mortality from this form of moderate drinking, I have adopted the plan of estimating its effects on health by comparing the death-rates given in the reports of persons who in the course of their vocations are exposed to the temptation of taking small quantities of alcoholic stimulants between meal-times, with the recorded death-rates of those, at the same ages, whose trades and modes of life do not so expose them. And the results are, I think, perfectly conclusive. For they not only furnish us, with a comparative absolute average death-rate in the two sets of cases, but in no ambiguous language point out both the exact organs of the body that are most affected by nipping, and give us the relative proportions of the deleterious influence it has upon each of them.

First, then, as regards the influence of "nipping" on the liver and kidneys—the two organs of the body not only more immediately affected, but most closely corollated, from the fact that when the one is diseased the other has to perform its functions, as best it can, vicariously. Seeing that the average amount of drunkards is much about the same in all industries, when it is considered on such a vast scale as over the whole nation's strength I scarcely think anyone will doubt the trustworthiness of the results as revealed in the subjoined table.

Death-rate of Men between the Ages of 25 *and* 65.

Men exposed to the temptations of "nipping."	Liver diseases.	Urinary diseases.
Commercial travellers	61	44
Brewers	96	55
Innkeepers, publicans, vintners, barmen, and waiters	240	83

The comparative death-rates of men of the same age engaged in other industries, not exposed to the temptation of "nipping," are, again, as follows:—

Death-rate of men not exposed to the temptations of "nipping."	Liver diseases.	Urinary diseases.
Gardeners and nurserymen	18	39
Printers	28	30
Farmers and graziers	41	31
Drapers and warehousemen	35	37

As an addendum to these most telling statistics, I think I cannot do better than quote what Baer says regarding the probabilities of life in persons exposed to the temptations of "nipping" compared with that of those not liable to be so tempted. The following is extracted from his table of Prussian statistics, and I arrange them for the sake of easy comparison in two parallel columns, showing the probable duration of life calculated at different ages:—

PROBABLE DURATION OF THE LIFE OF MEN.

Age.	In the liquor trade.	Not in the liquor trade.
25	26·23	32·08
35	20·01	25·92
45	15·19	19·92
55	11·16	14·45
65	8·04	9·72

This, as is seen, is an equally instructive table.

To return for a moment to the part played by the so-called moderate use of alcoholic stimulants in the production of fatal forms of liver disease. As it is, I think, impossible that we as medical men can know too much regarding the probable deleterious effects of mere "nipping," I here subjoin an extract from the Registrar-General's tables of the comparative mortality from liver diseases in different industries, between the ages of twenty-five and sixty-five, in the years 1880-1-2, which exhibits the matter in a stronger light than any words of mine can possibly do:—

Bookbinders	3	Fishermen	22
Booksellers	4	Brewers	42
Hatters	9	Innkeepers, publicans, vintners, waiters, & barmen	197
Tobacconists	10		
Druggists & printers	18		
Gardeners & miners	19		
Butchers	21		

The result here shown is so startling that the Registrar-General not inappropriately designates it as "appalling," seeing that the proportion of deaths from liver diseases is in reality six times greater among men exposed to the temptations of "nipping" than in that of all the other industries combined. The actual figures being: for brewers, 1,361; for vintners and other salesmen of wines, spirits, and beers, 1,521; and for waiters and barmen (those most exposed to temptation), no less than 2,205. Whereas, for maltsters, who are only concerned with the materials from which intoxicants are manufactured, and not with the intoxicating liquids themselves, the death-rate is only 830. Nothing could be more conclusive of the deleterious effects of so-called moderate drinking on the human constitution than this; for as all different effects in this world originating in identical causes are but relative, it is readily seen how a lesser proportion of "nipping," though giving rise to lesser results, must nevertheless cause a proportionate amount of cases of disease in the liver and kidneys to those given in the above tables.

Notwithstanding the familiarity of medical men with the fact that many cases of hepatitis, chronically enlarged liver, and cirrhosis are directly traceable to inebriety, few, I fancy, can have been prepared, without some special acquaintance with the subject, for the information furnished by the foregoing mortality tables of the potent action of alcohol on the liver, when only taken in small quantities at a time. And although it may at first sight appear strange that the liver, of all the organs of the body, should be most potently affected by moderate drinking, I think one can scarcely be surprised at this if he is acquainted with the peculiar action of alcohol introduced into the liver by the portal vein. For it requires, I think, but a small amount of reflection on the part of those acquainted with the mechanism of digestion to understand how alcohol, when taken into the stomach, even in small quantities at a time, is a powerful agent in the production of hepatic disease. Seeing that most of the liquid products of our food are carried directly from the intestines to the liver by the portal vein, it consequently follows that almost every drop of the alcohol, be it small or be it great, taken into the stomach must be directly conveyed by the portal vein to the liver, and compelled to filter through its tissues before it can possibly get into the general circulation and reach any of the other organs of the body. The knowledge of the fact that all the imbibed alcohol is directly conveyed to the liver by the portal circulation not only gives a clue to why alcoholic stimulants are so prone to induce hepatitis, as well as to increase the formation of sugar and aggravate diabetes, but to bring about an attack of gout. Seeing that the liver is regarded as the main source of both sugar and uric acid—the supposed gout-forming material; in addition to which, the direct conveyance of alcohol to the liver affords us a reasonable explanation of why alcohol taken along with the food is so much less detrimental to the constitution than when it is taken on an empty stomach. Moreover, it is now a well-known fact that the continuous excitement of the liver kept up by habitual "nipping" is far more injurious to its functions than an occasional outburst of drunkenness followed by intervals of strict sobriety. It equally accounts for the fact that the liver is not alone the first organ of the body that becomes affected, but is at the same time the one most seriously disordered by moderate drinking.

The effects on the kidneys of moderate drinking are far less apparent than upon the liver; nevertheless, they are sufficiently marked to merit attention. The reason why the kidneys suffer so much less from the imbibed alcohol when it is taken in only small quantities at a time is sufficiently obvious, seeing that a large quantity of what passes through the liver never reaches the kidneys at all, from a considerable part of it having been eliminated by the breath during its passage in the blood through the lungs. That intemperance is a fruitful source of Bright's disease has long been known, and the reason of this is not far to seek, seeing that it is the special duty of the kidneys to eliminate alcohol from the general circulation—as they do all other foreign materials. And the more work that is thrown upon an organ, the more prone are its tissues to become degenerated. Not only, however, do we know that the kidneys eliminate the imbibed alcohol (from its being met with in urine), but we likewise know that alcohol, as alcohol, saturates the renal tissue to such an extent that I and others have been able to obtain pure alcohol from the

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* Formerly Physician to University College Hospital. From the *Lancet*.

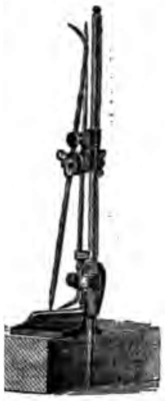


Fig. 1.

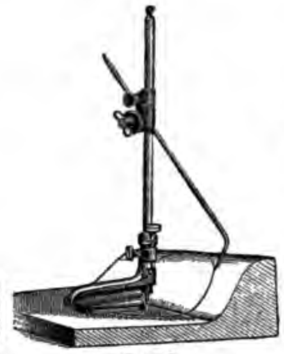


Fig. 2.

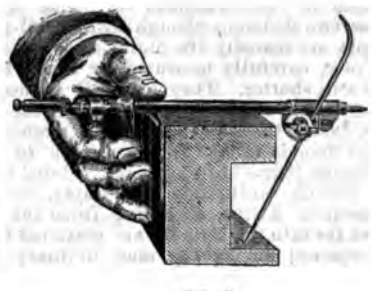


Fig. 3.

of persons who have died intoxicated by ple process of distillation. Besides all this, r, there is a special reason why the kidneys become diseased in so-called moderate s; and that is on account of the circulation icessantly increased in them, as it is else- from the accelerated heart's action induced repeated imbibition of stimulants in small ies. For no doubt the diameter of renal essels is augmented by their engorgement, isequently they exert a deleterious pressure intervascular tissues, which will interfere ieir proper nourishment. While, further, gorgement of the renal vessels will render neys more liable to the injurious effects of and chills are, as is well known, the most cause of kidney disease. This view of the pears to me to give not only the clue to the why Bright's disease is so particularly n among the inebriate; but likewise why nt attacks of albuminuria are so frequently th in moderate drinkers, among both men men. Spirit drinking is said to be mainly iental in inducing the variety of renal named granular kidney; while beer drink- n the other hand, thought to be most potent ging about fatty degeneration of the renal

Be that as it may, I well know, from a perience of urinary affections, that even uantities of alcohol habitually indulged in nes bring on most troublesome forms of nuria, without there being any well-marked ms of the existence of either granular or egeneration of the tissues of the kidneys.

KER'S ADJUSTABLE SURFACE GAUGE.

cuts presented herewith show a new ad- istable surface gauge, which possesses some atures of interest to mechanics who have such a tool.

1 shows the gauge in use as a depth gauge. be seen, the base is of a convenient shape dling, and has an overhanging projection, n which the stem slides freely. In a rect- opening in this projection is placed a block, n which the stem also passes. This block is nd can be clamped firmly to the stem by a l head clamping screw. The block is also out to receive the vertical adjusting screw, is journaled above, and by means of which ck is adjusted vertically, of course, carrying m with it when clamped. This provides the nent, when it is used either as a depth gauge surface gauge.

lower end of the stem is provided with a f pointed steel wire, which constitutes the f contact when gauging depths, and is also n the manner indicated in Fig. 2. This shows the manner of using the gauge for g a circle where ordinary dividers utterly work. In this application of the tool, the of the hole being located and a centre mark he point of the stem is placed in the mark ld there. Then, the scriber being set to the radius and clamped, the head is left loose stem, when, upon being swung round, it rises ls in a vertical line over the centre, thus g a true circle, regardless of the shape of the

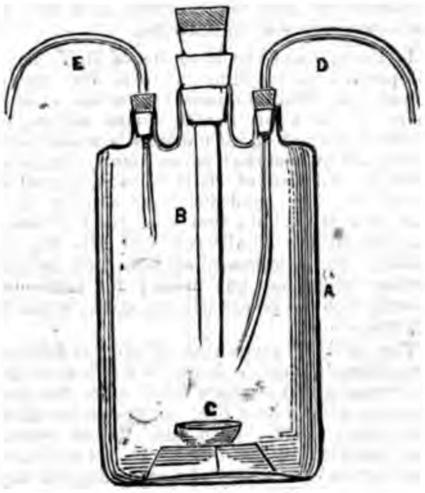
, if it is desired to lay off the projection of at an angle with the surface upon which it k, it may be done by blocking up under the as to make the stem stand at the required

stem may be inserted into the base from if desired, and the gauge then used, as shown . 3, where a line is being drawn in the recess l to the base of the piece, without the use of ing table or surface plate, the adjustment of course, available when in this shape as when in the other forms.

The needles are clamped independently of each other, and the screw by which they are clamped does not turn when they are moved to different angles. A part of each of these screws is squared, and the washers which are under the wing nuts fit over these squares, and are thus prevented from turning, thereby avoiding the tightening or loosening of the nuts when the needles are moved. As will be seen from the above, this tool is useful for a variety of purposes, some of which have not been easy of accomplishment heretofore. It is made by the E. Walker Tool Co., Erie, Pa.—*American Machinist.*

APPARATUS FOR PREPARING SULPHUROUS, CARBONIC, AND PHOSPHORIC ANHYDRIDES.*

HAVING had occasion to prepare a quantity of sulphurous anhydride for the purpose of reducing chromates previous to their analysis, I made use of the following apparatus, as represented in the accompanying figure. It consists of a glass vessel, A, provided with three tubulures, otherwise resembling a large Wolff bottle, the large tube, B, being provided with a stopper for the purpose of introducing pieces of sulphur from time to time into the small dish, C, intended for its reception, and fed with air by means of the delivery tube, D, thus allowing the stream of gas caused by the consumption of the sulphur to escape by means of the exit tube, E, to the vessel desired to receive it. In using the apparatus the sulphur is first kindled by introducing a red hot wire through the tube, B, and replacing the stopper that has been momentarily removed for the introduction of the same. A slight blast is now maintained from the bellows that are in connection with the pipe, D, until the whole of the sulphur is thoroughly kindled, when a somewhat more powerful blast may be applied. When the apparatus above described is in full working order, from 2 to 3lb. of sodium carbonate may be converted into sodium sulphite in less than half an hour, or several gallons of water saturated. I have also on connecting the apparatus with a powerful refrigerator obtained in a short time a large quantity of liquid SO_2. It will be found advantageous, however, during the preparation of sulphurous anhydride, to employ a layer of water covering the bottom of the vessel to about 1in. in depth. Carbonic anhydride and phosphoric anhydride may also be readily obtained in any desired quantity by slight alteration; but in case of phosphorus the air must be allowed to enter only gently, since a rapid current would at all times determine the fracture of the vessel.



USEFUL AND SCIENTIFIC NOTES.

Eyesight.—Mr. T. Henri, of Northumberland-avenue, W.C., has issued a fifth edition of his interesting and useful "Treatise on the Eye," which contains diagrams explaining all the common causes of defects in vision, and points out the remedies. He has also printed a few unsolicited testimonials from statesmen, scientists, clergymen, and others—including one received from Mr. Gladstone last December.

The Transport of Oxygen.—Dr. Hénocque is the inventor of a method of examining the blood, based on the fact that in examining the thumbnail with a small spectroscope one could follow the transformations of oxyhæmoglobin, the substance which, contained in the globules of the blood, serves to transport in tissues the oxygen furnished by the air. In this way, one can easily measure the rapidity with which the interchanges of the oxygenated blood and the anatomical elements take place. Dr. Hénocque has just performed some physiological experiments from the Tower of Eiffel which is being erected for the great Exhibition of 1889. The object of the experiment was precisely to determine the influence exercised on the activity of these changes by the ascension of 270 steps of the staircase to reach the height of 55 mètres, which nearly represents that of the first floor of the tower. The experiments performed by Dr. Hénocque on three tourists have confirmed the results obtained by him on other circumstances—viz., that the activity of reduction is augmented by the muscular exertion caused by the ascension of a staircase, or, in other words, that the muscular labour is accompanied by a greater activity in the exchange of the oxygen between the tissues.—*Lancet.*

Wax Cells for Microscope Slides.—At a meeting of the Washington Microscopical Society, Dr. Taylor gave a description and demonstration of his method of making wax cells. He said that much complaint has been made about wax cells on account of their becoming "foggy." This may occur if cells are made from sheet wax, as in its preparation it is passed between rollers which are continually wet, and much moisture is absorbed. The best way of making wax cells is to melt common beeswax over a spirit lamp; add to it 5 per cent. of resin; after the whole is melted, slightly lower the temperature, but not so much as to solidify the mass in any degree. Slides can then be placed on the turn-table and cells ringed in a moment. A cell can be made and varnished in ten minutes. The wax rings may be covered with a mixture of glycerin and solution of gum-arabic, and cover-glass then be put on and pressed down. The solution becomes hard very soon, and the cover-glass is firmly cemented. Dr. Schaeffer said he had long hoped that a good and cheap cell would be devised which would hold balsam. The ideal cell is a glass slide with a depression in the centre. Mr. Chapman said he had been using paper cells made by a pair of dividers with one point sharpened. These cells can be cut rapidly, the outer ring being cut first and then the inner. If these cells are soaked in benzole, placed immediately on the slide, and balsam added, the latter will not run. He cements the cell to the slide with balsam, mounts in balsam, and rings with balsam, and so far has had no trouble. Dr. Seaman and Dr. Schaeffer confirmed the value of paper cells. Dr. Taylor says wax cells can be built up, coated with shellac or copal, and made to hold balsam. In his opinion paper cells will be absorbent, but doubtless they can be made non-absorbent by soaking them in wax and coating with shellac and copal. He suggested tinfoil as a material for cells.

THE oyster fisheries of Maryland produce on an average about a million sterling annually, of which well on to a half represents the earnings of some 50,000 people to whom they are a means of support. From the area fished, ten million bushels are taken yearly, averaging 300 to the bushel. Oyster farming, which consists in rearing the oyster from the egg, the female oyster producing millions of eggs each year, offers almost unlimited profits. If all the ground suitable for planting oysters in Maryland waters could be made as profitable per acre as the oyster grounds of Rhode Island now are, they would annually return to their cultivators 120 millions sterling. By securely fastening the oyster-shells with a wire, the oyster can be kept fresh for a long time. Car loads of oysters so treated on the shores of Chesapeake Bay have been despatched to San Francisco, and arrangements have been made to send consignments to London, Paris, Rome, and other cities.

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* By H. N. WARREN, in *Chemical News.*

SCIENTIFIC NEWS.

THE death is announced of Mr. Thomas Tate, at Liverpool, in his 81st year. He made many improvements in mechanical apparatus, but will perhaps be best remembered by his double-action air-pump. Mr. Tate was born in 1807, at Alnwick, but at an early age abandoned his father's business of a builder, and after acting as a lecturer on chemistry at Newcastle and York, he was elected professor of mathematics and chemistry at the Battersea Training College, and subsequently was appointed head master in the scientific department of the Kneller Hall College. Mr. Tate retired on a pension in 1856, and devoting himself to literary and scientific pursuits, wrote several treatises on subjects connected with scientific work. Some of his labours in this connection were carried on in conjunction with Sir W. Fairbairn, with whom he was associated in the designing of the Conway and Menai bridges, so far as the researches and experiments were concerned.

George H. Corliss, the well-known mechanical engineer, died at Providence, R.I., on Feb. 21. He was born at Easton, N.Y., in 1817. Mr. Corliss was not educated for mechanical pursuits, but gave early signs of the ability which afterwards made his name famous wherever steam-engines are used. He was honoured more abroad than at home, having received the Rumford medal of the Royal Society, and the Order of Leopold from the King of the Belgians.

The Dun Echt Circular, No. 153, states that the elements of comet Sawerthal have been computed by Mr. Finlay, of the Cape of Good Hope Observatory, as follows:—T = 1888 March 17·18 G.M.T.; π – ☊ 4° 29′; ☊ 244° 6′; i 43° 57′; log. q. 9·8354. The ephemeris for Greenwich midnight, computed by Dr. L. Becker is: March 13·5, R.A. 21h. 3·4m.; Dec. S., 20° 29′, after which the brightness will decrease. The daily motion given in the last circular is, owing to a change in the telegraphic code, wrong. It should be + 6m. 56s., and N. 1° 15′. On March 30 the comet will be in the position about R.A. 22h., N. Dec. 2°, and will then be as bright as at the time of discovery, Feb. 18.

The council of the Iron and Steel Institute, taking into account the excitement consequent on a presidential election in the United States, have resolved to postpone the visit of the Institute until a future and more opportune time. The members agree with them in the wisdom of this course, and it will probably be in the autumn of 1889 or 1890 that the Iron and Steel Institute will visit the United States.

Dr. Isaac Bayley Balfour, of Oxford, has been appointed Professor of Botany in the University of Edinburgh, in succession to the late Dr. Dickson, and thus follows his father, Prof. J. Hutton Balfour, after an interval of about ten years. In 1879 he was Professor of Botany at Glasgow, and in 1884 was appointed Sherardian Professor of Botany at Oxford. He has done much good work, and as an alumnus of Edinburgh may be said to reach his natural position.

Dr. Dallinger commenced his course of three lectures at the Royal Institution yesterday, the subject being "Microscopical Work with Recent Lenses on the Least and Simplest Forms of Life."

At a recent meeting of the Anthropological Institute, Prof. Flower described two skeletons of Akkas, a small negro race from Central Africa—probably the smallest race of men in the world. The skeletons were forwarded to the British Museum by Emin Pasha. Since these remarkable people (probably the origin of the stories of pigmies told by the Greeks) were discovered in the Monbutto country, to the west of the Albert Nyansa, by Schweinfurth in 1870, they have received considerable attention from various anthropologists; and descriptions and measurements of several living individuals have been published; but hitherto no account of their anatomical character has been given. The skeletons obtained by Emin Pasha are the first that have been sent to Europe, and are, therefore, of great interest, especially as they fully confirm all that has been said of the diminutive size of these people, and prove them to be the smallest existing on the earth, smaller even than the natives of the Andaman Islands or the Bushmen of South Africa. These two skeletons, though both of full-grown people, are scarcely 4ft. high; and a woman of the race, carefully measured by Emin Pasha, was still shorter. They are well formed, and present most of the characteristics of the negro race, except that the skull is rather rounder in shape than is usual. With respect to their character, it has been long ago pointed out by the French anthropologist, Hamy, that in Equatorial Africa, extending from the West Coast far into the interior, are scattered tribes, interspersed among the more ordinary negro population, and distinguished from them by this form of head and by their diminutive stature. They appear to constitute a distinct branch of the great negro race to which the name of "negrito" has been applied, and they bear the same relationship to their better grown neighbours as the small negritos of the Indian Archipelago do to the larger Melanesians or Oceanic negroes of the same regions. It is to this negrito race that the Akkas, whose charrcteristics have now for the first time been fully described belong. As was pointed out by Prof. Flower, they differ in many important respects from the Bushmen, to whom Schweinfurth was inclined to ally them.

A Madrid newspaper (*El Economista*) states that a proposal is on foot for supplying the city with electric light and motive power, deriving the energy from the river Manzanares. It is calculated that 2,700H.P. can be obtained at the river, and allowing for the loss in transmission and in conversion to mechanical power, it is assumed that an equivalent to 1,350H.P. can be made use of. The present price per H.P. with gas-engines is 50 centimes, and it is stated that the new undertaking can supply the same power at 25 centimes. The same amount of light as produced by gas at 5 centimes per hour can be given, it is said, by the new venture at 2½ centimes.

In Paris, under the direction of M. V. Popp, compressed air is being utilised for motive power. At Menilmontant the works already cover an area of 15,000 square mètres, of which an extent of 2,000 mètres is roofed over. There are in operation seven steam-engines of 400H.P. and two of 100H.P. each, a total of 3,000H.P. The conduits have already been laid over the whole area comprised between the line of the Boulevards and the Rue de Rivoli. The compressed air is used for driving various machines, but mainly for producing electric light in places where engines would be objectionable.

The ordinary guarantee of life for Edison's incandescent electric lamps is 600 hours; but one lamp in the *Toronto Globe* office has just gone out after a long life. It was put in about November, 1884, when the Edison system was installed in the office. It has continued burning on the average 5¼h. every day, six days a week—a total life of 5,292h.

The summer meeting of the Institution of Mechanical Engineers will this year be held in Dublin, an interval of twenty-three years having elapsed since the previous meeting in the capital of Ireland. The Provost and Senior Fellows of Trinity College have offered every facility and accommodation in their power, and the members will thus enjoy a renewal of the hospitable reception which was accorded them on the occasion of their former visit. The meeting will commence on Tuesday, July 31st, and will last four days.

The third annual convention of professional and amateur photographers will be held at Birmingham on July 23 next, and will extend over one week. An exhibition of apparatus and pictures will be held, and already there are many promises of papers to be read. Full particulars can be obtained of Mr. J. J. Briginshaw, hon. sec., 128, Southwark-street, S.E.

"America, Pre-historic and Present," is to be the subject of anthropological interest discussed at the International Congress, which is to meet at Berlin on Oct. 2 next. The Congress invites the co-operation of all who are interested in the civilisation and natural history of the New World.

Mention of the New World reminds us th we have just received another volume of "Th Fisheries and Fishery Industries of the Unite States"—a portly quarto containing a "Ge graphical Review of the Fisheries Industri and Fishing Communities for the year 1880 We have already acknowledged the receipt two volumes—one text, the other plates- which are a monument to the intelligence an public spirit of the United States Governmen Since 1871 the sum of one million dollars ha been appropriated by the supreme governmen for the purpose of aiding fishermen and fis consumers, and with the exception of six all th State Governments have established fish commissions, and supported them with grants money. Notwithstanding, Prof. G. Brown Good reports that the undeveloped fishery resource are very great, that many of the fishe and invertebrates which are highly valued i Europe by the poorer classes are never used i the United States, and that only about 15 out of the 1,500 species of fish known to inhabit the waters of the United States are ordinarily found in the markets.

It is stated that the fossilised tusk of a "hairy northern elephant" has been found in the clay at Swalecliffe, between Herne Bay and Whitstable.

A new method of testing the refraction of the eye has been devised by Dr. A. Legge Roe, resident surgeon of the Hull and Sculcoates Dispensary. A trial frame is applied in the usual way, one eye excluded with a diaphragm, and the patient instructed to look steadily at a distant object. A blackened disc, perforated in the centre with a hole two millimètres in diameter, is rapidly passed across the eye to be tested in a horizontal direction by the surgeon. The patient is questioned as to the direction taken by the object: if the motion is in the same direction as that of the disc, myopia is present; if in the opposite direction, hypermetropia; if there is no apparent motion, emmetropia. The vertical meridian is then tested in the same way. If the motion is in opposite directions in the vertical and horizontal meridians, mixed astigmatism is at once diagnosed. An error of refraction having been detected, suitable lenses are gradually added and the disc used as before until there is no apparent motion of the object. The defect will then be corrected. A good test object is a small picture-frame, using the vertical sides for testing the horizontal meridian, and *vice versâ.*

It has often been asserted that the clearing of forests has produced a diminution of rainfall; but Dr. R. von Lendenfeld contributes a paper to *Petermann's Mitteilungen*, in which he describes the climatic effects produced by the destruction of the forests of Australia, and concludes by expressing the opinion that in a dry and warm region like that of the interior of Australia the humidity of the air and the rainfall will increase if the forests are cleared away.

Long-distance telephony is attracting much attention in Paris owing to the success of the experimental line between that city and Brussels. A line is to be erected between Paris and Marseilles which will be subterranean from the former city to Nogent-sur-Marne, whence it will follow the course of the Paris, Lyons, and Mediterranean Railway. The works have been almost completed in all the departments through which the wire will pass. It is only necessary now to cover some short spaces, and it is estimated that everything will be in working order by July 1. The wire, which is of bronze, is rather thicker than those of the existing long-distance lines.

The Prudential Assurance Company.—The annual meeting of the Prudential Assurance Company discloses a most satisfactory balance-sheet. The total assets have been raised during 1887 from £6,811,954 to £7,867,903, being an increase of more than a million sterling. The number of policies issued during the year in the ordinary branch was 37,450, assuring the sum of £3,903,635, and producing a new annual premium income of £192,109. The premiums received last year amounted to £535,131, or £138,191 more than the year before. In the Industrial branch, the premiums received during 1887 amounted to £3,058,501, being an increase of £147,206. The total number of policies in force on Dec. 31 last year was 7,599,554, including 89,232 free policies.

LETTERS TO THE EDITOR.

◆

[We do not hold ourselves responsible for the opinions of our correspondents. The editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, *332, Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

⁂ *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

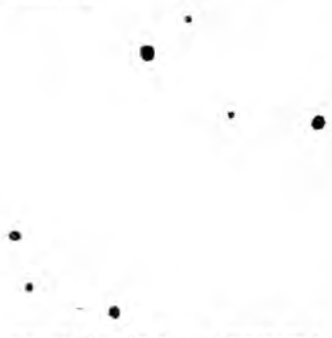
"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

◆

THE ANNUAL MEETING OF THE ROYAL ASTRONOMICAL SOCIETY—THE NEW STAR IN THE TRAPEZIUM OF θ ORIONIS — FINDING THE MERIDIAN—ORDNANCE DATUM — OPTICS — SUNDIAL — LUNAR ECLIPSE — EVOLUTION — DOUBLE DATES ON TOMBSTONES — PHOTOGRAPHS OF THE LUNAR ECLIPSE OF JAN. 28th—THE VISIBILITY OF THE MOON DURING THE TOTALITY OF THE ECLIPSE—THE FLOOD, AND WHAT IS THE LEVEL OF WATER?

[28469.]—YOUR report of the meeting of the Royal Astronomical Society on p. 598 of your last volume appears to me to convey a slightly erroneous impression of what actually happened. Reading it as it stands, it would convey the idea that a motion by Mr. Ranyard was followed by an amendment by Captain Noble, and that the ultimate division decided between such motion and amendment, with the result that the former was carried, and the future award of the Medal entirely abolished. Such was by no means the case. The President, in the first instance, put it to the meeting whether Mr. Ranyard's motion or Captain Noble's amendment should be the substantive motion before it, and it was decided by a considerable majority that the amendment should, thus brushing away the original motion entirely. What was, then, really decided was not to abolish medal-giving, nor to restrict the receipt of the medal to astronomers outside of the body of our own officers and council for the time being, but simply to let matters remain in *statu quo.*

Since I wrote paragraph three in letter 28425 (Vol. XLVI. p. 600), my Californian friend has, with his unvaried kindness, sent me a sketch by Mr. Keeler of the position of the newly-discovered star in the trapezium of θ Orionis. The engraving below is from a tracing I have made of Mr. Keeler's original drawing.



"Engineer's Pupil" (query 64550, Vol. XLVI. p. 610) does not say with what degree of accuracy he wishes to obtain a meridian line. If he is content to get it within 2' or 3' he may do so by the aid of a prismatic compass. At present the compass in this country deviates 17° to the West of North on a line running roughly through Winchelsea, the East End of the Isle of Sheppey, and Harwich. It points 18° to the West of North on a line passing through Southampton, Reading, Peterborough, Boston, and Spurn Head; 19° to the West of North on another running through Exmouth, a little to the West of Bristol, the East of Stafford, through Leeds, and close to Hartlepool—and so on. If, then, he were situated at, say, Leeds, he has only to turn his prismatic compass until the sight-vane corresponds to 19° E. of N., and place a vertical stick in the ground bisected by the thread, and then turning round through 180°, place a similar stick in the ground 19° to the West of South. A tightly-stretched cord joining these posts will be very approximately in the Meridian. But if he be close to a post-office whither Greenwich time is flashed at 10 a.m., he may do better than this—in this way. Let him carefully level as large a flat board as he can procure, and to the South of it hang a plumb line. Next, from any almanac let him find the Equation of time for the day on which the determination is to be made; then, obviously, by the proper application of this he can find the instant of apparent noon at his station, and at such instant the shadow of the plumb line will be his meridian. An example may make this clear. Supposing he is in Manchester. Now Manchester is 9m. 4s. West of Greenwich; in other words, at any given local instant it is 9m. 4s. later at Greenwich; or to put it another way, if it is noon at Manchester, it is 0h. 9m. 4s. p.m. at Greenwich. Very well. We will assume that the equation of time is + 9m. 33s., i.e., that the Sun is on the Meridian of Manchester at 0h. 9m. 33s. p.m. Manchester mean time. But, at that instant it is really 0h. 18m. 37s. p.m. at Greenwich, and as the post-office clocks show Greenwich mean time, if your correspondent were to go to the Post Office at 10h. a.m. on our hypothetical day, and set his watch to true Greenwich time, the shadow of his plumb line would be accurately in his meridian at 0h. 18m. 37s. p.m. by that watch. There is yet another way—that of equal solar altitudes—which has been described over and over again in these columns; but this will not be applicable until about the third week in June. At night, "Engineer's Pupil" will require either a transit instrument or a first-class theodolite. As to the mode of use of the former, he may consult Clark's capital little "Treatise of the Transit Instrument" (which you reviewed on p. 488 of your thirty-fifth volume) for full details. The theodolite he may employ to obtain the transit of a close circumpolar star like Polaris or δ Ursæ Minoris (either above or below the Pole); but for this he will require independent means of accurately obtaining his time. He must consult your back volumes for the method of finding out the exact instant such a star will be on the meridian. Or he may find the meridian by equal altitudes of any bright star to the south of the zenith by bisecting it by the horizontal wire of the theodolite (whose axis must previously be carefully levelled) three or four hours before its transit, and reading its azimuth on the horizontal circle, then following it, after it has southed, until it is again threaded on the wire, and once more reading the circle for its azimuth. Thus the half of these two readings will give the direction of the south point. Of course, in all this I am trying to make principles clear. It would require a short treatise to enter into the whole of the details.

The next question (64551, same page) I can answer much more shortly. The Ordnance Datum is mean half-tide level at Liverpool.

I strongly recommend "F. S." (query 64564, Vol. XLVI. page 610) forthwith to purchase and carefully study Vols. XXXII. and XXXIII. of the ENGLISH MECHANIC, as he will find everything he requires, and much more besides, in them in an excellent series of articles by Mr. Lewis Wright, entitled "Optics with the Lantern."

A portion of my answer to "Engineer's Pupil" above might also serve as an answer to query 64581 (Vol. XLVI. p. 611); but for the better apprehension of "Portobello" I will reply to his question specifically. On March the 1st the sun will be on his meridian 12m. 25s. after his local mean noon; that is to say, a clock regulated to local time should mark 0h. 12m. 25s. p.m. at the instant that his dial shows 0h. 0m. 0s. But he is, he tells us, 12m. 22s. west, or slow, of Greenwich; so that at that instant a clock marking Greenwich Mean Time would stand at 0h. 24m. 47s. All he has to do, then, is to set his watch accurately to Greenwich time by the 10 o'clock signal from the Post-office, carefully level the plate of his dial, and turning it slowly and very carefully, contrive that the shadow of the gnomon should rigidly coincide with the 12 o'clock hour-line when his watch marks 0h. 24m. 47s. If he adjusts his dial on March 21st, his watch (showing Greenwich time) must read 0h. 19m. 30s. p.m., when the gnomon is in the meridian; if on March 28th, 0h. 17m. 21s. p.m., and so on.

It is impossible to identify a Lunar Eclipse from such a vague chronological datum as the "about 1830" of your correspondent "B. R.," whose query (64587) appears on p. 611 of your last volume. Besides, it is very far from uncommon for the sun and (more or less) eclipsed moon to be above the horizon together. This happened on Dec. 28, 1879, and Dec. 18, 1880. On Dec. 5, 1881, the eclipsed moon rose just as the sun was setting; and on the 3rd of last August she rose eclipsed before sunset. On July 12, 1889, and on May 23, 1891, the sun will *barely* have set when the eclipsed moon is rising.

Speaking as an Evolutionist, I should answer the question with which query 64602 (Vol. XLVI. p. 611) commences, by saying that I should rather regard whiskers as a survival from our hairy progenitors than as a development. Moreover, I doubt if they are, as "Quis Est" assumes, "purely ornamental," inasmuch as they supply a very real protection against cold to the face and jaws. For an account of the manner in which sexual selection has operated in clothing the peacock, the golden pheasant, &c., with their gorgeous plumage, I would refer your correspondent to Darwin's own "Descent of Man, and Selection in Relation to Sex," published by Murray. As an elementary fact, the females would be most attracted by those male birds who possessed the gayest and most beautiful plumage.

The curious form of dating to which Mr. Friend refers in query 64621 (Vol. XLVI. p. 612) had its origin in the change of style. Formerly the year began on the 25th of March, so that was New Year's Day. Hence January, February, and the first 24 days of March belonged to the preceding year, so that, taking Philip Taylor's epitaph as an example, his death occurred in the 11th month of the year 1710, according to the old reckoning; but in the first month of the year 1711, according to that substituted for it, and still prevailing.

I am indebted to MM. Schleusner and Selb, of Anvers, through you, Sir, for a series of the most beautiful photographs of the lunar eclipse of Jan. 28th that it is possible to imagine. Assuredly the Belgians are in no way behind-hand in celestial photography.

Dr. Burder's notion as to the origin of the difference of brightness of the eclipsed disc of the moon, to which Mr. Jones invites my attention in letter 28450 on p. 7, is quite a novel one to me; but its novelty does not prevent me seeing that his suggestion is really a feasible one. Of course one crucial test of its truth or falsehood could be afforded by a comparison of the appearance of the moon during totality in recent times, with the recorded conditions of the Coronæ at the same date, or at a more or less proximate one, as there seems to be but little doubt that the aspect of the Coronæ varies with the period of sunspot maxima and minima. One thing is quite certain, either the Krakatoa dust did not cause the strange obscuration of the moon's disc during the eclipse of 1883, or it was guiltless of the fore and after-glows then, as the latter have quite recently reappeared, and everyone knows how strikingly visible the obscured face of the moon was on the 28th of last January.

[Since this was written, I see in *The Observatory* for March that Prof. Filipanti has advanced the theory that the moon is rendered visible during a total eclipse by a kind of phosphorescence, or heating from insolation.]

I regret that my mode of expression with reference to the mythical nature of the legend of the Flood should have in any way hurt Mr. Hampden (letter 28452, p. 7), and notably that my unfortunate form of diction should have made him reticent. Now, myself a geologist, I know that Mr. H. will forgive me if I say that "all geologists" do not positively assert "that every portion of the earth shows evidence of such a Flood as the Bible records." Has he ever opened any of Lyell's, Geikie's, Page's, Ramsay's, or Prestwich's books? Two hundred and fifty years ago, when men found fossil shells at a height of six to ten thousand feet above the sea level, they at once conceived that they had tangible evidence of the historical accuracy of the Biblical account of the Noachian Deluge; but as chemistry has grown out of alchemy, and astronomy out of astrology, so have geology and palæontology grown out of such wild and crude interpretations of natural phenomena. With reference to the latter half of Mr. Hampden's letter, I cannot resist the evidence of my senses—that the earth is approximately a sphere. I have seen scores of times the convex sea rising between my eye and the hull of a ship whose masts have just been peeping over the horizon, and this with a powerful telescope. Moreover, in the case of every lunar eclipse the outline of the earth's shadow on our satellite is sensibly circular, and, although a cylindrical earth would cast a circular shadow if set *endways* between the sun and the moon, yet it is impossible to conceive, on any recognised dynamical principles, that a drum-shaped body could always occupy this position. A convex sea, if its convexity followed the outline of the globe, would be rigidly level, inasmuch as a plumb-line would be normal to its surface at any and every point.

A Fellow of the Royal Astronomical Society.

THE LICK TELESCOPE AND THE SUPPOSED NEW STAR IN THE TRAPEZIUM—DOUBLE STARS.

[28470.]—IF "F.R.A.S." (letter 28425, p. 600) will do me the honour of comparing the diagram of the trapezium of θ Orionis given in the ENGLISH MECHANIC for January 13th, 1882 (Vol. XXXIV., p. 488), with the one given on p. 88 of the *Sidereal Messenger* for February, which shows Mr. Clark's *exceedingly* faint star, he will, I think, at once see that the star numbered "6" on my diagram is identical with Clark's supposed *nova*. No. 6 was discovered by De Vico and Dumenchel nearly half a century ago with a telescope of between 6in. and 7in. aperture, and it has since been seen by other observers with moderate apertures. The star, of course, is probably variable, as I remarked in my letter; but I am rather surprised that the observers at Mt. Hamilton should not have been aware that it had been seen long ago.

I presume that by 175 Struve "Ninip" (letter 28426, p. 600) means 175 OΣ. For this Perrotin gives 332·6° : 0·747" : 1884·04 ; Engelmann, 332·2° : 0·879" : 1883·48 ; Tarrant, 330·5° : 0·78" : 1885·03. For γ Tauri (A-B), Perrotin gives 224·7° : 0·405" : 1884·01. It has closed considerably since 1827.

H. Sadler.

SATURN—5th STAR IN TRAPEZIUM.

[28471.]—In reply to Mr. J. H. Jones (28450), I may state that I had a good view of Saturn last night with 6½in. mirror, when the crape ring was well seen, and apparently equal in both ansæ, but Encke's division was only glimpsed on the *f.* ansa, and the *p.* one was ill-defined, exhibiting no trace of the division.

I have been examining the trapezium in Orion on every available night this year, but have failed to see the 5th star, which, however, was usually plainly visible last winter. Will any readers state if they have experienced similar difficulty?

Ipswich, March 2. **A. Southgate.**

DIVERS MATTERS IN SUNDRY PLACES.

[28472.]—Would someone kindly say how far Capella is from the zenith when on the meridian? Happening to be in a very limited space to-night (about 6.30, 5th inst.), surrounded by very tall walls, I was struck by the very close approximation of this star to the zenith, the place of observation being in Lisson-grove. Remembering the discussion which took place in the "E. M." a few months ago on the visibility or invisibility of stars during daytime from the bottom of a shaft or well, it seemed to me to-night that Capella would be a fine specimen to select, say, three months hence, for an observer in this neighbourhood thus to attempt to prove or refute this theory; only I have no means of ascertaining its latitude. Remembering, also, what will be the position of the sun three months hence, would such a test, if practicable, be fair?

In common with a great number of others, I, too, was a very attentive observer of the progress of the total lunar eclipse of Jan. 28th, watching it from the commencement until about 11.15 p.m. (when the sky became most depressingly overcast, and my enthusiasm consequently suffered a relapse), both with the naked eye and by the aid of a 3in. refractor, throughout which time the eclipsed portion of the moon presented to me a decided clear grey line, contrasting most remarkably with the aspect of the eclipse of Oct. 4th, 1884. If, indeed, these different appearances are solely attributable to variations in the state of our atmosphere, such variations are very striking, and it would seem very interesting to discuss the probable character of them.

While perambulating the coast of Lincolnshire in August last, I one day found myself in the churchyard of the village of Ingoldmells, near Skegness; and, hunting among the old tombstones, I came upon a peculiar old monument, of which I could not, and cannot, think of the possible use. It consisted of a block of oolite about 3ft. square, having the upper angles bevelled, and inscribed on the west bevelled edge with the figures 6, 7, 8, 9, followed by 10 at the N.W. angle; on the north edge, 11, 12, 1, 2, 3, followed by 4 in the N.E. angle; and on the east edge 5 and 6. This table was surmounted by a piece of oolite about 4ft. 6in. tall, about 10in. square at the base, slightly tapering towards the summit. It stood nearly vertical, inclining very slightly towards the west. At 1.13 p.m. by my watch, which indicated very approximately Greenwich mean time, the preceding edge of the shadow of this concern fell near the figure 4, while the succeeding edge lay near the figure 1; by the time this edge reached the figure 1 the watch indicated 1.22 p.m. A very much corroded inscription runs round the table, of which I could just decipher the following:—"Jo: Clerke Christus Solus Mihi Salus Anno Dni 1600 N.B."

Could someone kindly give me the history and probable use of this arrangement?

William Godden.

PLEUROSIGMA ANGULATUM AND ITS SPECTRA.

[28473.]—In the *Journal* of the R.M.S. for Feb., 1888, there is an extract from Dippel's "Das Mikroskop" on the above subject, with a plate and six figures. I note that the three sets of striæ are drawn (Fig. 2, III.), as I drew them in the English Mechanic, June 18, 1886 (Vol. XLIII. No. 1,108, p. 337, Fig. 3). Might I ask what has become of Dr. Eichhorn's fantastic diagram supported by profound mathematical calculation? (For a copy of which see "E. M." as above, Fig. 2).

I suppose the officers of the R.M.S. since writing their strictures on my paper in the "E. M." have changed their minds, and have adopted Dippel's picture, which is similar to mine. I may here mention that I have never seen Dippel's book. My diagram was not copied from him or from anyone else. I think I must be right in assuming that the R.M.S. have adopted Dippel's picture, as this article is put forward by way of a preparation for "Prof. Exner's remarks on the optical character of living muscle fibres"; for they say, "In order that the subject" (Prof. Exner's paper) "may be fully understood we have prefaced the translation by notes on . . . the appearances presented by Pleurosigma angulatum under different optical conditions." Therefore it is probable of the two interpretations they have chosen the one they think is the more correct. Although the diagram (Fig. 2, III.) is immeasurably superior to the Eichhorn picture, the article is so full of misleading inaccuracies that I must take exception to one or two of the more noticeable ones.

The argument will not hold water for one moment. I will take the last paragraph first: "For this reason it may be concluded that the former image is less dissimilar than the others from the image which corresponds to the complete diffraction action of the valve, and which is unattainable by any microscope." This reminds one of a former dictum of the Society, which I will again quote: "Whether, for example, P. angulatum possesses two or three sets of striæ, whether striation exist at all, whether the visible delineation is caused by isolated prominences, or depressions, &c., no microscope, however perfect, no amplification however magnified, can inform us." (*M. M. Journal*, 1875, Vol. XIV., p. 250.)

Now, let me refer to the first paragraph, which states that "Dr. Flögel has proved, by means of transverse sections, that at any rate the upper surface of the valve (with the exception of the central rib and the edge) is to be regarded as flat, but that it is full of cavities between its upper and under surfaces." Here we have the argument in a nutshell. The orange is so small that no microscope, however perfect, can make it visible to the human eye; but Dr. Flögel has cut it in half, and has proved that each half is a hemisphere.

With regard to Fig. 1, Plate III., let me point out that there are 12 spectra of the 2nd order, and not 6 as figured. A correct picture of the spectra of the 1st, 2nd, and 3rd orders was given by me in the "E. M." for Feb. 26, 1886, Vol. 42, No. 1,092, p. 521, Fig. 1.

It is perfectly easy to verify the incorrectness of Fig. 1, Plate III. All that is necessary is to place a P. angulatum under a wide angled oil immersion, and then rotate a narrow and very oblique beam, by which means the spectra of the 2nd order would be successively brought within the grip of the objective, and could be counted on removing the eyepiece.

Apart from the actual observation of them, it is perfectly easy to calculate their number and position from an inspection of those of the first order. Let me note, in passing, that an aperture of above 1·00 N.A. is required to show three sets of striæ with central light. With an aperture of 0·7 to 0·8 N.A. and oblique light, they only get two sets of striæ, which evidences a want of knowledge in microscopical manipulation. It is, of course, perfectly easy to dot Angulatum with $\frac{4}{10}$ths of 0·65 N.A. and central light.

Without entering into any criticism on the resolution delineated in Fig. 3, Plate III., let me remark that the amplification is upwards of 13,000 diam., which must be regarded as an especially good preparation for the statement in Prof. Exner's paper that "no microscope has ever shown, or will ever show, anything actually existing in the object which cannot be clearly distinguished by a normal eye with a sharp immersion amplification of 800." I can only look upon Figs. 4, 5, and 6 as fiascos.

London, March 3. **Edward M. Nelson.**

THE HOYLAKE RAILWAY COLLISION.

[28474.]—The recent collision between two trains running in opposite directions upon the Seacombe, Hoylake, and Deeside Railway (Birkenhead) has brought to light such a loose system of working that the only wonder is that there have not been accidents before.

The line is supposed to be worked by the staff and ticket system; but it appears that the "tickets" have not been kept locked up in the proper box, and further, the "tickets" have been issued to drivers without anyone seeing the staff or even knowing that it was at the station. In the present instance, one train arrived at Hoylake, another at once started off with a "*ticket*" *to say staff following*, when, in fact, the staff was not following, but was coming upon a special train in the opposite direction.

The fireman of one train having been killed, two station masters, driver, and porter have to take their trial for manslaughter at Chester Assizes. The accident shows that loose systems of working single lines are most dangerous.

Chester. **Clement E. Stretton, C.E.**

SUSPENSION OF THE BLOCK SYSTEM.

[28475.]—Since the fearful collision at Hexthorpe the general impression has been that we should never again hear of the "suspension of the block system," and some surprise has been expressed in railway circles in consequence of the publication of a list of conditions lately drawn up by the goods agent of the Manchester, Sheffield, and Lincolnshire Railway, giving his views as to hand-flag signalling being substituted in place of the block system.

It is simply a waste of time to consider or draw up such "conditions," for under no circumstances should the *block* ever be suspended. To do so would be little, if any, less than a crime.

Clement E. Stretton, Consulting Engineer
Society of Associated Enginedrivers and
Firemen, Chester, March 5.

FRICTION.

[28476.]—"Ursa Minor" says: ". . . Of course, the bearing surfaces being an approximation to the ideal mathematical point, the friction is almost nil. . ." Now, the law of friction between two given surfaces is proportional to the pressure that keeps them in contact, and is independent of the area. And I always understood that it was bad to bring the surfaces in contact to a "point," because all the friction would be on that point, whereas, if the surfaces are large, there is the same friction distributed over a greater area, and therefore less on any given point. Still, we have the fact of the lathe running easier with the ball in the end, as described by "Ursa Minor." Will someone kindly explain this? **A. D.**

NEW AND IMPROVED FORM OF "WATER DECOMPOSITION APPARATUS" AND VOLTAMETER.

[28477.]—Some time ago I wanted to test some electricity by decomposing water into H and O, but I thought the apparatus that I used then was rather clumsy, and rather liable to get some air mixed with the gases given off. It was then that I thought that something neater could be used, so I made an apparatus in glass which did away with the pneumatic trough, and made the gas tube and electrodes into one tube, so that there can be no loss of gas. You connect the battery wires on to the platinum wires projecting from the arms in the tube. Fill the tube with slightly acidulated water, and put the indiarubber cork in the bottom of the tube. When most of the water is decomposed you can turn the tube upside down, and pass a strong current of electricity from a coil, when a spark will pass between the poles and decompose the mixed gases (H_2 and O) into water again; thus it can be used as a water decomposition apparatus and a eudiometer.

Liverpool. **W. A. Brown.**

CURIOUS ALLOYS (*Continued*).

[28478.]—*Antimony and Copper.*—Put into a clean crucible an ounce of copper and an ounce of antimony; fuse them by a strong heat, and pour the alloy into a mould. The compound will be very hard, and of a beautiful violet hue. This alloy has not yet been applied to any useful purposes; but its excellent qualities, independent of its colour, entitle it to consideration.

Mint Coinage of Gold.—Put into a clean crucible one drachm of pure copper; when fused, throw in an ounce and three drachms of pure gold. These metals will combine, forming an alloy of copper, 22 carats fine. The goodness of this alloy depends on the relative quantities of the metals employed: it is said to be 22 carats fine because 22 parts of gold have been used with two of copper, or, as here directed, eleven drachms of gold and one of copper, these being in the same proportion as 22 to 2. This alloy is rendered harder than pure gold, therefore not so liable to be worn away by friction. Pure gold loses very little of its colour by admixture with copper in these proportions. The gold of jewellers frequently contains one-half of copper.

Silver Coinage.—Put into a crucible an ounce and seven drachms of pure silver with one drachm of copper; they will combine by fusion. This alloy is harder and more durable than pure silver, and its lustre is not in the least impaired. The grand old native coinage of Hindostan consisted of the precious metals in a pure state, and is annually growing very scarce, owing to the demand by all classes to obtain genuine gold and silver for the manufacture of female ornaments. Thousands of pounds worth continually enter the melting-pot.

Alloy for Varnishing.—Fuse ¼oz. of tin with the same quantity of bismuth in a crucible over a charcoal fire; when melted, add ¼oz. of mercury. When perfectly combined, take the mixture from the fire and cool it. This substance mixed with the white of an egg forms a very beautiful varnish for plaster figures, &c. **Eos.**

(*To be continued*)

BREAKING STRAINS OF CABLE.

[28479.]—I AM very much obliged to Mr. F. Caws (letter 28461) for his long and able explanation to my question, which must have entailed much labour to prepare. There is just one part, however, that I can take exception to. He says: "I cannot imagine what 'Sailor's' object can be in paying out 90 fathoms of chain in 7 fathoms of water. A great part of the chain's length will be useless (?) on the sea-bottom, and the anchor will not feel the pull of the ship at all. I think those who are acquainted with practical seamanship would confirm these statements from their experience." I am afraid my friend is not acquainted with the river Mersey, otherwise he would not say so. 45 or 50 fathoms in ordinary waters are considered by the majority of masters of ships sufficient to constitute a good scope. This is a fallacious notion with regard to the Mersey, whose tides run 7 or 8 knots. No ship is safe under 75 to 90 fathoms. Indeed, the "Atlantic liners" never ride with less han 90 fathoms, unless at dead neaps. The teamer whose dimensions I gave in my query I have seen her "walk away" with 105 fathoms of able out and an anchor of 4 tons 15cwt. This from heer force of tide and a "clear anchor," which was proved at low water slack. My experience extends o over thirty years of sea life in all parts of the world, so that my friend will excuse me if I differ rom him when he calls upon those "who are cquainted with practical seamanship."

Sailor.

PAINLESS EXTINCTION OF LIFE.

[28480.]—"SATINE" (letter 28455, last week) may rest assured that my "pussy" was quite dead before it was buried. It is not surprising that a frog dosed with carbon dioxide should revive when xposed to the atmesphere and excited by electricity; but there is a great difference between a frog and a cat. The reptile is cold-blooded, and has an imperfect circulation. A frog can remain twenty minutes under water, and suffer no inconvenience thereby, but with an animal like the cat it is far different. The blood of the mammal must have oxygen at every inspiration. Failing this, the venous blood refuses to pass from the lungs, and they thereby become rapidly congested, and death, without possibility of revival, speedily ensues. It has been stated that, in regard to drowning persons, restoration of life is impossible if the person has been in the water for five minutes. Death from drowning is suffocation—oxygen starvation; the blood being charged with carbon dioxide comes loaded with it to the lungs, and will only give it up when oxygen is there to take its place.

Leytonstone, March 5. **A. P. Wire.**

ON VIOLINS.

[28481.]—"ORDERIC VITAL" (28430, p. 601), I think, has made a mistake respecting tone of violin back; it is lower, not higher, than a finished belly; it is lower because of greater density, and therefore heavier, having more resisting power than the belly. I think its action is analogous to a man dancing on a spring board stronger than required to carry the man, but with elasticity enough to create a reflex action. An indiarubber ball will not rebound on a substance of the same yielding material as itself, it must be something of more density, or harder surface, to give this reflex action.

Now my idea is that this mechanical reflex action, in these instances, would go on the same (providing the motion or force could be applied) if the air vibratory or sound-wave medium were pumped out altogether; the force and motion would still be there, but the sound would be gone.

I have got here two pieces of wood of the same size—viz., 14¾in. by 4⅜in. by ⅜in.—one of maple and one of Baltic pine. By driving a tack in the ends of each, and hanging them up with pieces of one string, the maple gives the note G, second line in treble cleff, pine C above, an interval of five semitones, maple being the heavier wood, giving the lowest tone. This is mechanically as it should be. "Orderic Vital" is right as regarde the belly. I have a piece of yellow pine which was 13½in. by in. by ¼in., which suspended as before gives F sharp in top of treble; by thinning same down to ⅛in. thick, it gives the note D below, an interval of three semitones; by cutting a hole in the centre of piece 3in. by ¾in., the tone is still lowered to C, or two semitones; so by cutting sound-holes it lowers the tone (mechanically weakens the belly), or sound-bar raises the tone by strengthening the belly.

I made two violins last year, of new pattern, the backs and bellies of which I tried by suspending them. The sound-bars were in, being worked from the solid; but, not attaching much importance the matter, I forget whether the *f* holes were cut or not; they were both about the same in tone—viz., back middle C, belly E above, difference four semitones. The backs are of curly sycamore, not cut on the quarter, as is usual. The belly of one is Baltic pine, cut on the quarter; the belly of the other is pitchpine, of the lightest and least resinous kind. These two violins are of the same pattern, and worked by the same moulds; they are both good in tone, yet they are different. The backs and sides are of the same material, so the difference must be in the bellies. The one of Baltic pine seems softer and deeper in the tone; the one of pitchpine is more brilliant and powerful. I have tried all kinds of pines, with much the same results, every different kind giving different timbre, still each kind being perfect as regards tone.

I forgot to mention, in the violin with the pitchpina belly, the grain of the wood lies at about 30° of perpendicular on each side from centre. I think this is an advantage, the pressure of bridge, when in motion, having a greater tendency to set in vibration the grain in belly, one grain acting against the other as a lever. **Byford.**

[28482.]—IN letter 28430, page 601, "Orderic Vital" alludes to experiments concerning the relative pitch of back and belly. These experiments were conducted by Felix Savart about the year 1819, at which time he presented a memoir on the subject of his celebrated trapezoidal violin to the French Academy of Sciences. This historical instrument, not to mention "Fiddler's" invention (see back vols. "E. M."), sufficiently proves that a curved form is not essential to the production of tone, and I quite agree with "Oasis" (letter 28431) when he says "some little sense, and a great deal of nonsense, has been written on this subject." Savant examined several valuable Stradivarius and Guarnerius violins, and found the back to be one tone lower in pitch than the belly, the pieces under experiment being placed in a vice between two cone-shaped bits of cork, at a point where two nodal lines, one transversal and the other longitudinal, intersected. The mass of air in several violins by Stradivarius yielded a sound having 512 vibrations per second, answering to the pitch of middle C at the time these instruments were made, and the same result as to pitch was obtained when the back and belly were put into combined vibration. Now, although these researches are curious and interesting, they do not seem to have been of any practical value as regards the improvement and simplification of violin manufacture. Various abnormalities have been made, tested, and in some instances highly approved by competent judges; but, nevertheless, we still take the work of the old masters as representative of the typical violin, and endeavour to copy them in every detail; indeed, these old fiddles possess an extraordinary fascination, not only as musical instruments, but from an artistic point of view.

Can anyone explain this inherent fascination? Why should people rave about the "life-like appearance" of an old Strad.? They never go into raptures over the personal attractions of a flute or trombone, although both instruments are far more antique than the violin.

I am not myself a Philistine; I too have been infected by the craze, but I never could understand why. **War.**

VIOLINS—THEIR INDIVIDUAL ATTRIBUTES.

[28483.]—A CREMONA violin is not likely to be in the hands of many of the readers of the ENGLISH MECHANIC. I am, however, the fortunate possessor of a fine specimen of Joseph Guarnerius' handiwork, and I thought a few remarks might interest your readers. It is a full-sized instrument, as most of that maker's are. It has on it the far-famed and unapproachable varnish. This violin seems to me to show most clearly that the varnish was put on in three layers at least. First, the clear colourless coat which seems never to leave the wood, and to have sunk into the texture of it. This, I believe, was a hard but thin varnish. Next comes a golden yellow varnish, highly transparent, which dried with a singularly bright gloss. This varnish does not appear to have been so hard as the first, and has worn away where much friction occurred, whilst the hard, uncoloured varnish has withstood this friction apparently completely.

Then there is a thick varnish which is much worn away. This seems to have been a soft-textured varnish, having considerable pigment in it of a very transparent character, in this particular instance of a reddish-brown colour, rather more red than the shell of the horse-chestnut. This varnish does not seem to have dried with the same beautiful gloss on it that the second coat has; probably its texture was too soft for it to do so. I have noticed in two instances that this outside varnish swells up and becomes somewhat opaque if wetted too freely to get off the resin, and, further, that if left to itself in a warm room, it quite recovers itself.

I believe the reason so few of the old instruments have much of this coating left on is that the performer's perspiration has softened it, and the rubbing against buttons, casual knocks against the bow and violin case and other substances have detached bits little by little. Resin especially seems a great enemy to it, and I believe it the greatest mistake to allow it to collect on the instrument, either back or front. Why was such attention paid to the varnishing of these instruments? A truly fortunate occurrence for us now that they did so; but it is not at all likely that the old makers knew the good they were doing their instruments at the time, or, indeed, that they were making instruments for posterity.

It must be remembered that most of these instruments were made for chapels and churches, and it was to resist the action of damp, heat, and cold that such trouble was taken over the varnish, the action of the vapours from the censers during the burning of incense being probably a very important factor in the elaboration of this celebrated and, as I believe, complicated varnish. Similarly, I believe, there was a demand for wood for the bellies which would not crack or warp when exposed to these influences, and thus great attention was forced on the wood used for this purpose. Of course, volume and tone were much prized also, as it meant money; for a larger number of small, toned instruments, and therefore men to play them, would be wanted to conduct a service than of large-toned instruments.

It was found that a certain class of pine timber combined qualities which remedied this state of affairs more than any other, and thus a demand arose, and the richest maker got the best wood, because he could afford to give the best price—that maker being Stradivarius.

If any old Italian violin is examined, it will be seen that on the E-string side of the tail-piece there are longitudinal cracks, undoubtedly due to the counter upheaval of the belly on that side when the chin pressed in the G-string side of it. But, apart from this, in old violins of inferior makers hair-like cracks in the belly are often seen, notably where the ebony block is inserted to take the pressure of the catgut cord fastening the tail-piece to the peg. The damp finding its way in, sets up dry rot (so called), and the destruction of the instrument is only a question of time. I am firmly convinced that to remedy these defects the great makers tried to obtain the hardest wood they could, especially when they found that this wood enhanced the tone, and not because they were able to say beforehand that certain balks of timber possessed acoustical properties in excess of other balks of timber.

Numbers of old instruments of merit have perished from decay, and are doing so now, and the inference is perfectly logical that they did so in 1700; but in that day it was more remunerative to *make* a violin than to *mend* one; now in this day it is far more remunerative to mend an old one.

It is exceedingly interesting to compare the tones of the various old masters of violin manufacture. The Guarnerius of which I write does not give out its whole tone on first being played on; but in a few minutes it seems to vibrate from scroll to tail piece, and becomes intoxicated with the melody, and even to work itself to a frenzy, and suggests to the player that if he ceased to bow the tune would still go on. This is a quality common to all good Italian violins. But on analysing the Guarnerius tone critically, you will find both players and hearers will say it is brilliant, clear, sweet, ringing, bell-like, and so on.

Of a Stradivarius you will hear remarked it is rich, round, of great power, of splendid volume, and so on.

It is strange, but a fact, that although these two greatest makers made scores of violins, that these characteristics pervade each instrument; and that it seemed as impossible for Stradivarius to make a violin of great brilliancy of tone, as it was for Guarnerius to make one of great roundness.

Magini's violins, we have authority for saying, were large-sized, and with their richness of tone always gave an idea of melancholy, an attribute we now know to be due to a certain prominency of one of the overtones.

A violin by Grancino, of Milan, I knew well and loved dearly, possessed a tone of excellent quality, and one of which the general verdict would be—How rich! And yet there is a roughness. And so one might enumerate the great makers, each having certain peculiarities of tone—making scores of violins, and yet each one having the same trait of musical character.

That the varnish on an instrument influenced the tone has all along been suspected; but it is interesting now to find it capable of proof. Since ladies have taken to the instrument, old makers, of high and low degree, have found a ready sale, and yet there is a demand for more. Under these circumstances new violins must be made; redoubled efforts were made to procure suitable oil varnishes, and with such success that new instruments, coated with these modern oil varnishes, found a ready sale; for they possessed qualities far superior to the instruments previously in the market coated with spirit varnishes.

May I ask, finally, what has become of Mr. Lake's discovery of Chinese gums and Roman Catholic priests, which were to revolutionise the violin and piano world—about a year since?

J. D. H.

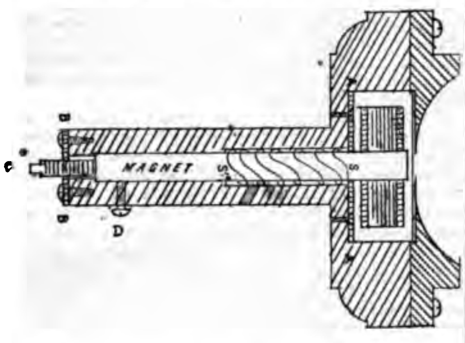
ESTIMATING THE SPEED OF DYNAMO MACHINES.

[28484.]—MY attention has been directed to letter No. 28849 in your issue of 24th. Feb. last. Will you please allow me to state that the telephone tuning-fork method referred to in the above-mentioned letter is identical with one I suggested in 1885 to, and used by, a well-known engineering firm?

Walter Hepworth-Collins, F.C.S.
Bolton-le-Moors.

A SIMPLE ARRANGEMENT FOR SETTING THE MAGNETS OF TELEPHONES.

[28485.]—AS it is difficult sometimes to get a screw set in the end of a hard steel magnet, I have used the following arrangement for some time with success. A A is a piece of brass screwed in the bottom of the case, having a hole in the centre for the magnet to pass through. S S' is a spring made of 22 hard drawn brass wire, and soldered about mid-way down the magnet. This spring presses against the plate A A, keeping the magnet away from the diaphragm; B B is another piece of brass having an ordinary screw passing through the centre at C. By moving this screw C, the magnet can be shifted at pleasure. I use an ordinary wood screw, D, to fix the magnet when properly set.



E. J. P.

STAUFFER LUBRICATOR—SMALL BOILERS.

[28486.]—THE suggestion of "Samothes," on page 324 of the Vol. just completed, appeared to me very good, as the lubricating grease of the Stauffer patent would be peculiarly applicable to centres of crank shafts where the pressure is considerable, and the plan would avoid all the mess of oil complained of. I wrote to Messrs. Trier Bros., at 19, Great George-street, and learnt from them that the patent would not cover that application. I obtained one of their charming little lubricators, which cost 1s. only, and some papers, from one of which I cull the following, which will, I think, prove of interest:

"Approximate rule showing how often to screw down the top of the lubricator from one half to a whole turn: Very light bearings, once or twice per month; shafting, two or four times per month; loose pulleys, once or twice per week; heavy or high speed shafts, once or twice a day."

This shows how much trouble as well as mess is avoided.

The letter on "Polishing and Nickel-Plating" this week mentions the Stauffer lubricator as a "grand thing on a polishing lathe." I should like to know whether anyone has used it for the mandrel bearings of an amateur's wood lathe.

I hope our friends who have small-power boilers will kindly notice my queries on page 611 last week, and give their experience of them. I want to get at the best form and cost of a 2-man boiler to go under the chimney of a room when the fire-stove is taken out; and also the best way of heating it by petroleum so as to avoid the constant stoking and to raise steam in about 10 or 12 minutes.

F. A. M.

YELLOW STAINS IN FINISHED COTTON CLOTH.

[28487.]—TO many of your readers, who, like myself, are engaged in the bleaching trade, the following matter may be of interest.

A quantity of heavy cotton shirting, bleached and finished in the usual way at the works where I am employed, was warehoused in Manchester for three weeks; it was then packed and shipped for one of the Argentine markets.

On arrival at its destination nearly all the pieces were found to be discoloured by a yellowish-brown stain which had penetrated through nearly every fold in each piece. Several of the pieces were sent home, and submitted by us to our consulting chemist, who reported the stains as tar-oil stains, and due to the tar-paper which had been used by our packers.

This, of course, meant a considerable loss to us, and as we have had claims of a similar kind before, we determined to avoid using any waterproof tar-paper at all, and we supplied our packers with a patent water and air proof paper, which is considerably cheaper than the old tar-paper, and has, besides, the merits of being very thin and tough, and almost transparent; the patentee's name I do not remember.

We have used this packing for over four months, during which time we have not had any complaint or claim for stained damaged goods.

A. De Casimir.

MAGIC SQUARE FOR 1888.

[28488.]—I DO not think the columns of the "E. M." have often contained a more curious numerical device than the following. It was invented by a Mr. H. A. Wood, of Cleveland, Ohio, U.S.A. It will be observed that no two sets of figures are the same. They begin with 457, and none exceed 487. The whole square is composed of 16 smaller squares, each containing three odd numbers.

457	485	483	463
479	467	469	473
471	475	477	465
481	461	459	487

If added in the following manner, each sum will exactly mount to 1888, whether taken vertically, horizontally, or diagonally. So will the sum of the four numbers composing the four quarters. So will the sum of the numbers composing the four small squares. So will the sum of the four squares composing the centre of the whole square. I think it will be admitted that such an arrangement of figures is more truly described as magical than the ordinary "magic squares."

John Hampden.

PARAFFIN-OIL LAMPS.

[28489.]—WILL "F. A. M." permit me to ask him if he is prepared to support the statements in the "interesting pamphlet" to which he refers? I have in the course of the last quarter of a century put out one or more paraffin-oil lamps every night, and although I am quite aware that it is easy to produce a "flash" in some patterns, I never yet heard of a well-authenticated case of explosion. I presume that such cases must have occurred, and possibly some of your readers can give details. I have some half-dozen lamps in my house, and most of the containers are of so-called "china" or porcelain. In the best lamp of all—probably the best paraffin lamp made—it is easy to produce a "flash," because by turning down the flame after the reservoir is hot and vapour of the oil escapes from the air hole, you can produce with a puff of the breath the required proportions of air and gas to make an "explosive" mixture, which the flame is unable to consume steadily, and therefore does so in a flash; but not an explosion. In the "interesting pamphlet" to which "F. A. M." refers there is a case of "explosion" (a fatal case), which I happen to know was not an explosion, but simply a dropped lamp. Knowing that, I naturally doubt all the other instances, and protest against any unnecessary alarm being raised, or any puffing of this or that lamp. Paraffin lamps are like steam boilers—perfectly safe if you treat them properly.

Saml. Ray.

HOW TO TEMPER YOUR OWN MILL-BILLS.

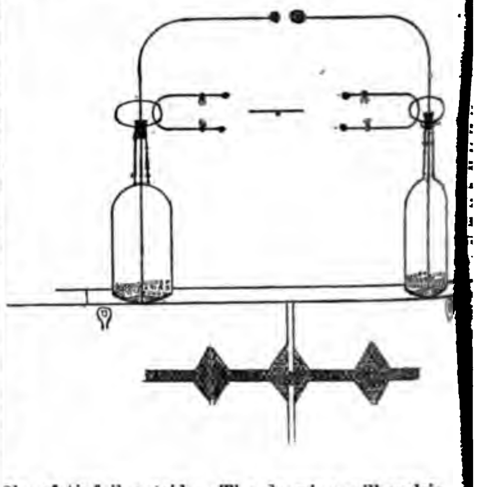
[28490.]—BEING a miller myself, I have known what it is to work with bad bills. Some may say bad workmen always find fault with their tools: it may be applied to me if anyone chooses, but that does not alter the fact. Living in a country village, I found it difficult to get my bills done so as to stand well, and you cannot dress a stone well with bad bills. Although the blacksmith is a tidy hand as a country smith, he does not understand doing the bills as they should be: some of them were too soft—others would brittle off at the cutting edge, as if too hard or burnt. Having Vol. II. of *The Miller* by me, I looked it over, and found on p. 470 a receipt given by R. R. Smith upon tempering mill-bills. It is as follows: "Draw out your bill to the proper shape. Mind never to hammer the bill on its edge when getting cool. After the bill is in its proper shape, take a spoonful of salt and a spoonful of sugar, mix well upon a tin plate; then put two or three handfuls of salt in about one gallon of water. Heat your bill to a dull red, then rub well into the mixture on the plate; then place the bill into the fire again, heat to a bright red (care must be taken not to get the bill end to a fierce red at all approaching a white), plunge the end into the salt and water; keep the water stirring all the time, so as to prevent the water causing any flaw in the steel; let the bill remain in the water until cool enough to handle." If "E. P. C." follows the above instructions, his bills will stand any French stones he may have to dress. I have done my own now for a long time. I can do them by my own kitchen fire by fixing a blower up. He can temper cold chisels and drills by drawing the colours as given in the "E. M." As I have obtained great help through "our" useful columns, I thought I would forward these few hints, hoping they may prove a help to some of our readers.

As regards grinding mill-bills, I always find it best to grind upon a rest, keeping the bill crossing the stone from one side to the other, and grind the bill rather stunt—not too much lead; then the pieces of stone will fly downwards, and not cut his hand. I was advised to grind so by an old miller many years ago. Although having five pairs of stones under my care, and do all the stonework myself, I have very few pieces of stone or steel in my hands. It will also prevent the stone flying into the eye. I have seen young men with only a few years' practice with more steel in their hands than I have got.

J. L. C.

A CHEAP BUT EFFICIENT FORM OF WIMSHURST INFLUENCE MACHINE.

[28491.]—HAVING carefully tested the plate-glass discs mentioned in a recent number of the "E. M.," I still adhere to my statement that I find plate-glass much the best. I thought it might be interesting to some of our readers if I gave a short description of the machine as I have constructed it. The discs are 13½in. diam. and ¼in. thick, running ⅜in. apart. Bosses for glasses are made from three machine thread reels. The insulating pillars are two glass bottles, with 3in. of gunshot inside and 2in. of tinfoil outside. The drawing will explain itself.



With the machine thus constructed I get a 7in. spark without anything to draw it out of terminals. To test the machine, I filled a room with steam, and on turning the handle I got sparks 4in. long, the plates being covered with moisture.

A machine like the above can be made with window glass for a few shillings. The local glazier cuts me 15in. discs for 9d. each; holes are drilled as I described in a recent number of "Ours." I shall be pleased to answer any questions respecting the machine as described.

Haslemere. **F. S. Fowler.**

CURIOUS ELECTRICAL PHENOMENA.

[28492.]—MY thanks are due to Mr. Perren-Maycock for his explanation of possible causes for the shock referred to in my letter No. 23432.

I should have stated in that letter that the dynamo used is not an alternating but a continuous current one. There are no arc lamps at all in the installation, and the only lamps burning at the time were about 20 16c.p. lamps in the pit, where, once switched on, they would have no occasion to either switch on or off other lamps, to cause any variation in the current.

Newcastle-on-Tyne. **G. Ralph.**

HOW TO AVOID "DELUGION."

[28493.]—MR. HAMPDEN and your ancient "F.R.A.S." are very similar in one respect; but Mr. Hampden has not apparently complained, as he would if more like "F.R.A.S.," that whatever subject is in hand, somebody "*must* lug in" the theory of a globular earth. Perhaps he has begun to perceive that there is a way to keep clear of this. He has but to ignore or avoid all reference to appearances of anything beyond two or three miles off; consequently all heavenly bodies, and the lengths of days, nights, or whatever they seem to affect, and most reasoning of things quite at our elbow, may go on swimmingly with as flat an earth as he likes. But "F.R.A.S." seems, on p. 600, to agree with Dr. F. E. Cane, p. 577, who would be better pleased if there were "less of the Noachian Deluge." Well, they can avoid that, perhaps as easily as Mr. Hampden may the globular earth. Certainly he cannot betake himself to a flat world, nor they to an unflooded one, nor to a country void of diluvium or the marks of the scour of that tremendous event; but they can perhaps keep to ancienter geology, that of the primary, secondary, and tertiary strata, the truly pre-historic or pre-human times, and to things off the present surface, and to such as have nothing to do with the geographic barriers and distribution of species. They must indeed keep very clear of most of Darwin's subjects; and between the tertiary geology and to-day they must place a great gulf, and agree to ignore all between.

By the way, what earthly "scientific grounds" are they on which Dr. Cane holds "only a flood could cause a glacial period"? Neither of these, that I can see, would have any tendency to cause the other. But it is plain matter of science that both have occurred since pliocene times, and the Flood since the glacial time, and that it might put an end to that frost, and was even the only kind of event we can readily conceive putting an end thereto. If both earth and sun are cooling—and the earth at least is so—this world always was, and now is, approaching a glacial period. Some myriad years hence, if nothing abnormal or accidental intervene, our temperate lands (or later, even the Equator) will be as glacial as these were before the Flood swept off the flint folk, with the mammoth, Irish elk, sabre-toothed tiger, &c., and cleared the New World of horses, and all islands of most of their fossil land fauna. How could any climate be warmed again to its present heat after being far colder? A fall of additional fluids —water, air, or both—from heaven would effect this; but so would nothing else that I can think of.

As for Dr. Cane's question, "Where have the moon's waters gone?" he has first to find on what grounds we are to suppose she eyer had any? Had the earth any as first solidified? or has her whole stock of this fluid, or both fluids, arrived, like this latest instalment, in the form of comets? Who can tell which of these is the more probable? At any rate, geology shows she has been in her orbit too long to have been without cometary encounters, or without dozens of them; and geology also shows her to have had dozens of world-wide catastrophes, even more violent than this recent one, of only fifty centuries ago. These are two certainties of science, whether you like to connect them in any way or keep them apart. If either of them do not suit the creed or mythology of Dr. Cane or "F.R.A.S.," we can't help it.

Whether Charles I. was beheaded, or William III. came, or the Queen's grandfather was crowned, are comparatively mere legends. Perhaps they all happened; perhaps none of them. Whether Red Riding-hood talked with the wolf, or whether Cinderella's slipper was of glass, would not be, I protest, more utterly incommensurable with such an event as the Flood than these mere historic or documentary tales. **E. L. G.**

ORGAN SWELL.

[28494.]—ONE of your correspondents refers, in last week's issue, to a trunk being connected with a swell-box of an organ carrying the sound into a ceiling and producing an echo effect. It may interest your readers perhaps to know that I and a friend have applied for a patent and have received provisional protection for a system of carrying out of swell-boxes the confined air by means of a pipe or trunk, a valve opening and closing automatically with the closing and opening of swell shutters. This contrivance allows the pipes to remain in tune and retains the purity of tone, while at the same time it carries off a large portion of the sound which is not required when the shutters are closed, and which in the ordinary swell-box must percolate out with the confined air as it escapes. We have also arranged that the trunk valve closes automatically, while the shutters open as soon as the organist ceases playing, thus preventing external air from entering the swell-box.

March 5. **Walter G. Clark.**

ORGAN MATTERS.

[28495.]—I HAVE been exceedingly interested in the recent discussions which have appeared in your admirable paper under the head of "Organ Matters."

It has been my privilege to exhibit a number of the Roosevelt organs, in which the entire choir organ and a portion of the great organ were inclosed in a swell-box; and I must confess to being a convert to the system from the very first. It did not require many trials to convince me of the manifold inherent advantages over the old system. It gave me immediately a feeling of conscious control over the entire instrument, and a realisation of a more extended scope and enlarged possibilities than I had ever before experienced.

The great and choir organs, instead of being stolid and unyielding, were flexible and sympathetic. An accompaniment played upon the choir or great, with solo on the swell organ, could be made elastic, so to speak, and a greater degree of artistic finish could be thereby secured, while a reversal of the order of solo and accompaniment rendered prominent stops on the great organ, like the trumpet and clarion, or the clarinet and other characteristic stops on the choir organ, available in a manner never before attained. The perfectly adjusted vertical shades of both swell-boxes are controlled by two balanced pedals placed side by side, and located in such a manner that they can be operated by either foot with perfect ease. A novel effect, obtained by gradually closing one swell-box while opening the other, is especially charming when the reeds of one organ and the flue stops of another are simultaneously employed.

The idea advanced by "Uranium" (letter 27906, p. 112), that "expression is, at the best, a poor affair on the organ, and the less of the kind we have the better," is a melancholy one, deserving condemnation. It may be true that "very few organists can manage *one* swell pedal"; but that is no reason why the manufacture and employment of swell pedals should be discontinued, neither is it a reason that an artistic use cannot be made of one, two, and even three swell pedals. For the incessant and aimless "pumping" of the swell pedal frequently practised by some players I have the greatest abhorrence. It is at times utterly nauseating, and one longs for a rest, or a cessation from the restless see-saw of such playing. Much would I prefer that the pedal or pedals be permanently fastened down. The organ in the Parochial Church, Berlin, where the great German organist, Haupt, has presided since 1849, when he succeeded that remarkable virtuoso, Louis Thiele, is one of the most effective, from an old standpoint, which I have ever played. (It was upon this organ that I studied for over two years, under Germany's leading master.) But the instrument was (and is) entirely devoid of any swell, or even of a combination pedal. The sharp keys of the manuals were veneered with white ivory, while the naturals were made entirely of ebony. This primitive condition of things was no doubt considered adequate for the performance of polyphonic music and the accompaniment of chorals in Divine service; but I must confess that, while playing there, I felt hampered, and unable to overcome a certain mechanical stiffness foreign to my taste and earlier teaching.

I am positive that Prof. Haupt realised the shortcomings of that organ, for he used to speak of effects which might be produced upon the modern English and American organs, and wished that Germany might be more progressive. He acknowledged that the English-speaking nations were taking the lead in all matters pertaining to the organ, and did not think because *his* organ contained no swell nor mechanical accessories for controlling the stops, because his natural keys were black and the sharps white, or because the instrument in its present state was even too complicated for some players, he could see no necessity for advancement in organ building and playing. The fact that all players are not *artists* is no argument that instruments should be made for the artisan, and I cannot agree with Mr. Eustace Ingram (letter 28209) that because "the majority of organists seem to be seldom able to make proper use of what they already have," it is "not desirable to add to the already numerous contrivances tending to make the instrument still more difficult of manipulation."

Should the art of organ building remain at a standstill because the majority of organists are not artists?

I can corroborate Mr. W. F. Crosby's statement (in letter 28208), as far as my experience goes, that everyone who "investigates the effect of the multiplied swell-boxes is invariably converted to them." To my knowledge, there is only one firm in this country, aside from Roosevelt, who have adopted this advanced system—viz., Messrs. Steere and Turner, and a member of this firm told me recently that since they commenced to inclose the great organ reeds, mixtures, mutations, and soft flue stops in the swell-box, the plan had given such universal satisfaction that they had concluded to adopt it henceforth. In my opinion, it is only a matter of time when all organ builders will find it to their advantage to adopt this system.

For Mr. G. A. Audsley's fearless and outspoken advocacy of artistic organ building I have the highest admiration. His clear and logical statements, so intelligently expressed, carry conviction to all who have the advancement of true art at heart. His answer (in letter 27941) to "Uranium," apropos of the professional builder who is called upon to cater to the whims of an ignorant organist, is quite pertinent—namely, "If the builder looks upon his calling as a dignified art, and really knows what is right and wrong, he will refuse to lend himself to what will lower his reputation in the musical world, and lower himself in his own respect."

I am confident that in his forthcoming handbook of the organ Mr. Audsley will define the most advanced and artistic principles of organ construction yet given to the world.

Clarence Eddy.

194, Michigan-avenue, Chicago, U.S.A.

THE ADULTERATION OF LARD.

[28496.]—I NOTICE Mr. J. C. Bell's article on this subject in your last issue. It is certainly not original, although interesting. This method was used in the ironworks laboratory (U.S.A.) where I was engaged as minor chemist seven years ago. Will Mr. Bell tell us what the strength of his benzoline was?

Liverpool. **John Howard.**

BERGERON'S WRITINGS AND BERGERON'S LATHES.

[28497.]—PROBABLY the extracts from the above work will give pleasure here, and raise a growl there, according to the predilections of the readers. A. will wonder why he should be bothered about the obsolete pole lathe. B. will accept the description with as much hearty good will as he would give to the details of "Grandfather's Clock," as a record of those bygone mechanical appliances which were the veritable progenitors of our present lathes and their belongings. I may, perhaps, advisably state here that not many papers will be devoted to Vol. I., merely enough to form an introduction to Vol. II.—in which there is a great deal worth attention.

The object, however, of this letter is to suggest resuscitation of one or two of these ancient worthies who have been unceremoniously elbowed out by their youthful compeers. I am growing old myself, and quite understand how prone the rising generation is to relegate us to the class of old fogeys before we have quite earned that questionable distinction. I do not plead for resuscitation of the pole lathe, though, as I suggested, it might well be found in many a cottage, where not even a solitary sovereign can be spent in a modern lathe.

But take, e.gr., Bergeron's "Spherical Rest," and the work of which it was capable—work which no modern turner with a £40 spherical rest could beat. I suppose a matter of £3 or so would purchase it—£5 would certainly do so. The lathe is already, to a great extent, popularised, and is no longer only the rich man's luxury; but a great deal of its apparatus is unattainable still, and why? Simply because in its most modern form it is necessarily very expensive. In its older form it would be quite the contrary.

And as these papers go on it will be seen that if modern appliances are neater, handier, and more perfect, the older patterns were far cheaper, more simple, and, therefore, less costly; and they were efficient, as is amply proved by the work accomplished. We shall never thoroughly popularise the lathe, and especially ornamental turning, if only very high-class apparatus is sent into the market. I am not sure that it would be sacrilege to impress a motto into the service which rightly belongs to another subject, "*τα αρχαια μενειτω*," "let ancient things remain."

We fall back readily enough on the Old Masters, and antiquated designs, and believe them unequalled by the moderns. We find some venerable tools—the Bansoolah, for instance—worthy of resuscitation. May not a few old lathe appliances be also worthy of similar honour? **O. J. L.**

THE case containing Paganini's favourite violin is said to have been formally opened at Genoa a few days ago, when the instrument, found in good condition, was played upon by the great fiddler's pupil, Camille Sivori. It is a large Guanieri, and is stated to have accompanied Paganini in all his travels. The fiddle, having been bequeathed to the town ef Genoa by its famous possessor, is preserved with great care in the Municipal Palace.

ing plane on both sides. The plano-convex is cemented to a plano-concave of crown, so e focal length of the combination is absoamenable to the indices of refraction of the constituting the respective elements in this ation.—SOLAR RADIANCE.

24.] — **Telescope.** — Caveat emptor! Is r" quite sure that his telescope came from ton's, and in the state that it is? With o.g. oth sides, it is possible to be achromatic— , if the radius of the concave lens is some s long as that of the other surface. But as spherical aberration—oh! he may, howrobably improve the latter a good deal by ng the plano-convex lens of the o.g.—which ume is the outside lens—and placing it with ved side facing the object. Without knowcurves of his various glasses, however, it ossible to say how far this will be effectual. . P.

30.]—**Electric Light.**—To "J. E. W. I." fe working current per square inch = 1,000 Suppose each of your lamps took ·75 amp. ent, 400 would take 400 × ·75 = 300 amp.

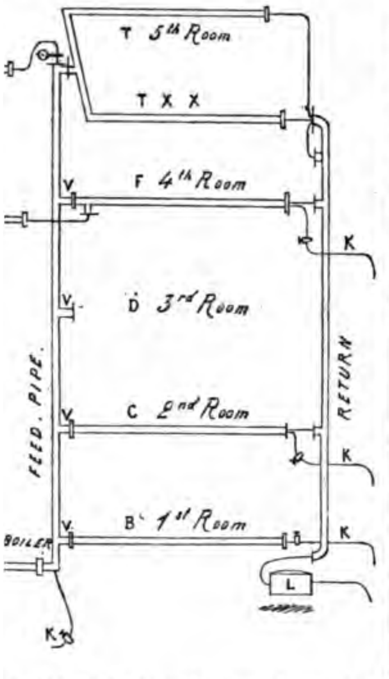
$$\frac{C}{C_1} = \frac{A_1}{A}, \frac{300}{1000} = \frac{A_1}{A}, \therefore A_1 = \cdot 3\text{sq.in. sectional}$$

A₁ would give you the size of wire to use r main leads. In a large building like an ou would not use main leads so large at the at the bottom, because they would not have so much current. Branch leads for rooms, $\frac{1}{10} \times \cdot 3 = \cdot 03$sq.in.—J. E. W. I.

39.]—**Electric Clocks.**—Set the commutaa stud near the hour arbor of clock, and let oved a given number of times in the hour ns of a "star wheel and jumper," such as turn the striking snail in Vienna regulators. arrangement the change from one set of es to the other can be made instantaneously. is no absolute necessity for the hour-wheel e changing, the 'scape-wheel could easily be do it every minute, or one of the intere wheels in the clock at longer intervals.— TE.

15.] — **Embossing Note-Paper.** — Has P." seen the stamp on a cheque, on an agreer on an envelope? That is done by inking e of the die with a roller. When the lines re to have ink, the depressions in the die are ith ink and the face is cleaned, just as the cleaned in copper-plate printing. I am at the boys in Somerset House who emboss ques and receipt forms get the munificent of 5s. per week, and are expected to do many ds a day, at the risk of their fingers being d. Upstairs the gentlemen draw hundreds for doing practically nothing, Mr. A. being ed to countersign for Mr. B., and so on. re "embossed in colours."—NUN. DOR.

2.]—**Steam Heating.**—TO MR. WEBER. d sketch; but am a poor one at it. How-



will explain with it as well as I can. The s up the middle of mill, and branches in s of 4in. pipes for top rooms T and X; pipe, 4in.; V is the valves turning in You will see that one row branches lower a descending pipe, so that it would work better; but is not satisfactory. Descending pipe is 2in. cast-iron, inside measure. Now this pipe, T X X, gets possession of descending pipe to trap first, and keeps water and steam back in the pipes F, T, and C, and they are breaking joints. K is blow-out pipes, and L is one of Royle's traps; X is to other rooms opposite side of mill; B is the bottom-room pipe, which I coupled up, but would not work. I may say, during this frost these blow-out pipes K have been frozen up, and when steam has been put in the joints are all broken, except T X X. As it is, there is endless trouble. It is not possible to couple these pipes to return in boiler. It is level with bottom floor. The more heating surface, the more heat is given off. Is this how you mean with relation to 2in. and 4in. pipes? If so, the 2in. must heat sooner than 4in., and be hotter. Is this not so? I have a trap to X and S X, and the joints in X pipes break, because S X gets steam sooner. I am thankful for your assistance. The pipe jointing into descending pipe is 1in.—JONATHAN.

[64461.]—**Altering Bell Circuit.**—TO MR. R. T. LEWIS.—It is the engraver that is the cause of all this misunderstanding. He made the battery appear short-circuited, and the two studs that the switch rubs on look like pushes. It is evident I am not altogether wrong, because when the switch is turned towards S. B. any one of the four pushes ring S. B. beautifully. It is only when the switch is moved towards H. B. silence prevails, and as my arrangement is precisely similar to that sketched by "C. T." on p. 459 of the "E.M." for Jan. 23, 1885, I should feel obliged if you would compare my sketch with that one, and say where the error is in the H. B. circuit. I may add the diagram of "C. T." is almost identical to the one given by you on Jan. 16, 1885 (not Jan. 1, as stated in to-day's issue).—A. I. E. E.

[64493.]—**Pewterers' Gas Blowpipe.**—If this querist will refer to Nos. 910 and 912, he will find in Mr. P. J. Davies' "Notes on Plumbing" some information about blowpipes which may be useful to him. There are many blowpipes illustrated in back volumes.—NUN. DOR.

[64511.]—**Ordnance Datum.**—"Engineer's Pupil" should have looked at "Nuttall's Dictionary," where he will find—"Datum: a principle or fact given, known, or admitted; in civil engineering, datum line is the horizontal or base line from which the surface points are reckoned or measured." The datum of the Ordnance Survey is the approximate mean tide at Liverpool, and the whole of the altitudes on the Ordnance Survey maps of England are measured from that datum. Where the heights are marked on the maps thus (B.M. 101·1), there will be a mark cut in the wall, post, or other convenient place, consisting of a horizontal line with a broad arrow underneath. The altitude given is the height of the centre of the horizontal line. The base lines mentioned by "Gilmore" were for the trigonometrical survey of the surface of the country; the difference between the two is the same as between a plan and a section. —CESTRE NUNT.

[64526.]—**Telephone.**—If, as suggested by "Acolyte," "S. M. S." has got one of the Swinton telephones, supplied by the Equitable Telephone Association, Limited, the screaming noise complained of may be due (1) to the transmitter being suspended too vertically, so that the small pencils do not rest with enough weight against the larger pencil at the back; (2) to the platinum wire on which the small carbon pencils hang having got bent so that the pencils do not hang freely against the horizontal pencil, but perhaps touch the bottom of the frame, which should not be the case; (3) to some of the terminals, battery wires, or line and earth connections being loose, and not properly screwed up. If "S. M. S." will attend to these various points I imagine he will put matters right; but if not, I advise him to write to the Equitable Telephone Association, whose address is 75, Queen Victoria-street, London, E.C., for a copy of their printed instructions.—A. S. T. E.

[64539.]—**Solder for Aluminium.**—As this query has not been answered by someone well up in the subject, the following may be useful to W. Norman. Take aluminium, 20 parts; zinc, 80 parts; or, aluminium, 10 parts; grain tin, 90 parts. Melt, and pour.—DENS.

[64539.]—**Solder for Aluminium.**—A process and means for soldering aluminium was patented by J. S. Sellon, Hatton-garden. The number and date of the same is 11499, Sept. 26, 1885, price 6d. The specification can be obtained by remitting the price, plus postage, to Mr. H. Reader Lack, Comptroller of the Patent Office, Southampton-buildings, Chancery-lane, W.C. The process consists of cleaning the aluminium surfaces by scraping, covering them with a layer of paraffin wax to act as a flux, and then, with a coating by fusion of a layer of zinc-tin-lead alloy, made preferably in the proportions of 5 : 2 : 1. The metal thus prepared is soldered in the usual way.—HENRY J. HARDY, F.C.S., Sheffield.

[64541.]—**Long Focus Rapid Lens.**—The reply of "B.Sc., Plymouth," to this query is likely to mislead if not corrected. The depth of focus of a lens depends on the focus of the lens, and not its rapidity or aperture, not in any other way on the maker of it. The shorter the focus the greater the depth of focus, rapidity being the same. A long focus lens cannot have equal depth of focus with a short focus lens, unless its rapidity or aperture is proportionately reduced. It is possible to have great depth of focus and rapidity together only in short focus lenses, such, for instance, as are used in detective and other fixed focus cameras.—T.

[64546.]—**Testing Lathe Heads.**—So ho! Mr. "No Sig.," you have copied your reply from my paper in *Amateur Mechanics* on "How to Test a Lathe."—F. A. M.

[64550.]—**Meridian.**—"Engineer's Pupil" does not say to what degree of accuracy he desires to find meridian; neither is it clear if he means "at any time during day or night." If within one degree be near enough, apply variation of compass to magnetic (i.e., compass) bearing; more accurately, by night, by applying Tables 1, 2, and 3 (according to accuracy required), pp. 481-3 *Nautical Almanac*, to bearing of Polaris, adding six hours to the times there given (for finding latitude) and explained; or in the day time by applying longitude in degrees, and equation of time in degrees, to bearing of sun at mean noon Greenwich time; or by equation of equal altitudes of sun or star measured by sextant; but if wanted at one and any time when sun or star is visible, proceed thus: Take bearing and altitude of heavenly body as near the same instant as possible; then—

	° ′ ″		
True alt.	…………	secant	…………
Latitude	…………	secant	…………
Polar dist.	…………		
Sum)	…………		
÷ 2 equals ½ sum	…………	cosine	…………
Dif. between ½ sum and P.dist.	…………	cosine	…………
		÷ 2)	
Gives	° ′ ″ …………	½ true bearing sine	…………
×	2		

Add together, rejecting tens.

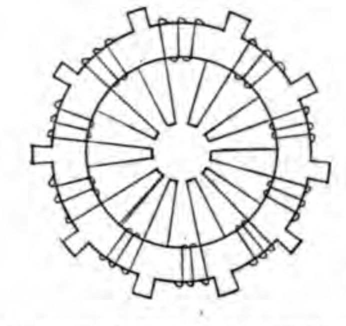
………… gives true bearing of heavenly body at time of observation, from which you will know true meridian.—DADDY.

[64551.]—**Ordnance Datum.**—The Ordnance datum is the approximate mean water level at Liverpool, and is the datum line from which all levels on the maps issued from the Ordnance Office are calculated. This reply is a copy of an answer to the same query in "E. M." No. 903; and I mention this as a hint to "Engineer's Pupil" that he will find replies to nearly every possible question by diligent search in back numbers of "Ours."—G. M. PEL.

[64552.]—**Chupatties.**—Of these there are many kinds—the "unleavened bread" of the East, eaten by all classes except the rice-consumers of Lower Bengal; they are very nutritious and dietetic cakes. You must first get a circular sheet of one-sixteenth iron plate, 12in. in diameter, slightly concave, about 1in. deep at centre. The hollow side is placed over a clear wood or charcoal fire for two or three minutes before using. Knead up enough flour and water till a stiff paste; coarse, fine, or medium quality of wheat flour, according to taste. On a board roll it into flat cakes ¼in. thick, sprinkling them with dry flour; put each separately on the iron pan, and cook them very slowly till mottled brown. Too hot a pan will burn them. This was my only form of bread for many years; it is good with every kind of dish. A favourite meal for breakfast was spreading the hot cakes with fresh butter, on that a layer of honey, then rolling each up into a sort of sandwich. I ate them with my cups of tea. At dinner I poured strong gravy made from game over them in a deep dish. I also ate them with my stewed lentils. All very satisfying, though simple food. The domesticated elephant gets a daily ration of coarse flour, so made and baked in enormous cakes (16 to 24lb. weight of flour); it is the only food on which he will stand weight-carrying work. *Dry Chupatties.*—Knead fine white flour with rich milk; make the cakes no thicker than a card, and bake till crisp on the above plate. These will keep, and have only to be warmed for the table. *Curry Cakes.*—Knead up two parts of lentil or pease flour with one part fine wheat flour, and some milk. Make into cakes, very thin, like the last, and cook on the iron till pale brown and crisp. This is always served with any curry on the Madras side of India, and is very appetising. Chupatties are nice if spread with any kind of jam or marmalade, and are very beneficial in cases of constipation. I have often been compelled on my travels to make my own chupatties, using a black bottle as rolling-pin, and an inverted frying-pan as baking iron. I have grown my own patch of wheat, and threshed it too with a rough flail when I was far out of Christendom.—EOS.

[64557.]—**Angle of Commutator Cuts.**—To MR. BOTTONE.—The angle should be about 5°.—S. BOTTONE.

[64561.]—**Dynamo.**—To MR. BOTTONE.—Your best form of armature would be a Pacinotti ring armature, built up of punchings $\frac{1}{20}$in. thick, of good charcoal sheet iron, with at least ten teeth. The annexed sketch shows mode of joining and winding



wires. Do you not think No. 18 on armature rather fine for a dynamo of this size?—S. BOTTONE.

[64562.]—**Rudder.**—The book is right enough. If we use the sine of θ in the formula instead of the square of the sine, the result of the formula will be a pressure on the rudder parallel to the keel of the boat; but what is required is the pressure at right angles to the rudder. Now this pressure parallel to the keel can be resolved into two others, one at right angles to the rudder, and the other along the surface of the rudder, which latter has no effect in turning the boat one way or the other, and it will be seen that the resolved force at right angles to the rudder is equal to the force parallel to keel multiplied by the sine of θ, hence, sin. θ appears twice in the formula or sin.^{2} θ.—M. I. C. E., Bath.

[64564.]—**Optics.**—"F. S." will find an excellent series of articles on Optics with the Lantern in Vols. XXXII. and XXXIII. of the "E.M." The articles were afterwards issued in a 7s. 6d. book by Lewis Wright, entitled "Light; or a Course of Optics, &c." For an introduction to the subject get Webb's little book, "Optics without Mathematics."—G. M. PEL.

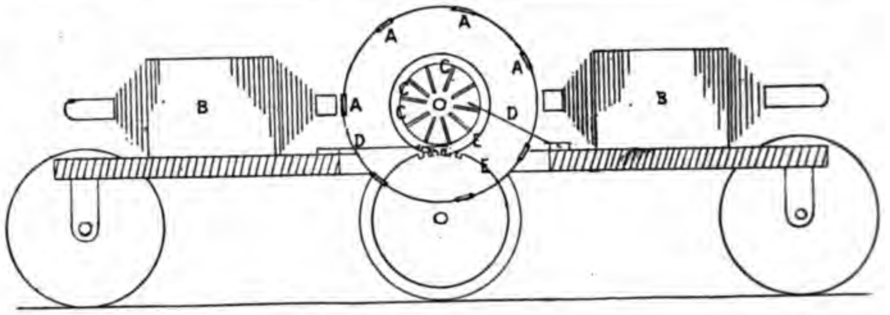
[64565.] — **Silica Bricks.** — If "Gannister" grinds up finely the material to which his query refers, and mixes with it about 1 per cent. of milk of lime, taking care to dry carefully before firing, he will probably be successful. The bricks should be fired at a high temperature for about a week.—W. H. S. S.

[64566.]—**Dynamo: Driving by a Weight.**—Perfectly possible, provided you have a sufficiently high tower and a sufficiently heavy weight. The amount of force required to drive one of my 20c.p. machines I find to be equal to 5,000lb. falling through 1ft. in one minute of time. The dynamo will therefore turn, to give current, until the 5,000lb. have reached the floor, going down at the above rate of 1ft. per minute.—S. BOTTONE.

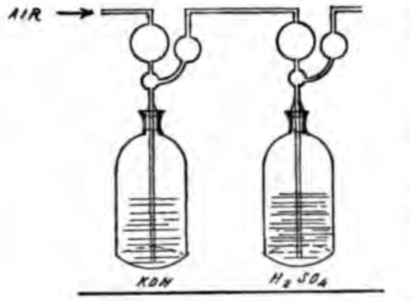
[64574.]—**Boehm Flute.**—In reply to "Au Revoir." 1. Cocus wood is best, but if made by the best firm, then entirely of silver is best; ebonite is weak in carrying power. 2. "Carte's" 1867 model is good; but Boehm's system with a cylindrical bore is the most used. I do not, however, recommend Rockstro's model for an amateur. 3. Collard's flutes have more complication, and the advantages are questionable. 4. It depends on whom you buy from. I should take it on the condition that if it was unsatisfactory I could return it (say) in ten days. In this matter, if a good instrument is desired, one must go to an experienced maker, and pay a fair price, and as there is no more difficult mechanical work than a Boehm flute, a good maker will always command a high price. The only doubtful matter is whether to select a closed or open G-sharp, and this depends on the player.—VULCANITE.

[64581.]—**Sundial.**—In my reply to this last week I omitted to explain what might not be self-evident respecting this latter tilting up sideways towards east till in the plane of Greenwich meridian to compensate for west longitude: it must not be about its horizontal axis, but that of its pole, i.e., using the shadow-casting edge for axis.—DADDY.

[64582.]—**Chemical.**—If you wish to deprive air of carbonic acid and moisture the apparatus you use must depend greatly on the use to which you put the purified air. Passing it through soda lime will deprive it of both substances at once, and the substances you mention only take one impurity at a time. Should you wish for any particular purpose to decarbonise it with caustic soda, you had better employ a solution and cause the air to bubble through it.—L. SIDNEY, 12, Rue de Belterre, Boulogne-sur-Mer.



[64582.]—**Chemical.**—Pass the air through a series of wash-bottles, preferably those of Drechsel, containing in the first a strong solution of caustic potash or soda; in the second, strong sulphuric



acid. The KOH removes the CO_2, and the H_2SO_4 absorbs the water. The apparatus is shown in the following sketch.—HENRY J. HARDY, F.C.S., Sheffield.

[64583.]—**Strength of Material.**—I answered this query last week, but as my letter was not acknowledged, I presume it was not received. Has not "T. C., Bristol," made a slight slip? He gives the formulæ for solid shafts varying as $4{\cdot}7\ R^4$, and for hollow shafts as $4{\cdot}7 \left(\frac{R^4 - r^4}{R}\right)$. Take the second formulæ and suppose r to be = O—that is, the shaft is a solid one; then $4{\cdot}7 \left(\frac{R^4}{R}\right) = 4{\cdot}7\ R^3$, which is the correct formulæ. The breaking weight of a solid circular beam = W $= \frac{4\,K \times 4{\cdot}7\,R^3}{L}$, and for hollow circular beams

$$W = \frac{4\,K \times 4{\cdot}7 \left(\frac{R^4 - r^4}{R}\right)}{L}$$

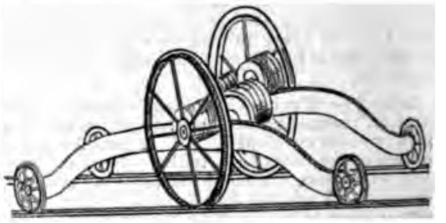
Where—W = weight applied in centre in cwts.
K = co-efficient of rupture = 68 for wrought iron, and 46 for cast iron
R = outer radius in inches
r = inner radius in inches
L = length of beam between supports in inches.—ELAG.

[64584.]—**The Best Kind of Small Boiler.**—The Shipman engine and boiler referred to on p. 17 was fully illustrated and described in No. 1,087, Jan. 22, 1886. I availed myself of an opportunity to see that engine, and I agree with "T. F. S. T." that although the burning spray makes a noise, it is a very useful little engine.—NUN. DOR.

[64584.]—**The Best Kind of Small Boiler.**—Thanks to "T. F. S. T." Yes, I admire the Shipman as a very clever thing, but I am a little afraid of anything so unusual—a thing I could not undertake to mend or renew if it required it; also I object very much to the noise of the jet. A 2-man boiler for an amateur's workshop should stand in the fireplace; the stove having been taken out, you have a space 3ft. high, 2ft. 6in. wide, and 1ft. 6in. deep, about. Is there anything better than a vertical with a cross tube? Will "T. C., Bristol," give his ideas with a dimensioned sketch? or perhaps some of those who have tried the small boilers in the market will give their experience as to their working?—F. A. M.

[64585.]—**Model Electro-Loco.**—"Sardonyx" does not say what form of motor he intends to use for his tramway. This is rather important, as it must be as powerful as possible, if the batteries are to be so small. I send a drawing of a small motor, which may be of use. The driving-wheel has fixed upon it seven armatures, A A, which are attracted by the two electro-magnets B B alternately. Contact is made by the points (seven in number) of the wheel, C C C, coming against the fine brass springs D D, which may be tipped with platinum and arranged so that the contact is broken directly an armature comes opposite the end of a magnet. By making the magnets attract alternately, the power is greatly increased as electro-magnets exert very little pull unless the armature is close to them, and the contact must not be made and broken too quickly, or the magnet will not have sufficient time to become saturated. The driving-wheel and wheel on which the motor runs are connected by cogged wheels, E E. This form of electro-loco. can easily be driven with one or two small bichromate cells placed as suggested in the tender.—CHRONOS.

[64585.]—**Model Electro-Loco.**—I have made many a locomotive to run for twenty minutes to half-hour at a time of the size mentioned by "Sardonyx," with self-contained chromic-acid battery of two cells, each 2in. square. The locomotive itself consists, as shown in sketch, of two electro-



magnets, one fixed to the frame, and the other capable of turning on its axis, which is at the same time the axle of the driving wheels. On the outside of the frame, on the movable electro side, are the commutator and springs. Any further information with pleasure, or will make you one if you desire.—S. BOTTONE.

[64596.]—**Cupolas.**—The cupola with steam blast, designed by F. A. Herbertz, of Cologne, a description of which is given by Beckert in "Stahl und Eisen," 1886, 6, 399, is said to be economical in fuel—at least, for small and moderate-sized foundries. The throat of the cupola is closed by means of doors, beneath which is placed a double tube within the wall ascending obliquely, and into which steam is blown. The hearth hangs beneath the shaft by means of bolts, and an adjustable slit is thus formed, which completely surrounds the furnace, through which air is admitted to the cupola, instead of by the usual tuyères. The whole of the carbon of the fuel is said to be converted into carbonic anhydride, resulting in decided economy in fuel. The iron melted is said to be less changed than in other cupolas, the loss being 2·4 to 2·6 per cent., as against 6 per cent. in other furnaces.—HENRY J. HARDY, F.C.S., Sheffield.

[64597.]—**Pig-Iron.**—Failing to recognise a particular brand of pig-iron from the description contained in the former part of "S. A.'s" query, I am unable to say with certainty of what brand this iron may be. But with reference to the latter part of his query, I should say that the brand of iron (which he describes as being cast in plates, about the sizes given) is Swedish white iron, the composition of which may be shown by the following figures:—

	Per cent.		Per cent.
Combined carbon	4·00	to	4·50
Silicon	0·20	„	0·50
Manganese	trace	„	1·80
Phosphorus..................	0·01	„	0·10
Sulphur	0·01	„	0·03
Iron	95·77	„	93·07
	99·99		100·00

And could, I have no doubt, be obtained through any import metal broker.—W. H. S. S.

[64597.]— **Pig - Iron.** — It is most probably Swedish iron, but of no particular brand. It has merely been notched for convenience in breaking, like many brands are. There are several brands of Swedish iron cast in plates, as described. Write to some metal merchant.—HENRY J. HARDY, F.C.S., Sheffield.

[64602.]—**Evolution.**—Would "J. H." kindly state what reliable information he has got, or where it is to be found, to show that mankind were ever in any way different from what they are now, or that either in general or particular they ever had more or less hair than has always been, and is now, to be found on their bodies? Also, what proof is there that civilisation has, or has had, anything to do with men's bodies, seeing that we have "all sorts and conditions of men," all with more or less hair, and would naturally suppose that as civilisation has, taking it on the whole, rather promoted the physical condition of men, it would most likely have made more hair to grow instead of "leaving it behind"? Another thing "J. H." might be able to explain is this: Seeing that the hair and whiskers of mankind are as different from the hair and whiskers of the anthropoid apes (from whom man is said to have been evolved) as the fur and whiskers of a cat are different from the bristles of a pig, or the wool of a sheep from the hair of a goat, how did the change in essence and substance come about? A little genuine information, not opinion, on a few such fundamental matters as this would do more to make things clear than any amount of such statements as "the peacock's gorgeous plumage probably owes it development to sexual selection," because, taking the same loose style of writing, the "moon is probably made of green cheese." As for "Devil's Hoof," when he has had a little more experience he will know less, and when that happy time comes about it may dawn upon his mind that "wisdom teeth" and "great toe-nails" are useful as well as "ornamental"; also that they are special creations, and that development is not evolution.—DENS.

[64608.]—**Attaching Engine to Lathe.**—I am pleased to know this has been done; it was a very old idea of mine, but never carried out. The cylinder must, of course, be lagged to prevent the unpleasant heat. I think it would be difficult to prevent hot greasy water from running down the piston-rod of an inverted cylinder, even though the stuffing-box was projected up into the cylinder. I think the usual belting and shafts a bore. What sort of "motor" does "T. C." refer to? "A. F. S." does not seem to see that the link-motion is all you require to start or "stop suddenly."—F. A. M.

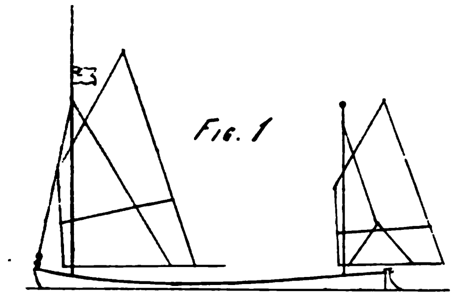


Fig. 1

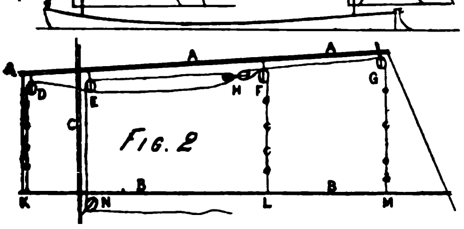


Fig. 2

[64617.]—**Canoe.**—The mainsail and mizzen battened lug is the almost universal rig amongst canoeists. Fig. 1 represents the craft under full sail; Fig. 2 the Baden-Powell reefing-gear on a larger scale. The following are the dimensions of sails:—Main head, 6ft.; foot, 6ft.; luff, 4ft.; leech, 9ft. 9in.; tack to peak, 9ft. 9in.; clew to throat, 7ft.; area, 32·5sq.ft.; mizzen head, 4ft. 4in.; foot, 4ft. 4in.; luff, 3ft. 6in.; leech, 7ft. 7in.; tack to peak, 7ft. 7in.; clew to throat, 5ft. 6in.; area, 19·5sq.ft. Triangular storm mizzen, for rough weather, the mainsail being stowed below and the large mizzen hoisted forward:—Luff, 5ft. 9in.; leech, 6ft.; foot, 3ft. 6in.; laced to a boom. The lugsails are shown with one reef in each; mainsail reef 2ft. deep on luff, 2ft. 9in. on leech; mizzen reef 1ft. 8in. deep on luff, 1ft. 11in. on leech; but more may be fitted, according to individual taste. The reefing gear is thus rigged:—A is a yellow pine batten 1in. diameter, in a pocket sewn to the sail; B is the boom, to which the foot of the sail is laced; C is the mast; D E F G are boxwood blocks, with brass sheaves and brass pins, D and E ⅞in. long, F and G ¾in. long, stropped to the batten, openings being cut in the pocket to admit the lashings; at H are a ¾in. and a ⅝in. block, stropped head to head; N is a ⅝in. block at foot of mast on deck. A piece of plaited blind-cord is made fast to boom at M, carried up through rings sewn on the sail, passed through the block G, through a ring lashed to batten above F, through the ¾in. block at H, through block F, down through rings, and fast to boom at L. A stouter-plaited cord is fast to boom K up through rings on luff, through block D, through ⅝in. block at H, back through E, down through N, along the deck, through a screw-eye close to hand, the end being knotted so that it is always ready to hand. The distance between E and H must be rather more than that between G and M. The cords in the reefing-gear must be plaited, not twisted cord, and should be dressed with boiled oil to prevent shrinking when wet. This design is from "Yacht and Boat Sailing," and was meant for a canoe 14ft. by 2ft. 6in., with centre-board, but will do well for the 15ft. boat. The mainmast was 1ft. 6in. from bows, and the mizzen 2ft. from stern; but with a fixed keel they would, I think, be better 6in. further aft, especially if the canoe has a broad, deep rudder. The mainsail has halliard, down haul, tack, topping lift, sheet, reef line. Mizzen has standing topping lift, halliard, reef line, sheet. Each passes through its own screw-eye on deck, and makes fast to its own cleat. "Practical Canoeing" contains much information. —GOLDEN SLIPPERS.

[64604.]—**Heating Small Boiler by Gas or Paraffin.**—Your correspondent, "T. F. S. T.," must be largely drawing on his imagination when he professes to quote my opinion as to the cost of gas for a hot-air engine. It is quite probable that I made use of the expression he quotes in reference to a 2 or 3H.P. *steam*-engine, and this may be a favourable opportunity to air a grievance which is a source of very serious trouble to myself, and no doubt to others in the same position—i.e., the very great carelessness, incompleteness, and indefinite style in which queries are usually put to experts, and the great difficulty in forcing correspondents to "disgorge" sufficient detailed information to enable a proper reply, or, in fact, any reply at all to be given. This tendency is painfully visible in the Query columns of the "E.M." every week, and causes many queries either to remain unanswered or to be answered incorrectly. If your correspondent had taken the trouble to state fully and correctly what he meant, he would have had a correct reply, and if his query referred to *large sizes* of hot-air engines, the reply he quotes would be literally correct. As a fuel in hot-air engines, two gallons of kerosene properly burnt are equal to about 20lb. of coke or 400 cubic feet of ordinary coal-gas, and if "T. F. S. T." will figure this out on a 10H.P. engine, he will see that it is "cheaper to keep a boy shovelling coke on than to use coal-gas," or kerosene at, say, 7d. per gallon—either of the latter being, duty for duty, more than ten times the cost of coke. Either may be used for very small powers or very irregular work, and show a decided advantage over coke in economy; but for steady work on anything like a moderate or large scale, coke, with the necessary hand labour and attention included, is by far the cheapest fuel.—THOS. FLETCHER.

[64618.]—**Red Concrete.**—May be made with broken red stone and bricks instead of gravel for the body of the mixture. The material for the surface would require grinding in a pug-mill. —G. M. PEL.

[64619.]—**Chemical Balance.**—I cannot give you information as to any advantages attendant on having a short beam, except that, of course, the shorter the beam is the lighter; for a balance depends on its sensibility greatly for its weight, and the lighter the better; but it depends more on the length of its arms, and consequently long arms are always recommended. It is true that they increase the weight, but the length of leverage obtained more than supplies this disadvantage. The beams are made now often of aluminium, as it has a low specific gravity—only 2·6.—L. SIDNEY, Boulogne-sur-Mer.

[64622]—**Screw Cutting.**—Surely, those who have replied to "Novice," as well as "Novice" himself, are in error as to the "ratio." It is true that $106\frac{7}{8} = \frac{855}{8}$; but that is not the ratio with the leading screw, which is $\frac{106\frac{7}{8}}{2} \times 8 = \frac{855}{16}$; and not $\frac{855}{4}$ as stated. The trains of wheels, therefore, based upon the latter assumption are incorrect. I do not quite make out whether "Novice" requires a thread of one hundred and six and seven-eighths, or ten decimal six and seven-eighths; if the former, he will have some difficulty in cutting it with so coarse a leading screw; if the latter, he can cut it with the following train: $\frac{20}{45} \times \frac{40}{95} = 10·6\frac{7}{8}$. —SYDENHAM.

[64623.]—**Bee Hives.**—Inner side-walls, on which frame ears rest, are 8⅜in. deep, including the bottom strip, which closes air space. They are bevelled down ¼in. from top to leave ¼in. bee-space below frame ears. The other inner walls are 8⅛in. deep, including bottom strip. To raise them to the level of tops of frames, pieces of ⅜in. stuff are nailed over the air spaces. The air spaces should be loosely packed with shavings before bottom strips are nailed on. The outside walls may be made of 9in. plank or broader. A 9in. plank will bring sides up to a level with frame tops, and this is the best height where hives are only used for doubling—*i.e.*, piling one on top of another. "Indian" may, however, use broader plank, if at hand, and make a deep roof to cover a doubling box or two or three tiers of sections. The complete hive with 9in. walls should consist of *a*, *c*, *d*, and *e* in Fig. 4, p. 161, Oct. 14, 1887. Or *d* may be dispensed with when the outer body-walls are made deeper than 9in. The main points to note are, given a "standard" frame, the hive inside should allow ¼in. space at the ends of frames and ⅜in. below. Hive should hold not less than ten frames. The walls should be double all round. Using thin material is no economy. A good colony is valuable property, and is worth knowing properly. If "Indian" will imagine the dummy (*d*, Fig. 2) removed, and the entrance to hive to be at *g* instead of *c*, he will understand my arrangement for winter. Three or four empty frames are placed in the vacant space to support the quilt, which extends over the whole top. The common hives would perhaps not allow of such an unorthodox winter arrangement; but with my floor-board, *real* non-conducting walls all round, and an air-tight top, I find stocks, if anything, better off than when closed in with dummies and the front door open. Fig. 5 represents section of a portion of hive body, not "roof." Air space would be 1⅛in. if ¾in. stuff is used for walls. An extractor is a very useful piece of the beekeeper's outfit (not only for extracted honey, but also for emptying half-filled sections, for giving breeding room when an excess of store exists, &c.), but would not be necessary for a start. A fairly effective extractor can easily be made, consisting of a funnel with rectangular mouth to take the comb, which lies on a wire net fixed about 1½in. below the mouth. The funnel is corked, and hangs by a wire loop on a pole; pole tied at one end to a tree or post, and grasped at the other end. On swinging the funnel round, the honey is thrown into it, and may be let out on withdrawing the cork. The smallest outlay would be: Bees, from ,s.; smoker, from 2s. 6d.; 100 sections, 2s. 6d.; foundation brood and super, say, 8s. Frames and section crates can be made by "Indian," so also veil. Gloves should consist of a leather pair, and over these a pair of woollen gauntlet gloves or woollen socks. Shall be pleased to assist further, if wanted.—SILKE.

[64624.]—**Crown Wheels.**—A crown wheel has its teeth standing at right angles to its side. "No Sig." must mean bevel wheels, which can be geared in any proportion, and with shafts at any angle to one another.—T. W. B.

[64624.]—**Crown Wheels.**—"Crown Wheel" is simply name given to some forms of bevel gears, and will, of course, run together, whatever the size, provided all lines of the teeth are drawn to the same point as that formed by the meeting of the centre lines of the shafts. See articles recently in "Ours" on Gearing.—T. C., Bristol.

[64624.]—**Crown Wheels.**—The query is not clear to me; but I think it must relate to the gearing together of what are called bastard wheels—that is, wheels nearly but not quite correctly adapted to each other. If so, the limits of such adaptation are very restricted. The true conditions which govern the pairing of bevel wheels are fully laid down on pp. 499, 500, of the volume just concluded.—J. H.

[64625.]—**Coil.**—Use a mercury break for this size coil. With ordinary break, you do not get a sufficiently large current.—CHAS. PROVIS.

[64625.]—**Coil.**—The fault is probably not with the old primary wire, but with the contact breaker, which may have lost its platinum tips; otherwise, how could it fuse together? Give your coil a good soaking in melted paraffin wax to insure thorough insulation.—S. BOTTONE.

[64625.]—**Coil.**—It is a waste of time to attempt to make a good coil with old wire. Age renders the wire hard and brittle, destroying its conductivity. Better take old wire off and use new. Unless your coil is a very large one, your primary is too thick, and you have too much of it.—H. CARRICK.

[64625.]—**Coil.**—Ten years in ordinary atmosphere will not materially affect No. 12 copper wire; fifty yards No. 12 would make a coil (if well proportioned) rather too audacious for an amateur of querist's evident experience to play with. Breakdowns in old coils are usually due to connections becoming corroded. See that primary is well insulated, and that spring is strong enough to only just allow easy separation of contact points.—DADDY.

[64626.]—**Model Boiler.**—Make it $\frac{1}{30}$in. thick for each inch diameter of boiler for 80lb. For line I would suggest laying on slating battens 2½in. by 1in. with ties every 4ft. or so.—T. C., Bristol.

[64626.]—**Model Loco. Boiler.**—You do not give size of cylinders or boiler, hence I cannot give thickness of copper required; still, $\frac{3}{16}$in. plate, if well riveted, would stand 60lb. pressure. For models, a large boiler making plenty of steam at 20lb. or 30lb. is best. I will send description of my loco. boiler—internal furnace—working about 30lb. pressure, and of railway, if desired.—AMATEUR.

[64627.]—**Detector.**—The reason that the needle does not deflect so much is probably due to the cell not being quite so strong as the one used that deflected the needle 40°. Some cells will give a much greater deflection than others, owing to small differences in the building, such as higher resistance in the carbon, different distances between the elements, &c. The needle is magnetised, or it would not move at all when the current passed. I don't suppose it would lose its magnetism unless it was heated or used roughly. The flame in the bichromate cell was probably due to the oxidation of the iron poker by the bichromate, or else a little paraffin wax had got into the cell, and was fired by the heat.—PRINCIPIA.

[64628.]—**Screw-Cutting.**—Your ratio is 14½ to 2 = 29 to 4, and as 29 is a prime number, you cannot cut exactly without a 29, or some multiple of it.—T. C., Bristol.

[64628.]—**Screw-Cutting.**—"In a Fix" can cut 14½ threads per inch with a two to inch leading screw by using any of the following sets of wheels: 20, 145; 20, 35, 60, 85; 20, 90, 100, 180; 20, 20, 29, 100. The second one he will find most serviceable.—THE MAGGOT.

[64628.]—**Screw-Cutting.**—To cut 14½ threads per inch with a leading screw of 2 per inch, you will require 2 by 20's and a 29 wheel, or else a 58 or 145 wheel as follows—

	Mandrel.	Stud.	Screw.
	20	29	
		20	100
or—	40	58	
		20	100

or 20 any wheel between 145.—CHAS. PROVIS, Emsworth.

[64628.]—**Screw-Cutting.**—"In a Fix" wants a wheel of 145 = 5 × 29, in order to cut 14½ to an inch; but 14·52, which is very nearly the same thing, will be got by a train of $\frac{400}{2904} = \frac{400}{24 \times 11 \times 11}$ $= \frac{100}{6 \times 11 \times 11} = \frac{1}{6} \times \frac{10}{11} \times \frac{10}{11} = \frac{20}{120} \times \frac{50}{55} \times \frac{100}{110}$. Another train not quite so near is $\frac{400}{2907} = \frac{4}{9} \times \frac{10}{17}$ $\times \frac{10}{19} = \frac{20}{90}\ \frac{50}{85}\ \frac{100}{95}$.—J. K. P.

[64631.]—**Polishing Marble.**—Rub down the surface with another piece of marble or hard stone with sand and water, using firstly river sand, and next fine white sand. Then rub with grit stone (from Ayr) and water. Finally polish with putty-powder (peroxide of tin) on a woollen pad, moistened with water, and kept down to the surface by weighting.—G. M. PEL.

[64633.]—**Scotch Putty.**—Probably Vulcan cement, generally used for hot-pipe joints; but Purimachos cement is better for dry heat. Both are used like putty.—T. W. B.

[64634.]—**Greenhouse Pipes.**—Remove the plants from house, and have water in the boiler only, so as to have steam in the pipes. Have a three-eighth vent at further end, so as not to burst the pipes, and the heat will then soon burn off the paint and tar. If you must black them, use black-lead.—T. C., Bristol.

[64634.]—**Greenhouse Pipes.**—Make a paste of one part of quicklime, three parts washing soda, and a little boiling water, and cover the pipes with it. Leave the paste on for an hour or so, and you will be able to clean off all, or nearly all, of the paint with an old knife, or similar instrument, after which they may be well black-leaded.—PRINCIPIA.

[64634.]—**Greenhouse Pipes.**—The only effectual way for "J. A." to get the tar off his greenhouse pipes is to disconnect them, and burn it off; but, however, before he does this I should recommend him (if he has not already done so) to heat his pipes as hot as he can, so as to soften the tar, and then to scrub them with a stiff brush, and use strong soda, potash, and black soap water. If he does not succeed with this I expect he will have to fall back on the burning; but I am inclined myself to think it will wear away in time.—JOHN OWEN, Neath.

[64635.]—**Dynamo, to Light 5c.p. Lamps.**—A small dynamo, with laminated Siemens armature, about 1½in. by 3, will do this easily, if shunt wound, with about 4oz. No. 22 silk-covered wire on the armature, and 2lb. No. 22 on the fields. Unless you use an accumulator, it is almost impossible to get a steady light from any dynamo, when the driving is irregular, because the E.M.F. varies directly as the speed.—S. BOTTONE.

[64636.]—**Steam Chest.**—As you will have something like 117 tons on the cover, you ought not have less than 60 bolts. If the brackets are tapered off to the crown on the outside, you should also have cross and longitudinal webs inside the crown—in fact, the strongest form would be with webs deeper in the middle and metal 2in. thick. If the outer edges of flanges meet it would be a great advantage all ways, and a few more bolts, also webs closer than 12in.—T. C., Bristol.

[64636.]—**Steam Chest.**—Do not make a cast-iron chest at all. Cast-iron is uncertain, especially in the form you describe, as there are contraction stresses left in, you cannot tell where. Wrought-iron plates and angle iron stiffeners are the best—a boiler-maker's job. A stiff angle iron on top and bottom, the bottom riveted thereto with a double row of ⅞in. rivets, the bottom plate stiffened by external angle irons riveted on. Dome your cover as much as you like, and cross it over with angle irons every 6in. or 8in. A bolt through each end, and one between, say, 24 bolts a side and the end cross bolts the same pitch. There is 125 tons on the cover—say, 2 tons per bolt.—W. M. I., Dublin.

[64637.]—**Test for Mystery Gold.**—I do not know of any easily-applied test except Hughes's induction balance, to which probably you have not access.—CHAS. PROVIS.

[64639.]—**Piccolo.**—You had better have an instrument with six keys, which will enable you to play in any key. I can recommend you to procure one the same as mine. It is made entirely of nickel silver, by Barnett Samuel and Son, with six keys, tuning slide, and cylinder bore. The cost was 10s. Boosey's "Shilling Flute Tutor," by Pratten, is good; there is also a more expensive one by Chapman, published by Lafleur, which is excellent. The fingering for the flute is the same as for the piccolo; but there is a difference in the blowing. I find that, after practising on the piccolo, I can blow the flute with the greatest ease. But, if I take up the piccolo after the flute, the result at first is far from satisfactory.—J. MCLAREN.

[64639.]—**Piccolo.**—Get a 6-keyed instrument in D, for the following reasons: 1st. Supposing you get one with only four, to make up for the absence of the other two you have to make combinations that are not so easy as using the keys. 2nd. If you intend afterwards to get a full-size (8-keyed) flute, the fingering would be the same, except that you would have a few extra ways of making some of the notes. 3rd. Get it in the key of D, not in B flat, as all flutes are made in the former. Of course, if you do not intend to get an 8-keyed flute, get a piccolo with the same number as the flute you do intend to have. One of the best tutors you can obtain is "Turner's Complete Flute (or Piccolo) Tutor," for instruments with 1, 4, 6, or 8 keys, compiled by Henry A. Hill, published at 33, Bishopsgate-street Within, E.C. This contains a very ample chromatic scale of fingering.—H. P. N.

[64640.]—**Test for Gold.**—Chip out all the metallic particles you can see, and boil in nitro-hydrochloric acid; evaporate to dryness on a water-bath, redissolve in water, and add a solution of ferrous sulphate—a brown precipitate indicates gold, which may be redissolved in the acid, and the other tests for gold applied. If the particles do not easily dissolve in the acid, they are probably pyrites. It is rather difficult to say what the hollow pebbles are without seeing them, possibly they are geodes.—PRINCIPIA.

[64641.]—**Lacquer or Enamel for Castings.**—Try Berlin black. It can be stoved, but will probably meet your requirements without.—T. W. B.

[64642.]—**Hot Water Fittings.**—Flow pipe from top of boiler to top of circulating tank, and return from bottom of tank to bottom of boiler. Connect cold feed to return pipe if possible.—T. C., Bristol.

[64642.]—**Hot-water Fittings.**—The pipes are connected with the close cistern and boiler by means of boiler screws, the return-pipe being carried to the bottom of the boiler, the flow-pipe leaving it at the top. The cold water should enter the return-pipe below the close cistern, which last should, of course, be below the main cistern.—G. M. PEL.

[64642.]—**Hot-water Fittings.**—Use 1in. pipes and fittings; both pipes to go in top of boiler, the flow quite flush with inside, the return to dip within 2in. of the bottom. The flow-pipe should be fixed higher than the return in circulating tank, and can go in at the bottom or the side. The feed-cistern must be higher than the circulating tank, and supply should enter in return-pipe. Do not neglect to fix expansion pipe in top of circulating tank.—H. CARRICK.

[64642.]—**Hot-water Fittings.**—The circulating cylinder must be below feed cistern. Fix cold-water supply pipe from bottom of feed cistern to bottom of circulating cylinder; also a steam-pipe from top of circulating cylinder to roof, or turn the end down into feed cistern. From this pipe branch off, close to top of cylinder, the supply pipe to bath, &c. The flow and return pipes must be connected to boiler and lower part of circulating cylinder, the flow pipe 4in. or 5in. above the return pipe. Fix the cylinder where its warmth will be of service—either in bath-room or a linen closet.—T. W. B.

[64643.]—**Making Cycle Wheels.**—1. What is known as a flat drill will do. It can be made to fit drill chuck in lathe; rims can be drilled in lathe. If the bed is not long enough, support the rim with something to allow the proper angle for holes. 2. Mild steel is used for axle. 3. The bearing parts of ball hubs should be hardened. Where the hub is made of two metals, as steel and brass, the middle or steel portion is first made and bearings hardened, after which the brass flanges are fitted and sweated, or soldered on, a good fit being made and flanges finished off. The material now used is either malleable cast iron or mild steel stampings. There is not much forged work now in bicycles; stampings of any kind are the best—malleable has flaws. 4. I think conical heads are best for spokes to solid rims, the rim being countersunk a little. If you can get the materials from any cycle agent or firm of manufacturers it will be best; stampings of all kinds and brass flanges can be had, also spokes cut in lengths, with heads, and convenient gauges. The bearings to be case-hardened. I am not aware that best steel is used unless it be for balls.—A. M. M. A.

[64644.]—**Cleaning Chamois Gloves.**—Make a batter of two parts powdered pipe-clay and one part yellow ochre (or other colour to taste) with water); put gloves on your hands, and well work them in this mess till clean. Leave some batter on, well dry in a warm place, then crumple up to break the batter, which is now cake (not plum); well beat the dust out, and they will be soft as new.—DADDY.

[64645.]—**Egg Problem.**—Perhaps the following consideration may help "A. C. G." towards the solution of this question. Let x be the number of eggs for 12d.; then $\frac{12}{x}$ is the price of each egg in pennies. And then it is obvious that $\frac{144}{x}$ is the price per dozen, and also that the number for 1s., multiplied by the number of pennies per dozen, invariably equals 144; or, putting it another way, divide 144 by the number for 1s., and then you get the price per dozen in pennies, and *vice versâ*. Now go ahead.—J. K. P.

[64645.]—**Egg Problem.**—Let x = number bought for 1s. at the market rate. Then $\frac{12^2}{x}$ = price per dozen in pence, and $\frac{12^2}{x+2}$ = the reduced price per dozen. Then the saving per dozen $= 12^2\left(\frac{1}{x} - \frac{1}{x+2}\right) = \frac{288}{x^2 + 2x} = 1$ (penny, by hypothesis). Thus $x^2 + 2x = 288$, whence $x = 16$, or a minus quantity. So the market rate was 16 to the shilling, or 9d. per dozen; and the lady received 18 to the shilling, or at the rate of 8d. per dozen.—W. M. M.

[64645.]—**Egg Problem.**—Let x = number of eggs for a shilling, $\frac{144}{x}$ = price in pence per doz. If she gets two more for a shilling, $\frac{144}{x+2}$ = price per doz., which is 1d. per doz. cheaper.

$$\therefore \frac{144}{x} = \frac{144}{x+2} + 1$$

$$144x + 288 = 144x + x^2 + 2x$$

$$x^2 + 2x = 288$$

$$x^2 + 2x + 1 = 288 + 1$$

$$x + 1 = \sqrt{287}$$

$$x + 1 = 17$$

$$x = 16 = \text{number for shilling}$$

$$\frac{144}{16} = 9\text{d.} = \text{price per doz.}$$

When she gets 18 for shilling, price per doz. is $\frac{144}{18} = 8$d. The rest of your query is not so clear. You say, "How many eggs, and at what price, must be bought to yield a saving of 1d. per doz.?" It depends on whether the dealer would allow a reduction on quantities of less than a shilling's-worth. If he did, she need only buy 1 egg at the reduced price of 8d. per doz., and she would be saving at the rate of 1d. per doz.—ELAG.

[64645.]—**Egg Problem.**—This problem is stated in an unusual and somewhat puzzling form. I have heard it before in this shape: "What is the price of eggs when two more for a shilling lowers the price a penny per dozen?" Solution:—Let x = number of eggs for a shilling (at first); then $\frac{1}{x}$ = price of one egg, expressed in shillings, and $\frac{12}{x}$ = price of a dozen eggs. Similarly, $\frac{12}{x+2}$ = price of a dozen eggs when two are added to the shillingsworth. We then get the equation—

$$\frac{12}{x} - \frac{{}^*1}{12} = \frac{12}{x+2}$$

$$144x + 288 - x^2 - 2x = 144x$$

$$x^2 + 2x = 288$$

$$x^2 + 2x + 1 = 289$$

$$x + 1 = 17$$

$$x = 16$$

—i.e., the original price was 9d. a dozen, or 16 a shilling. The "catch" is at *. One is apt to forget one is working in shillings, and to put 1 instead of $\frac{1}{12}$.—BANKER.

[64645.]—**Egg Problem.**—This is equivalent to saying that two more for a shilling lowers the price one penny a dozen, in which form this query was put and answered a short time ago. Let x be number of eggs for 1d. at original rate; then $\frac{12}{x}$ = price per dozen at ditto; also $x + \frac{1}{6}$ = number of eggs for 1d. at reduced rate, and $\frac{12}{x + \frac{1}{6}} = \frac{72}{6x+1}$ = price per dozen at ditto; hence the equation is—

$$\frac{12}{x} = \frac{72}{x+1} + 1$$

which gives 9d. the price per dozen, at which price a shilling's worth would be 16, the number of eggs she would have to buy.—W. A. S.

[64647.]—**Delivery of Water from a Pipe.**—Although not amongst the experts, and with apologies to so many better qualified, I beg to say that so far as I understand this very interesting question (or, rather questions), there cannot be much discussion as to the amount of water that a 5in. bore pipe can deliver at the height, nor have I ever heard the tables given in Molesworth disputed; therefore, as the water is taken from a point 40ft. above the main—which main is charged with water at a constant pressure of 180ft.—the water is delivered into the sprinkler under a pressure of 90ft., which is equal to 4,573ft. per minute; then $\frac{4573 \times 5^2 \times \cdot7854 \times 12}{277 \cdot 7}$ = 3,876gals. per minute, which agrees with the querist nearly. Then if the total number of the holes, ⅛th diam. (presumably in a thin copper pipe), be 7,500, the effective area of their outlets equals ·0,122 (area) × 7,500 × ·62 (coefficient) = 56·7sq.in. At first sight this preponderance of area (nearly three times greater than the 5in. bore pipe) might suggest that all the water delivered by the 5in. pipe into the open (viz., 3,876gals.) would easily escape through an area of nearly three times that of the 5in. pipe; but it is not so, neither is the 5in. pipe delivering into an open tank. It is delivering through a multitude of holes, and the collective area of these holes reduces the average discharging velocity to 1,580ft. per minute, and the head to produce this velocity is nearly 11ft. So if a 5in. pipe discharged into a box with a hole in the bottom of 56·7in. of area, the water, if permitted, would rise to a height of 11ft. But the sprinkler is not so arranged, and at the ends, away from the inlet, the water will spout with a velocity due to an 11ft. head; while near the inlet it will spout with a velocity corresponding to the head in the 5in. pipe, and if effect is to be considered, these various velocities should not be forgotten. I notice the tubes are 3in. and 2in. Surely "Irwell" is not making the mistake of supposing these two tubes, because they are 3in. and 2in. diam. each, are equal to a 5in. pipe. He should make the upper pipe the largest—say 4in.—and the lower one 3in. If he cannot do so then he must form branches on the bored tubes, and connect from the main in two or three places, and this would also, to some extent, counteract the tapering jets. If this is correct reasoning, the loss of head is 11ft., and the velocity due to this reduction is 4,174ft. per minute; then $\frac{4{,}174 \times 19 \cdot 6 \times 12}{277 \cdot 7}$ = 3,535gals. per minute. One thing "Irwell" may be sure of—viz., he cannot be charged for more than the largest quantity—viz., 3,876gals.—W. M. I., Dublin.

[64649.]—**The E.M. Telephone.**—TO MR. BOTTONE.—If time permits, I will send in a full account of this instrument, with illustration, in the course of a few weeks.—S. BOTTONE.

[64650.]—**Designing Machine.**—The instrument you speak of is a harmograph, and when well made is capable of executing most beautiful designs; but great care is requisite in making it. The probable fault in your machine is too much friction on working parts, which only allows a part of the design to be drawn. You might try altering weights at bottom of levers, adjusting till best effects are obtained.—H. CARRICK.

[64650.]—**Designing Machine.**—Your correspondent evidently means the harmonograph, so called from showing the harmony or discord produced by the vibrations of two pendulums. Two pendulums are arranged to swing at right angles to each other; one carries a small table on which the card or paper is placed (the table swinging with the pendulum), the other pendulum carries a glass pen and traces its movements on the moving paper. By altering the length of one pendulum various figures are described, some of them of great beauty. The machine is very simple, and could be made in a few hours at the cost of only a few shillings. If Editor can find space I will send sketch of the one in my possession.—JOHN HENRY KNIGHT.

[64653.]—**Steam Valve**—You cannot manage to govern an engine through the agency of a reducing valve alone, because of the varying pressure caused by the withdrawing of the steam at the beginning of the stroke. This might be met by a reservoir, but for the waste and expense; besides, there are reducing valves comparatively worthless. Try and get a good one, and enlarge the space between it and the valve chest; then you still have the varying load, and probably this is a common throttle valve regulated by a common governor; no cure for this type. Get a good "automatic expansion" gear, and a modern governor, to cover your range of work. Any good firm will supply you with what you want.—W. M. I., Dublin.

[64654.]—**Defective Coil.**—To MR. BOTTONE.—The coil is not far wrong. It cannot be expected to give such a good spark with No. 35 old wire as with a finer gauge of new. It is also likely that too great a thickness of tube occurs between primary and secondary. There should be little or no space if the coil is for a spark coil, while it does not matter so much for a shocking coil. Surely you can't bear a $\frac{1}{16}$in. spark through your hands?—S. BOTTONE.

[64656.]—**Joints in Slate Cistern.**—It appears to me that the joints were badly made, as red and white lead putty properly applied will certainly make good joints. You do not need litharge and gold size with it.—T. C., Bristol.

[54656.]—**Joints for Slate Cistern.**—White-lead, with a portion of red to harden it, is generally used for slate cisterns, and makes a good joint. Perhaps your joints were not quite dry when you applied your white-lead; and I think the best thing you can do is to try it again. You might try a paint made of white-lead, applied with a brush round the joints inside, which would most likely make it all right.—LEWIS.

[64658.]—**Furnace.**—Ordinary drain-pipes will stand no more heat than common brick. Try silica bricks: they stand the heat of a steel furnace.—T. W. B.

[64659.]—**Model.**—Throw your syringe away, and spend two to three shillings in a proper set of castings from one of our advertisers. It is a mere waste of time advising you to do anything else.—T. C., Bristol.

[64659.]—**Model.**—Do not trouble with an enema syringe for a cylinder, when you can buy the castings of a properly constructed cylinder, such as are advertised in "Ours," and fit them up. For ¾in. bore, stroke should be 1¼in. I use thread or tow for packing the piston.—AMATEUR.

[64659.]—**Model.**—"Pontesbury" cannot utilise the cylinder which he has got for a steam-engine of any kind; it is entirely unsuited for that purpose both in the proportion and in every way. The lost packing of the piston can be easily replaced by winding some soft lamp cotton round it. If "Pontesbury" wants to make a beam-engine, he had better go about it in the proper way, and if he can use the lathe, and turn and file accurately, I shall be happy to describe the proper way to go to work.—H. CHAPMAN.

[64663.]—**Deceptive Boiler.**—It is very evident this is much too small for the work, and is very possible it has very little steam room, and so causes priming, as indicated by the gauge glass. Do not work with more water than is safe. Keep the pressure up, and throttle closed as much as possible. This is about all you can do, except keeping grease out of the boiler.—T. C., Bristol.

[64663.]—**Deceptive Boiler.**—Probably this is a case of "priming." Clean out the boiler thoroughly, at the same time clean out the gauge-cocks. Then use clean water if possible; if not, blow down the boiler a few inches every day, and use the gauge-cocks frequently. An internal pipe attached to the upper hole and turned up into the steam space would keep out the dirt from the cock. The objection to the tube is that, if there is much priming the tube itself gets bunged up. Get the boiler insured. It is not a costly job, and the inspector will probably put you right.—W. M. I., Dublin.

[64663.]—**Deceptive Boiler.**—You must be very easily deceived if a steam boiler can manage it. The boiler is not at fault; but the top gauge tap is, and, on examining it, you will most likely find it is stopped up in some way. Therefore, when the boiler is full of water, the under gauge tap lets it into the glass, and when steam gets up it is maintained at the same level by the pressure of the steam acting only underneath the water, which is forced up the glass until the air pressure above the water equals the steam pressure beneath it.—COPPER.

[64660.]—**Grigg's Coil.**—TO MR. BOTTONE.—The wire from one of the battery binding screws goes to the platinum-tipped screw; the current passes thence around the electro-magnet coils through the vibrating clapper; leaving the electro-magnet, it passes round the primary coil, and comes out at the opposite battery binding screw. The object of this arrangement is to be able to withdraw the iron core without upsetting the make-and-break apparatus, which, of course, would be the case if the core were used as the electro-magnet. Personally, I prefer the sliding brass tube arrangement as described at No. 1,121, p. 52. See also my new book "Elect. Inst. for Amateurs."—S. BOTTONE.

[64664.—**Magneto Machine Sparks.**—TO MR. BOTTONE.—With the ordinary form of contact breaker these sparks are always seen more or less.—S. BOTTONE.

[64665.]—**Fireproof Floor.**—If such a thing is in existence, "W." will find sectional drawings in the sheet of girders issued on application by Measure Bros., of London, or possibly any other large dealer in rolled joists, as they are usually constructed from these.—T. C., Bristol.

[64666.]—**Joining Thick Wood.**—Groove and tongue the meeting edges, and clamp them together while you screw the top down to the legs.—J. H.

[64666.]—**Joining Thick Wood.**—Shoot these true, and plough a groove in each for tongues. You must now bore two ⅜in. or ½in. holes right through all, and bolt together with ⅜in. or ½in. bolts right through. Of course, you will sink heads and nuts flush.—T. C., Bristol.

[64666.]—**Joining Thick Wood.**—You should groove your boards on the edges that join, and glue in a tongue piece. That is to say, cut a piece of wood 6ft. long, 1½in. wide, and ½in. thick, then take the boards one at a time, and with a plough groove them so as to allow the strip of wood to go half in, glue well, and leave the bench top in a clamp to dry.—LEWIS.

[64666.]—**Carpenter's Bench.**—If "Amateur" has not begun his bench I should advise him to frame his legs first by letting two crosspieces into them, one piece level with the top and one about 6in. up from the bottom, keeping the legs the width of the top; he will then have the means of holding the top together. Put a dowel in the centre of joint to keep the top steady, then nail or screw them to the frame, keeping the heads well below the level of top, after which nail a board on each side flush with top for strength, and plane off level.—BANCO.

[64667.]—**Compound.**—The exhaust pipe of each cylinder is connected to steam chest of next, and last exhaust to condenser—that is all.—T. C., Bristol.

[64667.]—**Compound.**—In a triple-expansion engine the steam passes out of the high-pressure cylinder by the exhaust port as usual; then enters the slide-valve chest of second cylinder, where it is distributed to either end of cylinder by the slide-valve; it then passes out through the exhaust port into the valve-chest of third cylinder. But receivers are necessary between the cylinders when the cranks are not opposite each other; when opposite, no receivers are necessary.—T. W. B.

[64668.]—**Shock Coil.**—You should say the size of your batteries, and whether they are the porous-pot or agglomerate form. If you will let me have these particulars, I will tell you what to do.—CHAS. PROVIS.

[64668.]—**Shock Coil.**—TO MR. BOTTONE.—Will you kindly refer to No. 1,121, p. 52, of the "E.M."; or to my new book, "Electrical Instruments for Amateurs"? If you can get neither, ask again, and I will repeat instructions.—S. BOTTONE.

[64668.]—**Shock Coil.**—Here is a description of a coil which I made, and find it works very well. Outside dimensions of bobbin are—length, 4½in.; width, 1½in.; width of core, ⅝in. The primary circuit consists of two layers of No. 18 s.c. wire with three layers of paraffined paper over it; then the secondary of 18 layers of No. 36 s.c. wire with a sheet of paraffined tissue paper between each layer (this wire weighed about 5oz.); over the outside of the secondary were several sheets of paraffined paper, and then a piece of cloth glued on to finish it. The free ends of the primary are led through the end of the bobbin, and the secondary through the other end. The core is an iron rod ⅝in. in diameter, and the break is of the ordinary vibrating pattern. It has a condenser of fifty sheets of tinfoil 4in. by 2in., which greatly improves the effect of the shock; but it is very seldom that a shock coil is fitted with a condenser, and I do not think you will require one. It is regulated by a brass tube sliding over the iron core, and with one small bichromate cell will easily "curl up" three men. I should not advise you to use Leclanché cells for coil work, because they are not very satisfactory. The constant bichromate would be much better, but if you carry it about build a case for it and a battery, and use a good single-cell bichromate. I have found this to be the best battery of any—that is, for convenience and portability.—PRINCIPIA.

[64675.]—**Reversing Gear.**—It is best to have a movable eccentric on the crank shaft, held in position by a screw, and by simply tightening the screw the eccentric can be fixed in proper position for either forward or backward gear. By this means the requisite amount of "lead" can be obtained. It is much simpler than fitting up the link motion.—AMATEUR.

[64675.]—**Reversing Gear.**—You must have a link rocking on its centre, and with eccentric rod connected to one end. Fit a connecting-rod to end of valve spindle and connect to the block sliding in link. With the usual lever for shifting the block to one end of link or other you can reverse; or eccentric can be made loose on shaft to come against suitable stops for either direction. —T. C., Bristol.

[64677.]—**Cleaning Scale from Castings.**—Remove hard scale and skin from castings on grindstone when possible. Failing that, use an old file. —H. CARRICK.

[64678.]—**Blast Furnaces.**—The general composition of blast-furnace slag may be taken as $3CaOAl_2O_36SiO_2$. In practice more or less lime and alumina are replaced by other metals, as magnesia. For such an ore as Mr. Thomas mentions, the best flux would be bauxite or bog-iron ore, both of these containing considerable quantities of alumina. If we desire to calculate the amount of silica to add, from the above equation, calculate lime and magnesia to oxide, and calculate the amount of silica required to form calcium and magnesium silicate ($CaOSiO_2MgSiO_3$) respectively. The actual quantity to add in order to obtain the requisite slag will be twice this quantity, as is easily seen from the above equation. I roughly calculated that 22·2 parts SiO_2 would be required for the lime and magnesia in this particular case. Hence the actual amount to add would be 44·4 per cent. less 7·93 per cent., being the amount of silica in the ore; hence we should have to add 36·37 per cent.—CHEMIST.

UNANSWERED QUERIES.

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The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

Since our last, Chas. Provis has replied to 64257, 64274, 64[illegible]; "Trodbeck" 64257.

64[illegible]. Transferring Pat. p. 423.
64[illegible]. Magnesium Cement, 423.
64[illegible]. Metals—Physical Properties, 423.
64[illegible]. Blasting in Coal Mines, 423.
64[illegible]. Water-of-Ayr Stone, 423.
64[illegible]. Racquet Strings, 423.
64[illegible]. Pen Towers, 423.
64[illegible]. To "E. L. G." 423.

64[illegible]. Manometer, p. 517.
64[illegible]. Iron and Steel, 517.
64[illegible]. Photographing on Wood, 517.
64[illegible]. Phosphine, 518.
64[illegible]. Birds' Wings, to Preserve, 518.
64[illegible]. Cyclometer, 518.
64[illegible]. Medical Cotton, 518.
64[illegible]. Dynamos, 518.
64[illegible]. Diatoms Mounted in [illegible] Chloride, 518.
64[illegible]. Power of Solenoids, 518.
64[illegible]. Tracing Work, 518.
64[illegible]. Coloured Patent Leather, 518.
64[illegible]. Harmonic Motion, 518.
64[illegible]. Magic Lantern, 518.

THE manner in which the spruce and pine forests of Norway are being exterminated is becoming so serious that the Government is called upon to put a stop, by legislation, to the deforestation of the country. Apart from the wanton exhaustion of this commercial wealth, it is maintained that wholesale felling has the effect of changing the climate in the forest localities.

QUERIES.

◆

[64679.]—**Knife-Boards.**—Will any reader kindly say what is the best composition for covering knife-boards?—S. READ.

[64680.] — **Rags.** — Are rags imported from the Australian colonies? If so, through what English ports? —S. READ.

[64681.]—**Pit for Tender Plants.**—Will any reader kindly give a cheap method of constructing a pit for growing tender plants?—VEGETUS.

[64682.]—**Battery.**—I want to make a battery (single-fluid chromic) to give 20 amps. and two volts. I propose to use corrugated carbon rods, 11mm. diam., in three rows, with two zinc plates between. Length of carbons immersed in the fluid 5in. How many shall I want in each row, approximately, to give about the above current?—PHOTOMANIAC.

[64683.]—**Brewing.**—TO "LYDNEY DISPENSER."—Referring to your reply 64069, on Domestic Brewing, will you kindly tell me 1. What quantity of patent yeast to put, say, to each six gallons? 2. After adding yeast must the barrel be kept in a warm or cool place? 3. Does "tenth day after brewing" mean the tenth day after the liquor is put in the casks?—BEER.

[64684.]—**Ventilator.**—Will one of "ours" kindly show me how to mark out the plates (four in number) for a cowl for ventilator? Diam. of mouth 21in. and diam. of shaft 21in. A rough sketch and dimensions will oblige. Are there any books on making out such as the above, elbow pipe, and similar light plate work?—A. J. P.

[64685.]—**Cardew's Voltmeter.**—Can anyone tell me 1. How much current it takes at 100 volts? 2. Does it give trouble through breaking of the wire or recalibration? 3. Is it best to keep it always in circuit or not? 4. Does the scale commence at 10 volts or less for 120 volts maximum?—VULCANITE.

[64686.]—**Horse-power for Motors.** — Can any reader tell me what current used in what motor would give out 1H.P.? Is Dale's clutch motor, with a reciprocating armature, a success? Also the number of (1) Bichromate; (2) Leclanché cells, which would be necessary to furnish the current for, say, 10 circuits for 1H.P. What are the rules for calculating the equivalent in horse-power to an electric current given the efficiency of motor?—A. G. J.

[64687.]—**Roller for Drop Scene.**—I have to construct a bottom roller for drop scene, and as it must be 28ft., I find that it is too heavy, besides bending in the centre. I have thought that there must be some method to hollow for lightness. If any of our readers can inform me as to the best way, they will oblige.—CHROMO.

[64688.]—**Magic Squares.**—Can some one inform me whether there is any law for the construction of the alternate series of even magic squares 6^2, 10^2, 14^2, 18^2, &c., having the natural diagonals. I can trace the law for the intermediate even squares 4^2, 8^2, 12^2, 16^2, &c. Also for the odd squares 3^2, 5^2, 7^2, &c.—W. T. P.

[64689.]—**Leclanche Cells.**—I have two batteries and find, when I couple them as described in your issue of Feb. 3, that the result is not equal to the two zincs joined and the two carbons, one wire connected to the zincs and the other to the carbons? What I wish to know is, Is there any advantage in coupling them as first described? If, so, what? Is there any loss by connecting zinc and zinc, carbon and carbon?—W. W. D.

[64690.]—**Electro-Magnet.**—TO MR. BOTTONE.—I want an electro-magnet of the following proportions (5½in. long—i.e., from the top of bend to the end of poles, 1in. diam., and 2in. between the poles), to lift the heaviest weight possible, using only three Bunsen cells. Would you kindly tell me the gauge of wire best suited for it? Is there any particular formula for finding the gauge for electro-magnets?—ANXIOUS.

[64691.]—**Portable Gas-Making Machine.**—I am constructing a portable gas-making machine, but cannot get my blower or fan to give a steady and continuous blast of air. It is made exactly like a gas-meter drum, working with a barrel, cord, and weight. The blower makes two revolutions to one of the barrel. I have a small holder to equalise the pressure. When I set it going the blower fills the holder up, and then stops, and won't start again until holder is right down. I have tried all ways to get it to work by balancing the holder and regulating the weights; but to no purpose. Would some kind brother-reader help me in the matter? Is the blower constructed properly? If so, how should it be made?—METER MAKER.

[64692.]—**Pepper Decorticating.**—Being a large consumer and grinder of white pepper and wishing to decorticate, dress, and grind it from the original black pea, would any practical reader kindly give a few hints as to the decorticating process, and the machinery employed? Also the preparing of the corns previous to decorticating. Cooley, in his "Encyclopedia," says that "Steeping the black peas in a solution of common salt until the outside skins are soft, then rubbing them off in the hand." This hand process would be costly, and I wish the process employed by the large grinders of pepper by machinery.—ST. MUNGO.

[64693.]—**Hardening Bicycle Springs.** — Will some kind reader who has had any experience in the hardening of bicycle springs kindly inform me of the best way to harden Arab cradle spring?—SUBSCRIBER.

[64694.]—**Piston.**—I want to pack my piston of 1in. bore cylinder, 1½ stroke, so as to stand 60lb. pressure without breaking. Will anyone oblige by telling me what packing to use and also what power I shall get out of it? —ROSE.

[64695.]—**Steel Bronzing Gas Fittings.**—I am a brass-finisher by trade, and have got a lot of gas-fittings to steel bronze. Have tried with the usual bronze, corrosive sublimate and vinegar, and pale gold lacquer. They come out brown, not like steel. Will some of your correspondents kindly say how it is done?—JOHN TOON.

[64696.]—**Biunial Lantern.**—I am thinking of making a biunial lantern. Would any of your readers give me the size of the inside of the lining, which will be of tin? How is the mahogany fixed to the same, and what space to allow between for ventilation? Any other hints which would be useful, or can I get a book with drawings to scale?—LANTERN.

[64697.]—**Raising Air to High Temperatures.**—Can any of "ours" suggest to me a plan by which I can heat alone 2 cubic feet of air per minute to a temperature of 1,000° F.? I have applied to several shops more likely to have apparatus suitable for this object, but without avail. A rough sketch of something likely to meet my requirements would much oblige.—HOT BLAST.

[64698.]—**Heat.**—Can some of "ours" tell me the calculated heat of the earth at, say, every 500 miles from surface to centre? Also is the centre supposed to be liquid, gaseous, or what?—PRINCIPIA.

[64699.]—**Soap-Bubbles.**—Will any of "ours" give me the composition of a mixture for blowing soap-bubbles? I believe it contains glycerine.—PRINCIPIA.

[64700.]—**Spectroscope.**—Can any reader explain the internal arrangement of the pocket spectroscopes, which consist of a single short straight tube? How are the rays of light made to leave the spectroscope in the same straight line as they enter it? Is it done by means of a mirror?—E. G. H.

[64701.]—**Chiretta.**—I have derived much benefit in health from the use of a cold infusion of chiretta, as recommended by your correspondent "Eos" some time since, and should feel much obliged if some of your correspondents would tell me how to prepare this infusion in such a manner that it would keep, so as to be ready when it might be wanted. If in a somewhat concentrated form it would be better.—J. B.

[64702.]—**Six's Thermometer.**—For ten years I have had one in good order, but last summer a change took place in the reading of one side. If the minimum side reads 32, the maximum now reads 30½, and this difference of 1½ keeps on all the way up. Compared with other thermometers the maximum side reads correctly, and there is no appearance of injury. Can it be put right?—SIMONIDES.

[64703.]—**Varnish.**—Can gelatine or isinglass be prepared in any way, so as to be soft and flexible when dry, and at the same time waterproof? How is the brilliant flexible varnish prepared that is put on one side of calico? It is used very much for lining tobacco pouches, and can be cracked by bending and has a gloss like best copal varnish? What is the best way of preparing a quick-drying indiarubber varnish?—A. T.

[64704.]—**Sulphuretted Hydrogen.**—I shall be greatly obliged if any of your readers will tell me how to make a simple and cheap apparatus for generating sulphuretted hydrogen gas. A saturated solution made in the ordinary Woulff's bottles soon becomes worthless, and I want some self-acting contrivance that will generate H_2S without having to pour away the acid from the metallic sulphide when this gas is not required. Does Kipp's apparatus do this? About five weeks since one of your correspondents gave a method for making carburetted hydrogen on the principle to which I refer, but will it apply equally well to sulphuretted hydrogen?—R. CLEGG.

[64705.]—**Turkish Bath.**—I have one on what may be called the radiating principle with firepot or grill in the centre for holding the fire, and a circular skin outside this, both for conveying the smoke to its pipe, and allowing the heat to be transmitted into the chamber. I find the last skin I have had put on has been Belgian sheet-iron of the thickness of 5-10 millimètres of an inch. My former skin of same thickness, about 35 minutes after the fire was lit, on its entire upper surface was red from the heat, and gave a temperature from 160° to 200° Fahr. This last skin with same firing can only give, after more than an hour's good stoking, a temperature of 155° Fahr. Can anyone advise as to the use of French sheet-iron, or would thin steel, if used, allow the heat to be transmitted through it to red heat? I believe Belgian sheet-iron is made with wood to give it ductility. French with coal.—T. H. W.

[64706.]—**Carbon Transmitter.**—I have a transmitter which works admirably from third story of building to basement, and when I interpose 70yds. of No. 8 s.c. wire no appreciable difference is detected either in loudness of speech or articulation (using 1 pint Leclanché cell). But having run about 50yds. of the same wire out of doors, from my house to a neighbour's across the street, it would only transmit message for the most part in whispers. Will any correspondent say why the difference arises in the two cases? The weather was fine, and the atmosphere seemed free from moisture. I used the water tap for the return wire. Assuming that the instruments were well-made, what battery power would be required to transmit speech intelligently over the following length of wire respectively, using earth for return—1 mile, 5 miles, 10 miles, 20 miles, 50 miles, 100 miles, 500 miles.—W. R.

[64707.]—**Lalande and Chaperon's Cast-Iron Cells.**—Would some reader kindly tell me what ingredients to use? Also the quantity required to form a solution for the above. Mine are 2½in. diam., 4½in. deep inside.—MAZMETH.

[64708.]—**Boiler.**—Would any kind reader or engineer tell me full details of a steam cooking boiler, whether tubular or flat bottom, and what the chain arrangement is for on the top of the boiler? Also are they filled with an injector, as I was asked by a friend and could not tell him. —STAPLE.

[64709.] — **Bicycles.** — Will some practical cycle mechanic inform a novice how to straighten a dropped handle bar, which is bent; how to straighten a bent crank; how to straighten a twisted backbone, and how to true a buckled tangent wheel having hollow rims? Please avoid as much as possible technical phrases.—ORDINARY 53in.

[64710.]—**To Lay Ivory on Ebony.**—Can any kind friend tell me the best substance to stick ivory on the edge of an ebony box? I have tried all sorts of glue, but it will not hold, damp or a knock soon knocks it off.—HAMILTON.

[64711.]—**Engine.**—Would "T. C., Bristol" be kind enough to help me? I am making an engine with a cylinder 2in. by 3½in. The ports cast in are ½in. inlet and ¾in. exhaust. In such an engine is it advisable to cut off before the end of stroke? If so, please give the and throw of eccentric to effect this. If not much would you give the size of boiler, pressure, er of revolutions to develop about ½ horse?— LED.

—**Filling up Ends of Grain of Pine-** I have considerable difficulty in making the ends in of pine-wood look well when varnished with nish. The boards are well shot by a shooting but after the varnish is applied the grain seems ain and appears rough. Can any of our readers good filling-in material that I can varnish and er, and that would have a good surface? It imple and cheap to apply, as a large quantity of to be done.—YESALLAW.

—**Gas-Engine.**—I have a ½H.P. non-com as-engine, which I have been making into a on engine. It has now a 4in. crank and a 6½in. Gas and air are drawn into the cylinder through are hole and ignited by a red-hot tube, kept to by a Bunsen burner. When gas is turned on t ignites regular, but has very little power, and is turned on more I get 180 revs. per minute; s not ignite only every other time, and has then e power to drive anything. The gas and air s compressed into one-third? What sized holes nt in valve for air and gas, and why do I not power from it, as what I have seen of other on engines I ought to get double the power as er principle?—G. G.

—**Dynamo.**—Would some kind electrical ase inform me what number of lamps could be the following dynamo? The machine is of the bbin pattern, introduced a short time ago by ennedy, of Glasgow, and is built up of cast-iron in. thick. Best soft Scotch pig-iron will be les and magnet waist all in one piece in each nd built up to form a magnet with a waist 3½in. d poles 1½in. thick in the arch over the armature. ture is of the Pacinotti pattern, 4in. diam., and e face, and wound in 20 sections. It is also built st-iron laminæ, 3-16in. thick, and ⅛in. radial core. The magnet waist is 4in. long, and is th 1,104 turns of No. 20 B.W.G.c. wire in coils ers deep for convenience of coupling up for purposes, as series, shunt, or compound winding. ion of the armature to be wound with 19ft. of W.G. c. wire. Would you please say if the above what current I should get from it? At how lutions should I drive, and what power would What voltage lamps should I require? Should o use the same machine for plating, or should I other armature wound with thicker wire? I . Thompson's book on "Dynamo Machinery," but nderstand the equations.—AMATEUR ELEC-

—**American Organ.**—I am purposing to ; but am in want of some information, and shall if "Organon" or some such able instructor will ist me. The proposed instrument when, com- be two manuals, great and swell, containing ay, about six sets of reeds, and also pedal organ I have a short description of an American organ which I propose making—viz., one full (5 octv.) and one full (5 octv.) set diapason reeds, and ch of the following—viz., Principal, dulciana, violetta, cremona, gamba, bourdon, and delicante vox humana, &c. Not being acquainted with) names of some of them, and also not wishing ce until I am clearer on some points, I append stions. 1. What tone should each set possess? sets would combine best in the swell and great? hat note should the respective half-sets start? reeds would it be best to use? 5. Can anyone better combination? I want one set in swell soft. I have "Organon's" account of "How to ," in Vol. XXVI. Of course tube boards and be purchased, as suggested therein. One manual ished first, completing the remainder *ad lib.*—

—**Air Chest.**—Can you or some of your corre- give me a little information on the following? air chest 15in. by 12in. by 11in., in which works by 7in. by 3in., oval-shaped and loaded till it bout 1in. of free board without any pressure in I would like to know what occurs on getting 5lb. of pressure in the chest and tank. Will ire of air gradually force the float on a level water, when it would be difficult to sink it d the float remain passive, the water gradually r it? Or will the float still retain the inch free- keep rising in proportion to the water, until pressure was up, say, from 15lb. to 20lb.? I to know how the float acts after the top is n. The water comes in slowly at the bottom.— VE.

—**Private Tutor.**—Would any of your readers kindly say if there is an opening in the which he lives (North of England preferred) for tutor or "coach" in elementary mathematics, g, and science generally, especially with re- "Intermediate" examinations, and the engineer- ls of colleges, Cooper's Hill College, &c. In- would be given in surveying, levelling, and ngineering work, computing, &c., by the querist, had considerable experience in these matters, —AN ASSOC.MEMB.I.C.E.

—**Faulty Loco.**—I have a locomotive which work right. I think one of the slide-valves is he right-hand valve is open to lead in forward ard gear when crank is on dead centres. The when in backward gear, and crank on dead in the middle, overlapping the ports ⅛in. each forward gear all the lap is at one side—that side one which would require steam first. Both alike. Parts, eccentrics, and eccentric rods are The eccentrics are cast two together.—THISTLE.

—**Winter Electric Machine.**—I am e of the above with a 24in. plate, and shall be one who has had practical experience in the give me a hint as to the best size, &c., of ring best results. I have made one same diameter ⅛in. thick with a ½in. hole running through, in which I thought of placing a ⅜in. iron ring. Will this be likely to give a good result? For a conductor I have a 5in. brass ball with a 2in. ball projecting, both well polished. Can I do better than this? I am insulating the plate with glass axis and ebonite supports. What length of spark ought I to get?—G. H. D.

[64720.]—**Podura.**—At p. 497, of the vol. just completed, a sketch of the Podura is given. I have never seen anything like it, and should be glad to know where the creature is to be found. Hitherto I have taken for the Podura a such fish-like insect with silvery scales and three hair-like appendages projecting from its tail, which I have on rare occasions found in an old box, or perhaps in damp places, and I have supposed that its scales which come off in abundance when it is touched, were the true microscopic test objects.—I. C.

[64721.]—**Crystallisation.**—Will some chemical reader oblige? I have to keep a piece of cloth in a saturated solution of sulphate of soda, but do not want the crystals to form on it. Are there any chemical means of treating the cloth or solution to prevent this, or of precipitating the crystals other than on the cloth, or of retarding crystallisation?—ONE IN A FIX.

[64722.]—**Iron Casting.**—Will some reader kindly say best way to mould and cast rings or tires for mortar mills in a small foundry, without crane or top box? Can it be made in open sand? If so, would it be better to put sand cakes over top edge and put weights on them? Tires to be about 4ft. diam., 15in. wide, 1½in. thick.—CONSTANT SUBSCRIBER.

[64723.]—**Vanishing Lady.**—Can anyone tell me the way to make a canopy for vanishing lady? Is it same as the cabinet trick, only using curtains for the three sides instead of wood? Rods are erected and curtains are put up by audience who remain round canopy. Lady seated on ordinary chair inside, curtains closed and raised in few seconds, when lady has disappeared. She also reappears at pleasure.—B. B.

[64724.]—**Bronzing.**—I have some copper electrotypes, and am desirous to stain them the usual green one so often sees on figures, &c. Can any reader kindly give instructions how this bronzing is done, and how the lighter green lines are produced in the undercut parts, &c.?—S. W.

[64725.]—**Brothers and Sisters-in-Law.**—I wish to ask if, by the death of a man's wife, or the death of a woman's husband, the relationship as to brother-in-law, or sister-in-law, or mother-in-law is maintained after death or is dissolved thereby.—INQUIRER.

[64726.]—**Stamping-out Bells.**—I want to make a good stamped bell. I have tried several lots of soft steel, but I find I cannot get a good sound out of them. Could any kind reader tell me what kind of steel or other substance I could get to make a good sounding bell?—R. H.

[64627.]—**How to Make Caustic Potash.**—I shall be much obliged to any reader who will kindly oblige by telling me how to make caustic potash on a small scale at home, in crystals? Where I am I find it dear to buy.—ARMOURER.

[64728.]—**L. and S.W.R. Single Expresses.**—Could any of your readers kindly inform me if there still exists any of these locomotives on this line? They are single expresses, Mr. Beattie's type, built 1855. Driving wheel 6ft. 6in. diam., Duke class?—C. F. G. M.

[64729.]—**Shiny Brown Leather.**—I have some brown leather gaiters, and should like to know how to go about giving them the shiny appearance such as the black shiny gaiters and bags.—SHINEY.

[64730.]—**Photometry.**—Will any fellow-reader give me some idea as to how I may estimate the c.p. of a lamp? I have two, an Argand and a Duplex. I want to find out which is the more powerful of the two.—ESSEX.

[64731.]—**Brilliantine.**—Can anyone tell me how to make brilliantine for the hair? It is not a proprietary preparation, but a sort of cosmetique which imparts a gloss to the hair and keeps it in position?—POOR BARBER.

[64732.]—**Telescope Object-Glass for Photography.**—Would a 1½in. good achro. telescope object-glass, 15in. focus, make a good landscape lens? If so, for what sized picture, and how about a 3in. ditto?—NEVA.

[64733.]—**Incombustible Black Pigment.**—Can any of your numerous readers tell me of a non-combustible black pigment, or the name of a black pigment that will stand a great heat?—T. ALLEYNE.

[64734.]—**Racing of Engines.**—Will some practical reader kindly say whether, when the engines of a screw steamer begin to race, the ship is always at the same angle from the horizontal, or whether it depends on the length of the waves at the time?—APPRENTICE.

[64735.]—**Lightning.**—Please inform me of the latest and most effective method of imitating lightning in a dramatic representation of a storm scene, either sheet or forked lightning?—GROT.

[64736.]—**Differential Calculus.**—$y = f(x)$ the equation to a curve; y_1 the ordinate of the curve corresponding to the abscissa $x + h$; y_2 the correspponding ordinate to the tangent at the point (x, y); then, $y_1 = f(x + h) = f(x) + h f^1(x) + \frac{h^2}{2} f''(x + \theta h)$ $y_2 = f(x) + h f^1(x)$. How is the value of y_2 obtained? Has the equation to the tangent at (x, y) anything to do with it, and if so, how?—G. C.

[64737.]—**Pharmacy.**—I took a prescription given me by my medical man to a druggist to be made up. In the prescription was an "infusion" of something. The mixture was made up in about 10 minutes, and in the margin of the prescription the druggist wrote opposite to the supposed "infusion" thus:—*v/g*. What did this mean? Was there any "infusion" in the mixture as made up?—G. C.

[64738.]—**Storage Battery.**—To MR. BOTTONE OR OTHERS.—I have referred to the answer to the query, No. 63875, in No. 1,186, of the "E. M.," but do not quite understand from that how to make up one for a 5c.p. incandescent lamp; so if Mr. Bottone could condense the article he mentioned before and get it published, he would greatly oblige.—AMATEUR.

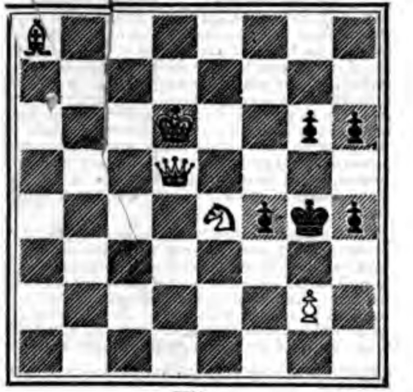
[64739.]—**Soft Type-Metal.**—I want a type-metal, rather soft, to bend round cylinder without f[illegible]r of breaking—TYPICAL.

CHESS.

ALL communications for this department must be addressed to J. PIERCE, Langley House, Dorking.

PROBLEM MLXXXVI.—BY F. J. HOWITT.

Black.



White. [5 + 5

White to play and mate in two moves.

SOLUTION TO 1,084.

White.	*Black.*
1. Kt-Kt 4.	1. Kt takes Kt-P (*a*).
2. Kt (Kt 4)-Q 5.	2. Anything.
3. Q or Kt mates.	
	(*a*) Kt-K 6 (ch) (*b*).
2. K-Kt sq, &c.	
	(*b*) Kt takes B-P (c).
2. P takes Kt, &c.	
	(*c*) Q moves.
2. Kt takes B or Q accordingly, &c.	

NOTICES TO CORRESPONDENTS.

CORRECT solutions to 1,084 by Link (very good; several near solutions).

SOLUTIONS to 1,085 acknowledged next week.

QUILTER.—If in 1,084, 1. R takes Q, B takes R, 2. Kt-Q 4, P-Q 4 and white cannot mate next move.

J. KILBEE.—We doubt very much if 1,084 can be done in any of the four ways you suggest. Will you send all the variations, and point out how you proceed if after 1. P-Q Kt 3, R takes R; after 1. P takes Q, Kt-K 6 (ch), 2. Kt takes Kt, P takes R; after 1. R takes R, Kt-K 6 (ch), 2. Kt takes Kt, B-Q B sq; after 1. K-K sq, R takes R?

H. M. ACKERY.—If in 1,084, 1. Kt-K sq, Kt takes Kt P. You seem to have overlooked this defence.

A DEAN.—If in 1,084 1. Kt-Q 4, R takes R, 2. Q-K 2 (ch), K-B 5, or if 2. Kt-Q B 4 (ch), Q takes Kt (ch).

A. BOLUS.—Thanks for the problem. Very acceptable.

LINK AND J. BRYDEN.—Names entered for Tourney.

THE *Norwich Mercury* is about to start a chess column under able editorship. Address, Chess Editor, 45, London-street, Norwich.

THE *Sheffield Independent* announces a Problem Tourney in two and three-movers. Book prizes. Every competitor may send in two problems of each class any time up to the 31st inst.

THE same column announces also one of their highly popular Solution Tourneys to commence on the 31st. inst, in which a number of prizes including oil paintings are offered.

THE Northampton Chess Club beat the Birmingham Club on the 16th inst., by six games to five.

IN the Canadian Chess Association Tournament, the first prize, a Trophy Cup valued at £24, was won a second time by Mr. N. Macleod, aged 16. The cup now becomes the property of the youthful victor.

THERE will be an International Problem Tournament open to all composers in connection with the B.C. Congress at Bradford.

IN the Ladies' Handicap Tournament at Brighton on the 24th and 25th ult., Miss Joynes won the first prize, and Mrs. Dunhill the second. There were eleven entries.

CAPTAIN MACKENZIE is expected in England early in July, in anticipation of the Congress at Bradford.

A CHESS Tourney will be one feature of the Melbourne Centennial Exhibition.

Antipyrin in Whooping-Cough.—Sonnenberger has tried antipyrin in seventy cases of whooping-cough, and with very satisfactory results. In young infants it should be administered three times a day in doses of half a grain to a grain and a half; and in older children each dose of the drug may be increased up to fifteen grains. A little syrup of orange, raspberry, or tolu forms a suitable medium for the drug, which must be taken systematically lest the amelioration should not continue.

A WORK on a large scale, called "The Picturesque Atlas of Australia," in three large folios, is expected from Sydney shortly. It has cost £70,000, the engravers and the machinery having been imported from the United States. Dr. Garran, M.L.C., the editor of the *Sydney Morning Herald*, has furnished the letterpress.

ANSWERS TO CORRESPONDEN[illegible]

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*** *All communications should be addressed to the* [illegible] *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and p[illegible] for illustrations on separate pieces of paper. [illegible] to queries, and when answering queries put [illegible] as well as the titles of the queries to which [illegible] refer. 3. No charge is made for inserting le[illegible] or replies. 4. Letters or queries asking fo[illegible] of manufacturers or correspondents, or where [illegible] other articles can be purchased, or replies giving [illegible] information, cannot be inserted except as advert[illegible] No question asking for educational or scie[illegible] tion is answered through the post. 6. Lett[illegible] correspondents, under cover to the Editor, a[illegible] forwarded, and the names of correspondents are [illegible] given to inquirers.

*** Attention is especially drawn t[illegible] N: 4. The space devoted to letters, queries, and [illegible] is scant for the general good, and it is not fair to [illegible] it with questions such as are indicated above, wh[illegible] only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "[illegible]penny Sale Column" offers a cheap means of [illegible] such information, and we trust our readers will [illegible] themselves of it.

The following are the initials, &c. of le[illegible] to hand up to Wednesday evening, March 7 [illegible] acknowledged elsewhere :—

F. PEARSON.—A. and B. Vagniez.—W. J. Roberts.—R. Mosse.—Soc. of Tel. Engineers.—London Lathe and Tool Co.—H. Hewlitt.—F. J. N.—Amateur.—A New Subscriber.—R. L. Driver.—M. J. Smith.—R. R. N.—J. R. G.—I. N. Cognita.—W. Robinson.—Dr. F. Terby.—Wood.—R. W. M.—Engine.—E. T.—A. M. M. A.—R. W. T.—C. Provis.—Bijli.—F. Caws.—J. H. Schucht.

WEBSTER. (Why "involve" yourself in a discussion of the kind? Surely there are plenty of textbooks at low prices if you cannot refer to back volumes. If your opponent says the textbooks are wrong, let him revise them. We do not understand why you should think we have nothing better to do than to reply to questions about elementary facts, the answers to which are to be found in cheap manuals. The present generation has an enormous advantage compared with the generation fifty years ago.)—EDWARD NORRIS. (What result did you expect? All that can be done by primary batteries was stated in our columns some years ago by "Sigma," and in his work "Electricity," &c. (E. and F. N. Spon), you will find the principles and the elementary facts upon which you can work. If you want more information than has been given of the battery mentioned, we must refer you to the Patent Office, where the specification should set out its features in detail.)—ELECTRICAL ENGINEER. (By getting employment in practical work, we presume. We know of no other method.)—INVALID. (It will have to be a powerful magnet, and therefore, expensive. 2. The matter is the other way about. It would be a discovery, indeed, if you could find some substance that would isolate the magnet. It can be prevented from moving by friction, but a magnet free to turn will always take up a position in line with the magnetic poles, unless compelled to turn by means of a current or a more powerful magnet.)—FRICATOR. (The amalgam should be of mercury and tin, with zinc added, and only sufficiently hard to act as lubricant. See indices or the textbooks. There are various recipes.)—A. B. (All sorts of statements are made in popular magazines; but oxygen is cheap now, though the price depends on the quantity. The Brins Company will send you their prices on application.)—NOVICE. (One of the best of lubricants for all rubbing surfaces is blacklead (or plumbago) mixed with washed hog's lard—that is, the lard is washed by pouring on it hot water, allowing it to get cool, then lifting off the fat, and giving another dose of hot water. A very little goes a long way for cycle chains.)—B. (The directions for making rubber-stamps have been repeated many times. The rubber must be masticated and mixed with sulphur (it is generally bought already prepared). The mould is, as a rule, taken in plaster of Paris, and the rubber is pressed in and "cured" at the same time by such pressure and heat as can be obtained in a vulcaniser. They can be made by screwing the rubber and mould between iron plates while they are being heated over a gas-jet. See indices.)—TWISTER. (The question is altogether against the rules; but no doubt some of our advertisers can supply you.)—PISCINE. (Do not understand you. Why should you want some one to advise you "how to turn amateur," or where to "procure an inexpensive article suitable for the purpose." Your question seems to have something to do with an aquarium fountain. If so, you will find descriptions and illustrations in Nos. 402, 405, 459, 582, 801, 967, 973, 974.)—R. W. M. (The answer has been frequently given. You can stick brass rims to glass vessels with plaster of Paris (freshly burned) mixed with alum water, or with melted alum, or with silicate of soda.)—A. T. C. H. (Culpeper's book will perhaps suit you as a herbalist. Any bookseller can procure that.)—JOHN WHITAKER. (Try David Nutt, Strand, W.C.; Trubner and Co., Ludgate-hill, E.C.; or Williams and Norgate, Henrietta-street, Covent-garden.)—BIT BAT. (Try E. and F. N. Spon, 125, Strand; but perhaps you want the Pharmacopœia.)—SICILIEN. (See indices for various remedies. Try the effect of soaking with benzoline first, and then with strong solution of soda mixed with whiting, polishing off when dry.)—MACHINE MINDER. (Simply because in passing from the liquid to the gaseous state it absorbs heat from anything surrounding it. See indices. The air-compressing machines are in most favour nowadays, for should the ammonia escape it is rather more pungent than pleasant.)—OBSERVER. (Many things have been recommended in back vols.—rubbing over with beeswax in No. 1168, p. 566; but the best thing is to have the iron pot, copper, or boiler thoroughly galvanised.)—SNOW. (Approximately a foot of snow is equal to an inch of rain.)—NOVICE. (If you are making a Wimshurst Influence Machine, you are presumably making it from some instructions; but *where did* you get the idea that it was worked by an accumulator, or that it would "generate power to work a small lathe, or light a small incandescent lamp"?)—[illegible]. P. H. G. (It has been frequently stated in our columns that chromic-acid cells are about the best that can be used for incandescent lamps; but a battery of Leclanchés will do for such momentary work as illuminating a clock to see the time. Please see indices, including that to be published next week. 2. See advertisement columns.)—PHOTO. (Mount with starch paste in the ordinary way.)

A Small Rupture is sometimes more dangerous than a large one, as the smaller the aperture the greater the danger of strangulation. Certain relief and ultimate cure may now be obtained by adopting Mr. C. B. Harness' new treatment. Call and consult him to-day, if possible, at the Electropathic Establishment of the Medical Battery Company, Limited, 52, Oxford Street, London, W. (corner of Rathbone Place). Don't suffer any longer, but note only address, and call and see Mr. Harness at once, who will examine you carefully free of charge.

The Work Lost to England.—Some ingenious soul with a turn for tables of statistics might draw up a singularly valuable and interesting paper on the work lost to England through adverse foreign tariffs and insular foolishness. In the heyday of our prosperity, when wealth rolled in like a flood, British manufacturers were too prone to present a stiff lip to any strangers who suggested a new pattern or a novel style. It was largely through this shortsightedness that the United States manufacturers obtained command of the Australian markets, as well as the West, in axes, adzes, saws, spades, forks, and other tools and appliances which English makers, after adversity had suffered the scales to drop from their eyes, set themselves to imitate. That they re-conquered so many lost markets was exceedingly creditable to their stubborn determination not to be beaten. There is no feeling the way now. No longer is the colonist told he must take the tools English makers think best for him. The drift is all the other way. English firms invite the colonists to suggest changes and improvements, and send representatives to take their ideas at first hand. Foreign tariffs are now the difficulty, though foreign labour, long and cheap, is also a factor in the fight. Nottingham firms have stockings and lace made in Saxony and Germany; Stockport has its "Silent" gas-engines made in Ghent; Deepcar (Fox and Co.) its paragon frames made in France; and so the list might be extended. Our warehouses are full of German nippers and other German and American hardware, while English artisans walk moodily about the streets, or try, as at Sheffield, with bleeding and blistered hands, to level themselves down from handicraftsmen to labourers and stone-breakers at 8d. a day. Who is to be the man to solve the problem of the unemployed—to win back the lost industries of the land, and to widen the sphere of labour for those who earn a living more by the skill than the strength of their hands.—*Engineer.*

Lighthouse Illuminants.—Mr. John R. Wigham, M.R.I.A., recently delivered a lecture on "Lighthouse Illuminants" to the Belfast Natural History and Philosophical Society. The great gas lighthouse lights with which Mr. Wigham's name is identified, especially those which have been recently erected at Mew Island in Belfast Lough and at Tory Island, were exhibited in actual operation, and compared with the oil lamps used in lighthouses, and also with the electric light, which was also in operation. Mr. Wigham also explained several new inventions of his connected with lighthouse illumination which presented features of much interest. One of these was for a light of equal intensity to the electric light, but combining great volume with its intensity, and, furthermore, having in itself that predominance of red and yellow rays which renders it suitable for penetrating fog. Mr. Wigham also exhibited a perfectly new method of illuminating lighthouses which he called a fourth illuminant. This plan consists of supplying air under pressure to lighthouse lamps, so as to surround the flame with a cylinder of air and do away with chimney glasses, and thus avoid a serious element of expense and danger.

Population and Area.—Some comparative tables of the population and area of the various countries of the world, taking them with their dependencies, appear in the "Statesman's Year Book." In point of area the British Empire stands at the head of the list, the number of thousands of square miles being 9,339, Russia following closely with 8,644. China, with her 401 millions, tops all the countries of the earth in population. The British Empire comes next with 307, and Russia with only 104 millions; while France has but 71, the United States 58, and the German Empire 48. While the United Kingdom has since 1800 risen from 16¼ to 37 millions, Russia in Europe from 35 to 88 millions, and the German Empire from 27 to 47 millions (including Alsace and Lorraine), France has only advanced from 33 to 38¼ millions. It is estimated that between 1810 and 1870 the entire population of the world about doubled—the figures being 682 millions at the former and 1,391 millions at the latter period.

A MODEL FACTORY
IN
A MODEL CITY.

IF WE MAY TRUST A VERY EULOGISTIC description, written by Mr. John Swinton, the town of Waltham, in Massachusetts, must be one of the most attractive places in the world. Not only does it charm by the beauty of its position, and of its arrangements, but it affords to the student of sociology a wonderful example of what a factory may be. There are other model factories both on this and on the other side of the Atlantic; and they are said to be generally so successful that it is strange that their systems are not more frequently copied. Is it that the *auri sacra fames*, the desire to become rich quickly, blinds men to all that does not tend immediately to this end?

The town, or as the Americans say, city of Waltham, now contains some 16,000 inhabitants. It owes its existence and growth almost entirely to the famous Waltham Watch Company, which established itself there some thirty-five years ago, and which now employs directly nearly one-sixth of the whole population. The Company owns a large quantity of land in and about the town, and has devoted a very handsome proportion of this property to the use of its work-people and of the public as parks and gardens. At the present moment the Mayor and about half of the Board of Aldermen are operatives in the factory. 1,350 men and 1,121 women make up the total of 2,471 workers. Of these rather more than a half of the men and about one-fifth of the women are married, the latter being in almost all cases wives of men in the factory. No persons are employed under the age of sixteen. It is a remarkable fact that, although there are no excluding regulations, all the workpeople are of American birth except about 120, and of these many come from the British-American provinces, and are therefore not quite foreigners. The wages of the men vary from about £2 to £6 per week, those of the women average about half of the men's rates. Men and women are paid alike for the same work, and the apparent inequality is due to the fact that there is a far larger proportion of inexperienced hands among the workers of the fair sex, and that they also cease to work early in life. Taking the whole number of operatives, the average weekly earnings of a man are a little over £3, those of a woman a little over £1 10s. In all parts of the work where it is possible (in three-fourths of the whole), the system of piece-work prevails. Our English mechanics will admire these rates of payment; but they should observe that they are not earned without real hard work. The daily hours of work are ten, except on Saturday, when they are only one hour less, making in all fifty-nine hours weekly.

It is is superfluous to speak of the work produced, because it is quite certain that American ingenuity, backed by ample capital, will always win a first place at least in the mechanical arts. The Company claims to have made and issued over three millions of watches since its establishment; and for some years past its annual output has been more than 350,000.

The social life of the workers in this great factory is guided rather than governed by the Company's Chiefs; and it is only fair to say that it shows many signs of a broad and public-spirited intention. The Company administers a boarding-house for women, and another for men, at both of which very moderate rates are charged; but all the operatives are perfectly free to live elsewhere if they prefer it. A very large number of the married workers live in houses of their own, bought or built out of their savings, to which the Company frequently adds by loan or by guarantee of continuous employment. The Company, it should be said, makes it a policy to encourage their workers to become their own landlords; and it also gives generous support to the "Co-operative Loan Society," the "Mutual Relief Association," and to the various literary and athletic clubs which the employés have formed. It treats all difficulties with, or among the workpeople with readiness, with fairness, with generosity; and, as a consequence, there has never been a strike in the factory during its 35 years of life. Mr. Robbins, the present Director of the place, holds the wise and great opinion that the large outlay in beautifying the site, in short, that all outlay that tends to content and to cheer the workers, is wise even from an economic point of view.

Under such admirable conditions of life, in a beautiful and healthy situation, it is not wonderful that a wholesome spirit of independence is developed; and with self-respect there will always be found a good moral tone. The relations of the sexes in this vast establishment are excellent. Drunkenness is almost unknown. The death-rate is very low. In a word, Waltham is a pattern of order and prosperity.

The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, MARCH 16, 1888.

EXTRACTS FROM BERGERON.—II.

Method of Turning—To Turn a Cylinder.

A CYLINDER well turned is the most simple and, at the same time, the most difficult of all the pieces that are made in the lathe. It is the primary one of all the articles which can be produced by its means, although it is the only piece on which it is necessary to guide the chisel perfectly, to keep the determined size, and to judge accurately of the quantity cut away, so as to equalise it perfectly with the gouge in order that nothing may remain but to reduce it to a level surface with the chisel. It is at this point, then, that we ought to start, and this which we shall always set before beginners.

A man of means purchases a complete lathe. He adds to it an oval and an eccentric chuck; sometimes also a Rose engine. He thinks he can make a tobacco-box, carve it, &c., because he has seen it done. To put him back to turn a simple cylinder between centres, and to repeat this operation many times, is to condemn him to what is most tiresome. But skill is not to be bought: it must be acquired, and we do not hesitate to assure our readers who will put up with this "ennui," and will not proceed to other work until they have succeeded with this first, that they will have the satisfaction of succeeding with all they may subsequently undertake.

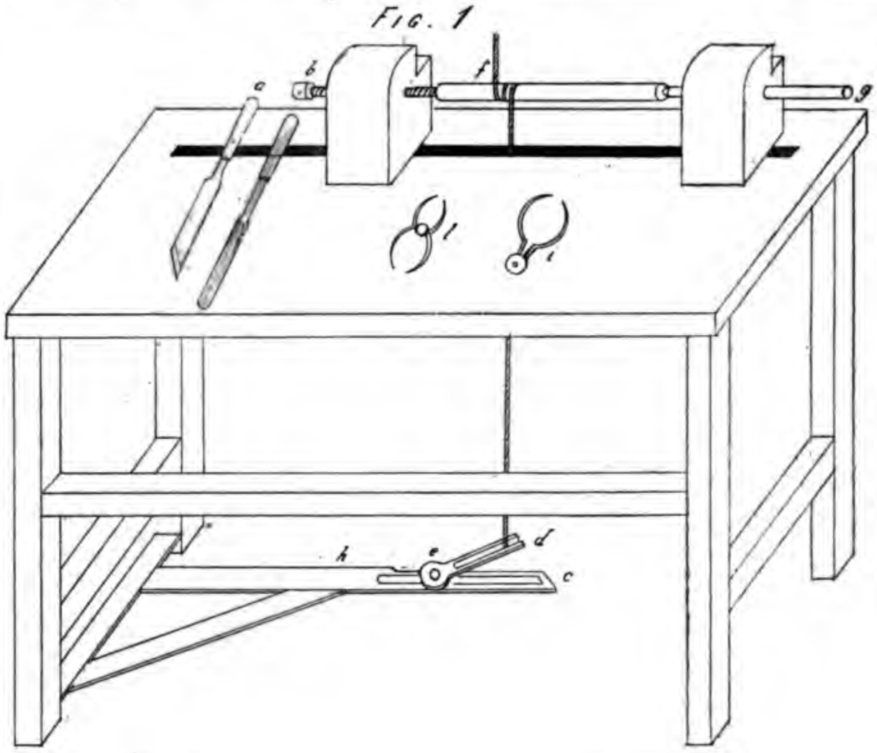
To mount the prepared work in the lathe the left-hand poppet must first be securely fixed by passing through the bow of the clamping screw the end of a lever, which should always be at hand, and which serves to advance and withdraw the centre point of which we shall speak. (It is understood that every screw is advanced by turning it from left to right, and is unscrewed by the contrary motion.)

We say nothing here of the method that used to be adopted to fix the poppets upon the lathe bed by means of wooden wedges which enter a mortise cut in the tenon of the poppets, and of which the turners of common work still make use. This method occasions considerable noise, and a concussion which is communicated to the whole house.

Moreover, when the bed is a very wide one, it is very difficult to loosen the wedge, because it is necessary to stoop down, and with a mallet or sledge-hammer to strike the smaller end, which is on the further side of the lathe-bed; in place of which ordinary turners, having for a lathe-bed only a pair of simple cheeks formed of two planks mounted upon footed standards, and which does not give a width of more than 10 or 12in., can easily loosen the wedges either from the front or back without stooping, by forming them so as to project on both sides.

When, then, the left-hand poppet is sufficiently firmly secured, the right-hand poppet must be brought up almost to the distance determined by the length of the cylinder it is desired to turn, and it must be fixed at that place as securely as the other. Then, putting the point of the lever into one of the holes, *a*, Fig. 1, Plate I., which are on the head of the centre screw *b* of the right-hand poppet, the bit of wood is mounted in the lathe by making the centres enter the holes left by the compasses when the circle was traced at each end, and the centre screws are advanced so that the two enter the wood each to the depth of about two lines. The cord is then to be made to take a couple of turns round the cylinder from left to right, so that the cord in its ascent and descent may be opposite to the workman. By this arrangement, when the foot is placed upon the treadle or foot-board, the wood will turn so as to meet the tool. A drop of oil must be put on each centre to reduce the friction.

FIG. 1



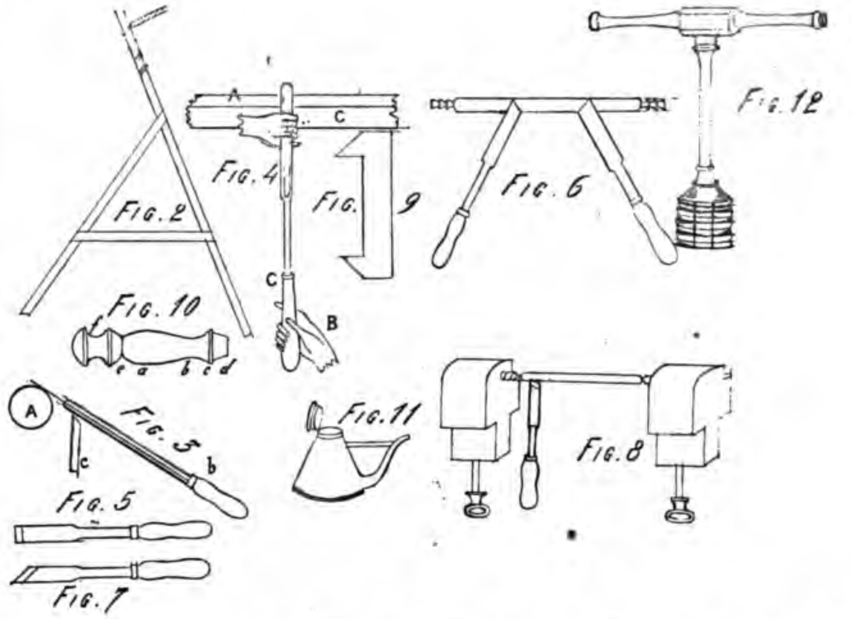


FIG. 2

FIG. 4

FIG. 9

FIG. 6

FIG. 12

FIG. 10

FIG. 3

FIG. 5

FIG. 11

FIG. 8

FIG. 7

It is always necessary to have at hand, when turning, an oil-can (Fig. 11) so as to be able to put a drop of oil upon each point. This can ought to be of conical form with a large base, that it may not be upset. It should have a hinged cover, so that the chips which the gouge sends flying on all sides may not drop into the oil. It is necessary, not for the lathe only, but also for every kind of work, and for the tool needed by it, to employ the best olive oil. Every other kind thickens in the oil-can or the collars of the mandrel, the axles of the fly-wheels, and even dries on the oilstone and prevents it from sharpening to a keen edge the chisels and other tools.

It is seldom that the cord is found of adequate length for the work to make a sufficient number of revolutions between the height to which the treadle is carried by the elasticity of the pole and the time when it touches the ground. A little practice will soon determine at what point it is necessary to fix it.

The perch can frequently be replaced by a bow placed in the following manner. At the two extremities of the lathe-bed two columns or two pillars are erected, which can be fluted to improve their appearance. Two arms fixed at the top of these pillars carry a cross-bar, on which slides a bearing of wood or brass, which sustains the middle of the bow.

These bows are constructed in many ways. Some are of steel and in one piece, of which the two ends are united by four cords which pass through a wooden reel. That kind has the inconvenience of being too slack when at rest, and too stiff when strained. Its use, moreover, is now almost abandoned, and it is replaced by a bow made of three or four deal laths placed flatwise, below which are small brass rollers to render the motion more uniform and smooth, and at the end of which a cord is fixed, stretched to form a spring equivalent to that of the perch. On this cord is a small pulley with a hook underneath, on to which the loop of the lathe-cord is coupled. When, by the descent of the treadle, the cord is pulled down, the pulley necessarily goes to the lowest point, and is always in a line with lathe mandrel and treadle, whether one is turning on a chuck lathe or on one with dead centres; and as it is frequently necessary to carry the cord towards the right or left, which is effected by pushing the perch along the bar, the same effect is obtained by shifting the suspension box of the bow to the right or left. By this device the cord is always perpendicular to the lathe-bed. These laths are also made of steel nicely tempered and very thin, similar to those which compose the C springs of carriages, and whose elasticity is well known. But the bows made of plates of deal are preferable; their elasticity is of as yielding a character as that of the pole, and yet at the same time is sufficiently decided. Lastly, a pole may be used constructed in the same way of many very thin plates of deal of increasing lengths, the shortest being below.

If a steel bow is used with a bobbin, the first turn of the bobbin is too weak; it is necessary, however, that the treadle at its highest degree of elevation receive a slight resistance from the spring, and in order to increase it the cord must be sufficiently shortened for the treadle to be drawn somewhat higher when it is left to itself, and, for this purpose the bobbin must retain nearly one turn when the treadle is at its highest point.

By this plan, when turning, an equal resistance will be felt during the entire descent of the treadle. But if we render the commencement of the unrolling of the bobbin a little too hard, it will become infinitely more so by the time the treadle arrives near the ground, and in addition to the fatigue that the turner will feel, the work will also show it. The motion must be easy, without being too weak or too severe.

Generally the treadle forms a kind of λ, or Greek "l," terminated by a cross-bar, the whole soundly framed up by tenons and mortises. It is fixed at the bottom of the standard by hinges. One end of the treadle bar, which moves parallel to the space between the bed, is wrapped round with a quantity of the cord of which we have just spoken, so that it may not need to be so often removed, and in order to shorten or lengthen the cord as occasion may require, it is sufficient to give it fewer or more turns.

Sometimes also—and this method is exceedingly ingenious and more convenient—the bar has in one portion of its length a groove, C, six or eight lines in width. Into this groove a square bolt is passed which almost fits it, and of which the somewhat large head is below. The remainder of the bolt is cut with a screw-thread, and on this part is fitted a piece of any sound wood, such as walnut, service, beech, or any other, d, from four to six inches in length, of the width of the treadle, and from nine to ten lines thick. This is secured by a wing-nut, which can be screwed or unscrewed at pleasure. The other end of this piece is forked lengthwise for about two inches to receive the cord, which, by this means, cannot escape or shift from the place where it is intended to be; and if it is desired to carry the cord more to the right of the piece that is being turned, the nut e is unscrewed and the movable piece is shifted on the treadle, so that the cord shall hang perpendicularly from that spot on the work at which it is desired to place it; otherwise it is evident that this cord, being always drawn towards the left by the end of the treadle, would not remain on the part of the work more to the right at which it was required to be.

It is seen by Fig. 1 that the foot-board or treadle is not a right line, but is slightly bent towards the extremity where the groove is. It is thus arranged in order that the cord may pass into the interval of the lathe-bed as it comes down from the top of the piece that is being turned without rubbing against the bearers, as the part c is perpendicularly in a line with the said interval. This method is specially useful, since without removing from the bed the mandrel headstock which may be there, one can turn between centres, which compels one to place the poppets towards the right hand. But in that case it is better that the bow shall be capable of sliding to the right or left on the bar which is carried by two brackets of wood or iron, such as we have described above.

Some people, instead of a treadle attached to the standards, of which the given length cannot be great, use a bar of deal of very straight grain, and about 5ft. in length, 4in. wide, and ten lines thick, which they place where they please, and pass from the right foot to the left, according to need. By this plan it is possible to turn at any part of the length of the lathe without having to shift the cord if it is not on the work.

This bar is slotted at one end to allow the cord to pass, and this arrangement is, moreover, very convenient for lengthening or shortening it, according to need, by turning the bar over either side up.

To lessen the noise which this treadle makes in the room below, each end is cut into two rounded bevels, and a double band of felt is attached at that part by wire tacks. Turners of common articles use a treadle of the form of a letter A (Fig. 2, plate I.), one of the legs of which is prolonged upwards, and round the end of which they wrap the cord; but as this A is but 18in. or 2ft. long, it is the radius of too small a circle, and is not very well adapted for giving to the piece that is being turned several revolutions. Nothing is simpler than the construction of this A. Each of the three bars which compose it is mounted by a half-lap joint, and fixed by nails clenched below. O. J. L.

IGNITING APPARATUS FOR GAS-ENGINES.

THE arrangements for exploding the mixture of gas and air in gas-engines have long exercised the ingenuity of inventors, and although fairly satisfactory devices have been made, it is well known that there is much room for improvement. In the annexed engravings we illustrate the invention of the Gas Motoren Fabrik Deutz, of Deutz on the Rhine, patented in this country by C. D. Abel on behalf of the company. The apparatus consists of a slide that is pressed against a slide face of the cylinder by means of a loose cover acted on by springs, and is worked by suitable gearing from the engine shaft, such slide being provided with ports and passages arranged and operated as described by the aid of the figures, in which Fig. 1 shows a horizontal section of the apparatus at the moment of igniting the cylinder charge; Fig. 2 shows an end elevation, Fig. 3 a view of the inner face of the slide, Fig. 3^a a cross section on line X X, Fig. 3, and Fig. 4 the same view as Fig. 1 with the slide at its extreme left-hand position. m is part of the gas-motor engine provided with a slide face and an igniting port, a, the ports and devices for admitting the combustible charge into the cylinder not being shown, these being of any suitable known construction; n is the igniting slide, and o is the slide cover pressed against the slide by springs, p. The slide n has on its inner face a recessed groove, b, communicating by a small aperture, c, with a chamber, d, having a narrow annular aperture, d^1, opening into one end of a passage, e, the other end of which communicates by two opposite side openings, e^1 e^2, with the outer air when the slide is in the position Fig. 4. Thus, as the slide moves from the position Fig. 4 towards the left, a portion of the compressed combustible charge will pass from the cylinder through port a, channel b, and opening c, into chamber d, whence it issues through aperture d^1 into passage e, and in escaping through the opening e^1 it becomes ignited by the stationary gas flame at f. By means of the restricted area of the channel b and openings c and d^1, the pressure of the gases become considerably reduced on its way from the cylinder to the passage e, so that the gas issues with only slight pressure from the opening d^1. The flame at e^1 will burn slowly backwards into the passage e, and will then continue to burn as an annular jet from the orifice d^1. The striking back of the flame into the passage e is facilitated by the opposite positions of the openings e^1 e^2. As the slide moves to the left, the flame in e will continue to be fed from the cylinder through the channel b, and at a certain point of this motion the openings e^1 e^2 will be covered by the cylinder and slide cover, so that e will become a closed space. In order to allow of the escape of the products of combustion from the flame at d^1 under these circumstances, a channel i in the slide establishes a communication between e and a passage, k, leading to a chamber, l, that communicates with the outer air by a cock, g. The flame thus continues to burn in e until the slide arrives at the position Fig. 1, in which the communication between a and the chamber d is just about to close, and the igniting port is just about to be put in communication with the flame at d^1 by the passage h so as to fire the cylinder charge.

Fig. 2.

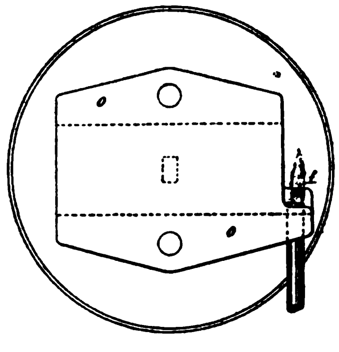


Fig. 3^a.

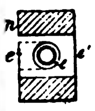


Fig. 3.

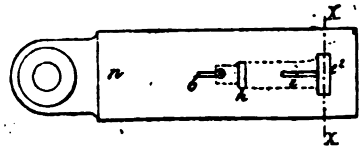


Fig. 1.

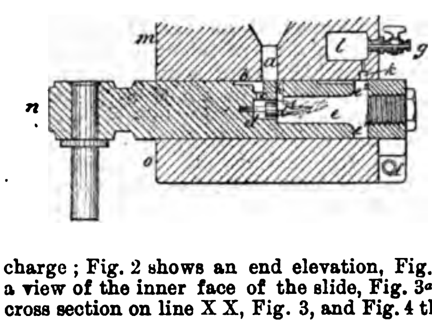


Fig. 4.

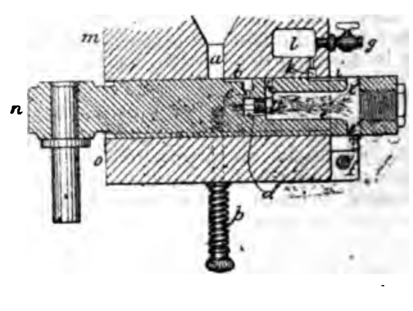


FIG. 1.

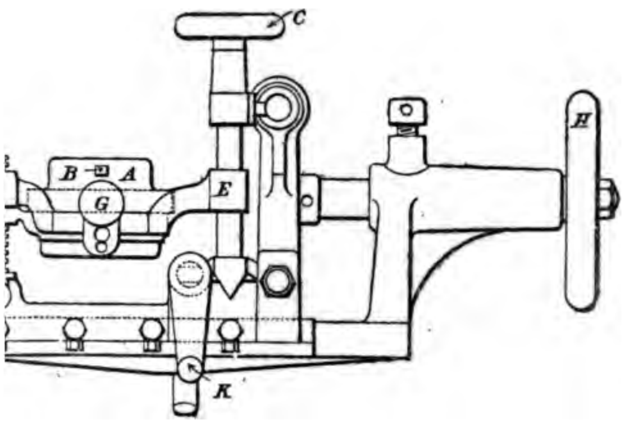
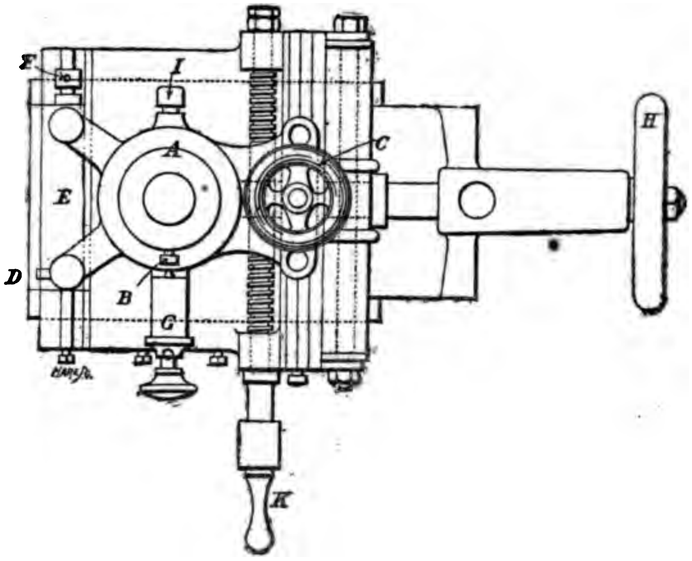


FIG. 2.



RITANNIA CO.'S MILLING MACHINE.

annexed engravings illustrate in detail he Greatorex patented apparatus for in the lathe, made by the Britannia Co., e following directions will suffice to the capabilities of the appliances:— apparatus (shown in Figs. 1 and 2) on he-bed at a convenient distance from the ck of the lathe, the cutter being already lace. There must, of course, be a suit- uck to hold the work. It is convenient w out the reducing socket the same size bore chuck of the lathe, and so utilise he chucks when desirable. For larger t is better to make the chuck to fit the ng socket (A, Figs. 1 and 2). Now for ity we will suppose we have a hexagon shape up: A tool is fixed in the drill chuck lathe, and the object to be milled screwed g chuck fitting the reducing socket, or olving socket (A, Figs. 1 and 2), as the y be, the reducing socket or chuck being d by the screw bolt B; it is then ad- by the wheel C of the vertical slide, to uisite height—i.e., the centre of the ss of the object to be milled should be the height of the centre of the tool. p the running nut D (Fig. 1) to support le E, and fasten the set-screw F (Fig. 2). e that the spindle of the spring catch G s with the requisite series of division In this case it will be the series of -four holes, and taking every fourth ives the six sides required. The cut now be set by the wheel H of the hori- slide, and the socket A secured by the w I. Now traverse the work by the K, but be sure not to let the work come e cutter until the lathe is working at a e. Set the cut to the gauge by taking uantities off two opposite sides of the to be shaped, and the cut thus set com- he hexagon. It will be seen at a glance illing is performed by merely substi- a drill for the cutter, and the adjustment d by the vertical wheel C (Fig. 1) and dle K (Fig. 2), the feed being given by izontal wheel H (Figs. 1 and 2).

two processes represent the principle hich an endless variety of ornamental hard wood or metal can be executed, ting edge of the tool being turned to uired pattern, always remembering, if k is concave, to turn the tool convex; on, with reference to mouldings and r sunk forms, and with perforations for designs and coronas for lids, and the nethods of ornamenting turned work, l only by the taste of the operator. fixing the combination chuck in the (A, Fig. 3) of the apparatus, see that bolt (B, Figs. 1 and 2) faces the head- the lathe, also that the spring catch is f the division holes, and the set-bolt I tightened; the chuck can then be to the socket A, Figs. 1 and 2, by the B.

ill now suppose a tap is to be fluted. Place the tap between the centres (C, Figs. 4 and 5), securing it by the clamps B, tightening up by the screw D. A round-nose tool (Fig. 4) is used, and the centre line of the tap adjusted to the centre of the tool; or if the tap is a little below the centre of the tool, it gives a more decided cutting edge, thus J (one size tool will do several sizes of taps). Engage the spring catch (E, Fig. 4) with the requisite series of division holes in disc K, and traverse the tap to the tool by the handle K, Fig. 2, until the flute is the required depth, then set it by the division holes for the next groove, and so on, until the job is completed.

FIG. 3.

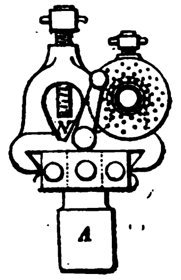
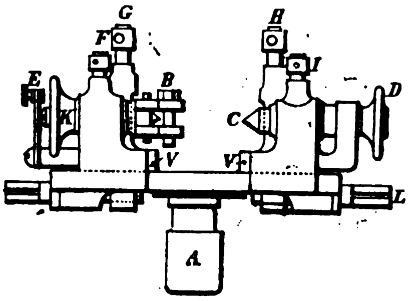
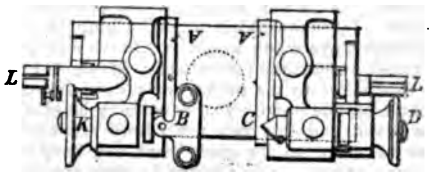


FIG. 4.



We will now suppose a slot is to be cut in a rod. Place the rod in the V gap (Fig. 4), fasten down by the screws G, H; use a suitable tool. It is best to drill a hole at the two extremes of the length of the slot required. Let the centre line of the rod be exactly opposite the centre of the tool; then traverse as in fluting. To use the chuck as a vice, remove the clamps (B, Figs. 4 and 5) by withdrawing the screws, and then objects can be gripped for shaping, drilling, boring, or any other operation within the range of the apparatus. A small cylinder can be gripped in the vice and bored with accuracy by following the lines already given; but it is not well to stop until the cut is through.

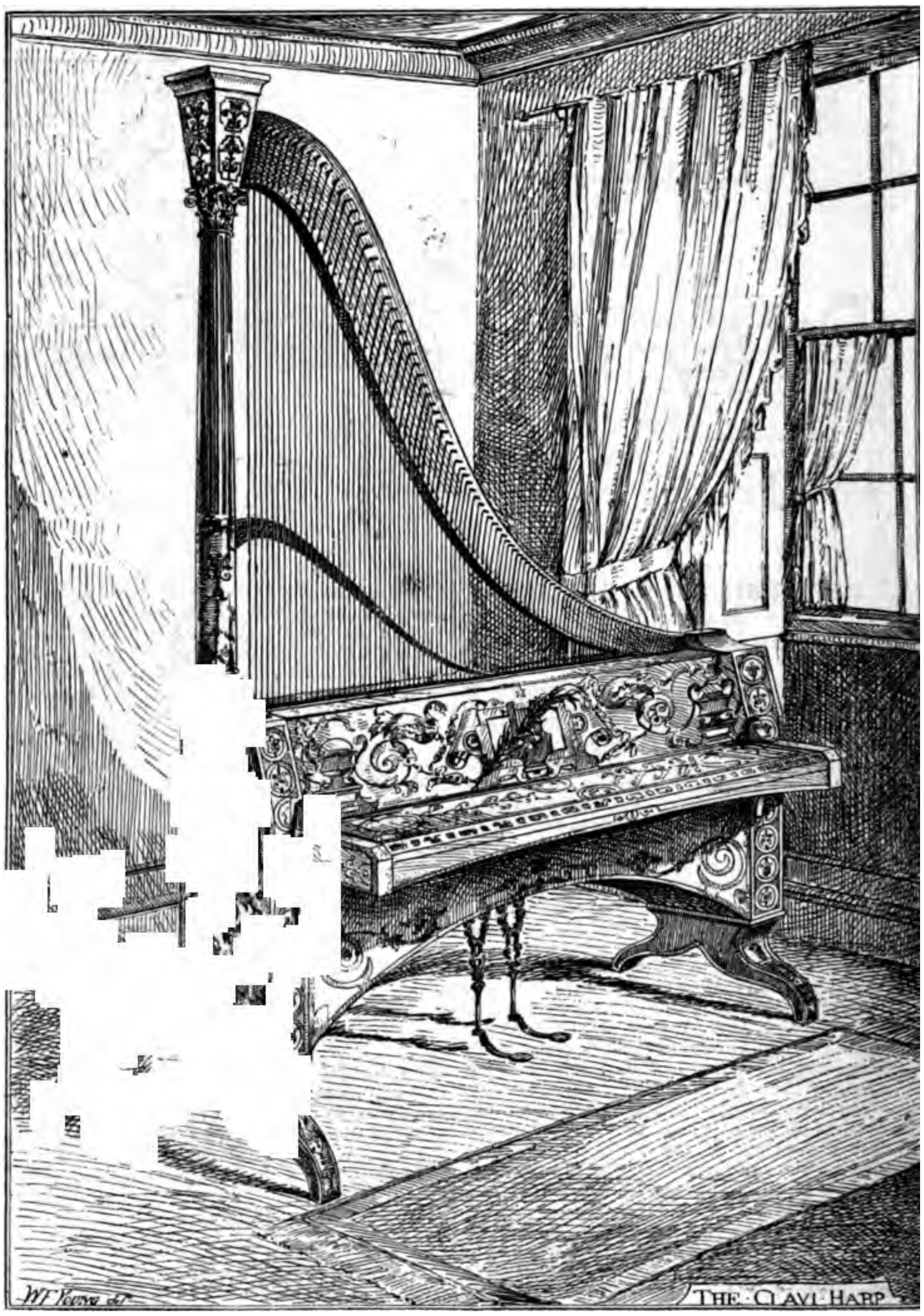
FIG. 5.



The remarks already offered concerning ornamental work apply even more forcibly to the use of the combination chuck.

THE DOTY GAS-FLAME LAMP.

AN exhibition of Capt. Doty's gas-flame lamp, or retort burner light, was held last week in one of the large sheds of Messrs. Braby's works at Deptford in the presence of a numerous company. Capt. Doty will be remembered as the inventor of perhaps the most economical lamp for burning paraffin oil, and also as the designer of the apparatus which rendered possible the use of mineral oil in lighthouse lanterns; and now he will be known as the inventor of a portable lamp in which high illuminating power is obtained by converting the oil into gas and producing a large flame on little consumption of oil. At present the lamp, which is secured by patent, is made in three sizes, the reservoirs being respectively of a capacity of 14, 17, and 20 gallons. These reservoirs are strongly made in galvanised iron, and a portion of the "capacity" is occupied by an air-reservoir and an air-pump, the oil being forced up to the burner by compressed air. The 20-gallon, or No. 3 size, is a cylindrical tank 18in. in diameter by 24in. high, fitted with handles, so that it can be readily carried from place to place. From the centre of the top rises a tube, coiled in the form of a spiral, or rather more like a "sofa spring," with the convolutions close together. At the bottom is a small tray to hold asbestos, cotton, tow, or other material which is, at starting, supplied with oil from a little branch-pipe. A metal screen is placed around the coil of pipe, and a light being applied to the material in the tray, a flame rises in the centre of the spiral tube, which is rapidly heated, and the oil which is forced round the convolutions up to the top, and then brought down near the bottom, where it issues from a small hole in the shape of gas, is consumed in a flame of from 2ft. to 3ft. in height, perfectly free from smoke, and, owing to its great area, giving the full luminous value due to the oil, which may be paraffin, kerosene, or Russian—in fact any ordinary burning oil of the truly liquid series. The time occupied in causing the oil to vaporise will vary with the conditions; but the time specified in the descriptive circular of the Doty Lighting and Heating Corporation (five minutes) is ample—two minutes will suffice. Once started, the flame itself keeps the coil hot enough to vaporise the oil, and the lamp continues to burn without more attention than is implied by giving a few strokes of the air-pump at intervals of about a couple of hours. The cycle of operations is briefly as follows: The reservoir is charged with oil; the air-pump is then worked until the pressure gauge fitted on the reservoir shows, say, 15lb. on the square inch; a little "wick" material is placed in the tray, and the tap of the branch pipe turned so as to supply it with oil, which is ignited, and the metallic screen is placed round the spiral. In a couple of minutes, or, say, five, the hydrocarbon in the coil begins to vaporise, and, issuing as gas, a brilliant flame rises up, giving a light of about 500 candle-power for a consumption of about three-quarters of a gallon of oil per hour. From the commencement of charging to the production of the gas-flame need not occupy more than ten minutes, while the apparatus being self-contained and portable, its utility is at once apparent—notably, for contractors, railway yards, shipbuilding, and other works, building operations generally, and for lighting any places of large area at the shortest notice. One great advantage is that the light can be placed where it is wanted; it also requires attention only at intervals of two or three hours, and can be used for heating as well as lighting. For fixed lights there is no necessity for the air-pump, and at Messrs. Braby's works a lamp was shown in which the oil was supplied by gravity from a tank. The portability of the Doty light is, however, its chief recommendation, and that, added to its economy, safety, and illuminating power, will commend it to the attention of all who have to carry on their operations by the aid of artificial light. We understand that Messrs. F. Braby and Co., 352—364, Euston-road, N.W., are the sole manufacturers of this "Doty Lamp," while Mr. J. R. Shearer, the secretary of the Doty Lighting and Heating Corporation, Mansion House-chambers, Queen Victoria-street, E.C., will no doubt give any information as to its possible applications.



THE CLAVI-HARP.

THE beautiful instrument which we illustrate to-day is the invention of M. Dietz, of Brussels. His grandfather was one of the first manufacturers of upright pianos, and being struck with the difficulties and defects of the harp, constructed in 1810 an instrument *à cordes pincées à clavier*—the strings connected with a keyboard. Many improvements have from time to time been made on this model, which at last arrived at the perfection exhibited in the newly-patented Clavi-harp. The difficulty of learning to play the ordinary harp, and the inherent inconveniences of the instrument, limit its use. It is furnished with catgut strings, which are affected by all the influences of temperature, and require to be frequently tuned. The necessity of playing the strings with the fingers renders it difficult to obtain equality in the sounds. It gives only the natural sounds of the diatonic gamut, and in order to obtain changes of modulation, the pedals must be employed. Harmonics and shakes are very difficult to execute on the harp, and—last, but not least—it is not provided with dampers. The external form of the Clavi-harp resembles that of the harp, and all the cords, or strings, are visible. The mechanism which produces the sound is put into motion directly a key is depressed, and acts in a similar manner to the fingers of a harpist; the strings being pulled, not struck. The Clavi-harp is free from all the objections inherent in the ordinary harp. The strings are of a peculiar metal; covered with an insulating material, which has for its object the production of sounds similar to that obtained from catgut strings, and to prevent the strings from falling out of tune. The keyboard, exactly like that of a piano, permits of playing in all keys, without the employment of pedals. The Clavi-harp has two pedals. The first, connected with the dampers, permits the playing of sustained sounds, or damping them instantaneously. The second pedal divides certain strings into two equal parts, to give the harmonic octaves; by the aid of this pedal the performer can produce ten harmonic sounds simultaneously; on the ordinary harp only four simultaneous harmonics are possible. An ordinary keyboard being the intermediary between the performer and the movement of the mechanical "fingers" which pluck the strings, perfect equality of manipulation is secured. The mechanical "fingers" instantaneously quit the strings on which they operate, and are ready for further action. The "fingers" are covered with suitable material, so that their contact with the strings takes place with the softness necessary to obtain the most beautiful tones possible.

The Clavi-harp is much lighter than the piano—so that it can easily be moved from room to room, or taken into an orchestra, by one or two persons—and is of an elegant form, favourable to artistic decoration. Sufficient will have been said to give a general idea of the new instrument.

It is undeniable that at the present day that beautiful instrument, the harp, is seldom played; still seldomer well played. This is attributable to the difficulties it presents to pupils. Its seven pedals must be employed in different ways when notes are to be raised or lowered a semitone; chromatic passages easy of execution on the piano are almost impracticable on the harp. The same may be said of the shake, and it is only after long and exclusive devotion to its study that the harp can become endurable in the hands of an amateur, or the means of furnishing a professional harpist with a moderate income. It is needless to point out how far, in these respects, the harp is surpassed by the Clavi-harp.

Vocalists who accompany themselves on the harp are forced, by the extension of their arms to reach the lower strings, and by frequent employment of their feet on the pedals, into postures and movements unfavourable to voice-production; but they can accompany themselves with ease on the Clavi-harp.

Composers are restricted in the introduction of harp passages in their orchestral scores, owing to the paucity of harpists. In some cases, composers have written harp passages beyond the possibility of execution by a single harpist, and the difficulty and cost of providing two harpists have been inevitable. These difficulties will disappear, and composers may give full play to their inspirations, when the harp is displaced by the Clavi-harp.

AN END OF THE ALKALI-WASTE NUISANCE.

AN ancient and most serious nuisance seems at last destined to extinction. Many of our readers are familiar with, and not a few have suffered from, the foul emanations emitted from the vast piles of alkali waste, or vat waste, as it is often called, which surround some of the great alkali works of the country. The nuisance dates from 1823, when the ingenious process of Leblanc, the French apothecary who made so many millionaires, and who died himself in a French workhouse, was first adopted in England. This process, which is still extensively used, although of late it has suffered from a formidable rivalry, consists in

THE MANUFACTURE OF CHLORIDE OF SULPHUR.

THE monochloride of sulphur is a reddish yellow liquid, fuming strongly in the air, and is decomposed by water into sulphur, sulphurous acid, and hydrochloric acid. Its specific gravity is 1·68 (136° Tw.), and it boils at 139° C. It dissolves sulphur readily, and is largely employed for the vulcanisation of indiarubber, and for the manufacture of indiarubber substitute. Most works on chemistry, even those of more recent date, tell us how chloride of sulphur *may be* prepared, but few save poor neglected Gmelin tell us how it actually is made. There is no need for bringing the sulphur in the state of vapour in contact with dry chlorine gas, as is usually mentioned; the operation is much more simple. The articles required are *dry* flowers of sulphur and *dry* chlorine gas. Roughly, it may be taken that flowers of sulphur will absorb their own weight of chlorine gas, so that to make, say, 150 grammes of chloride of sulphur we should require :—

Peroxide of manganese (70 per cent.)	150	grammes
Muriatic acid (30° Tw.)..................	600	"
Flowers of sulphur (in excess)	90	"

In the laboratory the operation may be carried out as follows: Lightly fill a Wolff's bottle with flowers of sulphur (90 grammes), fitted with a tube reaching nearly to the bottom of the bottle, and connect the outlet with another bottle of sulphur fitted similarly. Now evolve the chlorine slowly from the mixture of manganese peroxide and muriatic acid, and after passing it through a cooling tube to deposit as much water and vapour of hydrochloric acid as possible, dry it thoroughly by passing it through a cylinder filled with coke moistened with strong sulphuric acid (sp. gr. 1·845). This dry chlorine must now be turned through the sulphur contained in the Wolff's bottles, standing by preference in iced water to keep the contents cool. The chlorine is rapidly absorbed by the sulphur, which becomes liquefied as the absorption proceeds, and when the whole contents of the first bottle have become liquefied the operation may be stopped, and the contents set aside for purification.

The liquid obtained by this method is sometimes sold as such to the indiarubber manufacturers; but as it contains a very large quantity of free sulphur dissolved in it, it has in times gone by caused much annoyance to the manufacturer by producing an objectionable "bloom" on some descriptions of waterproofed goods; it has therefore become customary to distil it, and so to free it from dissolved sulphur. This is done in a large glass retort heated either by a large "rose burner" or by a naked fire, the former being the preferable method. In the laboratory this operation is easily performed, but in the works and on the large scale it requires more care. In manufacturing this substance on the large scale, the operations may be strictly conducted on the foregoing lines, and it will be seen that the construction of the plant presents no new difficulties to the chemical engineer.—*Chemical Trades Journal.*

DR. RICHARDSON ON IDEAL FOOD.[*]

A SERIES of six lectures was commenced on Friday evening, March 2, at the Memorial Hall, Farringdon-street, E.C., by Dr. B. W. Richardson, F.R.S., on Ideal Foods, "with an eye to the practical." The first lecture was entitled "The Study of Foods for Natural and National Utility and Progress."

Dr. Richardson observed that we had reached a period in our national history when we must either sink or swim. Some were of opinion that those steering the national ship would carry us safely through all troubles and dangers; and, indeed, if we were to judge of the real importance of so-called politics by the space and time given to them, we might be led seriously to believe that out of Parliament there was no salvation. For his own part, however, he did not share in that belief; but, on the contrary, thought that, if we wanted to get out of our difficulties, people must begin to legislate out of the four walls of the two great Houses, and within the four walls of all the little houses that make up the nation. They must accept the wholesome fact that a sound policy, like sound charity, began at home. The illustrious philosopher who *did not* write Shakespeare, but who in his own immortal way wrote many things just as good, gave us a splendid truth about the extension of the light of knowledge. "We set a light," he says, "to one tiny torch of knowledge, and then light other torches at that one, and so the light spreads until all are alight." They were about to study the question of foods—how, as a nation, they should live naturally and rationally. If there was a question of vital moment, that was the question of questions, for England at least. He would use no words calculated to excite the slightest alarm, but put it to them, as plain, common-sense people, what would be the condition of this vast metropolis to-morrow if, by some chance, the supplies of food which came to them from foreign sources, and which kept them some three weeks from famine, were for a single week to become imperilled? What would they do? They need not actually run short of food to insure a panic; the mere rumour of such an event would be sufficient to create a rush and a tumult such as had scarcely, if ever, been surpassed. The word "Ideal" would be observed on the prospectus; but there was no need for alarm at that term. It was not intended thereby to convey that these discourses were to be of a dreamy character—not at all. There was always some good in the ideal; and the ideal at present in view he knew to be good, and it was not at all remote or strange. It was an easy ideal, to be realised without much difficulty, and carried out in any English home. The invitation for those lectures sprang from a particular centre—from those who were deeply interested in the progress of the vegetarian movement. Well, they knew all about them! They were an aggressive, enthusiastic, and determined body, who would give no peace till the merits of the cause they represented were heard through the length and breadth of the land. But that fact need not appal the flesh-eaters present in the slightest degree. Personally, he was not a vegetarian himself, and they might therefore trust he would extenuate nothing in favour of the vegetarian system, or aught set down in malice against the common practice of living upon animal food. Indeed, it seemed to him a bold course on the part of the members of that society to challenge an opinion on their cause from one so entirely unbiased and unprejudiced as himself. It showed, at all events, that they believed what they taught, and practised what they believed.

In commencing to speak of those parts of their possessions which they called food, and which went to form the constructive portion of their bodies, it was as strange as it was true to discover that man should for ages have lived upon these blindly, and not have found out the way to use properly the very substances on which he had been living. In ordinary mechanical pursuits man advanced with much more rapidity towards perfect knowledge than towards that knowledge which was nearest and dearest to himself. In setting their inanimate machines to their work, they looked very carefully to the fuel they put into the furnace; they were particular to the last degree not to cast in anything but what would burn steadily, clearly, and in such form as to produce the largest amount of work in the shortest possible time. They did not throw in every conceivable substance simply because it would burn. On feast days and holidays they did not treat an engine to brandy, whisky, and other such fuel in order that it might be frisky, and, in a manner peculiarly jolly to itself, knock itself and everything else into a cocked hat. (Laughter.) On the contrary, they would dismiss such an engineer, and would not allow him to drive a piece of mechanism so costly and so perfect on any pretence whatever. More than that, in constructing the bodies of their machines, the boilers, the wheels, axles, pistons, cylinders, they did not take those materials that first came to hand, but selected those substances for them that would supply the greatest possible precision; they tested and tried each part before they allowed it to be used, and employed the most skilled men as workmen, so that all should be sound and trustworthy. Yet, as a rule, they seemed to ignore all this care as applied to themselves. "I want something to eat as quickly as you can bring it, because it is for a hungry man. I don't care what it is, so long as you come quickly"—hot or cold, soft or dry—it might contain all the constituents appertaining to food essential to life, or it might contain one principle alone, and that not required. It might be specially adapted for a Polar bear dwelling on an iceberg, or a tiger living in the Equatorial jungle. It mattered not so long as it was called food, and ready at command to satisfy the immediate cravings of nature. It often gave one absolute pain to be forced to observe this utter disregard of a vital subject among those whose means were perhaps most limited and labour most exhaustive. One might see a body of men going in the early morning to their toil—they carried with them the day's supply of food. It was not intended at present to refer to the quality of that supply, whether it would adequately represent the requirements demanded by the work and necessary for the worker. That might or might not be; but mark the mode of conveyance. The food which that man carried was just as precious to him as his skin, his hand, his eye, or any other part of his organic frame, because in fact it was going to be absorbed and become the veritable substance of that frame; it was going to make and shape and form those selfsame organs, the skin, the hand, the muscles. Nay, more, it was going to perform a far nobler duty, the directing and moving of the body, as well as building it. What the man should or should not do depended upon that morsel of food. Talk about a precious thing, that was indeed precious. But mark how he treasured it and prized it; he carried it perchance tied up in a pocket-handkerchief, exposed to wet, to cold or heat, and every kind of atmospheric change, fair or foul. He reached his place of business or work, and see how he put it aside—his sustenance—into any corner, taking far more care of hat or coat than the sustenance which was to carry both. (Applause.)

In that preliminary discourse, the lecturer proposed to omit all reference to any special system of diet, and especially to point out certain broad reforms in the use of foods, without which any system, however good it might be, could not hope for any rapid success. In this light there were five great reforms with respect to foods that called for immediate attention. Social pleasure was the basis of all true reforms in the future, for pleasure had much to do with the ideal in food. Far better a dinner of herbs where love was, than the feast but hatred therewith. The first reform, leading both to the ideal and practical in the use of foods, had reference to the feast as a source of human enjoyment and luxury. This reform was not only the first, but the hardest one. A good friend of his, the Master of a City Company, told him quite lately how good-natured it was, for an ascetic like him, to go to their board—inferring, because of his simple fare, that he must necessarily be an ascetic. On this subject it was necessary to be clearly understood. As a matter of fact, nothing could be further from his mind, and his ideal, than anything approaching to asceticism; and nothing was so grand as rational and enlivening intercourse of man with man. He, further, held that every meal they sat down to eat should be a social holiday, because good conversation, interesting and enlivening, promoted digestion.

The lecturer here commented on the absurdity of relying on certain artificial provocatives to pleasure, for which there was no real need, such as intoxicating drinks, and which were all but certain to bring sorrow. They should be at one with the world in its reasonable enjoyments—eat, drink, and be merry to their heart's content—but on their own ground. This same rule extended to reform in eating as well as drinking. Eat, drink, and be merry—certainly, but let it be according to nature. Reformation in living was required in every class and rank of society. The rich man set the example of overgrown feasts, sometimes out of perverted hospitality, too often from sheer ostentation and a vulgar desire to outvie his neighbour in appearance and prodigality. The poor looked on, meanwhile, in envy and repining. "Who are these people, that they should regale on the fat of the land? Let us bear this shameful feasting and inequality no longer." Sometimes, when work was plenty and wages were high, the poor not unnaturally imitated their richer neighbours. In the year 1864 he had been making inquiries into the sanitary and social state of the town of Wolverhampton, and had been told on good authority that the colliers, who earned good wages and found provisions plentiful, were given to luxuriate in a right generous style when they had money at command, and then again living as sparingly at work as they had previously lived sumptuously at play. On asking one of these players whether he did not think an equalisation of the good things at his command would be the wisest course to follow, he did not dissent, but put the matter in a fresh light. Turning on his questioner, he asked whether he had ever been to a Lord Mayor's feast, and whether that was not the kind of meal the Lord Mayor had every day. Let the Lord Mayor set poor folks a good example, and perhaps they might follow it. Thus the whole matter was put in a new form, which he had never forgotten. The lesson ought to be taught in high places, that the choicest as well as healthiest feasts were those in which the simplest fare was supplied with the greatest refinement and elegance. He once had the opportunity of presiding at a banquet of that kind, provided by the earnest philanthropist who filled the chair there that evening; and he was free to declare that a more elegant, substantial, and satisfactory banquet he had never attended in his life before. Several hundred persons of all ages and both sexes sat down to the repast, which was such as to gratify the most refined, and at the same time the most keen appetite. The tastes were regaled with good things, the palate gratified with fruits and pleasant drinks, and the stomach satisfied also. The eye was charmed with a wealth of flowers which were spread on the table so that it looked like a garden; and all that was said and done was equally pleasant and refreshing—except, perhaps, the speeches, and even these were borne with more than usual equanimity, of itself a sufficiently good sign. He moved amongst the guests at that rational feast, and heard but one expression of unqualified praise and pleasure. "Pity poor people cannot have a dinner like this oftener, sir!" said one man. "I wonder whether Mr. Hills has a dinner like that every day, mother?" said a little girl, as they were making their way home. "Why, of course," was the response; "those rich folk can have just what they like." It showed in the most striking manner the necessity that existed for education. Those poor people, who had been specially invited to come and see what a grand dinner they could get for the smallest possible cost, went away longing that such happy feasts could be had in their humble homes, the fact possibly being that their own miserable dinners cost as much again, and afforded not a tithe of the enjoyment. He believed that the cost of that sumptuous repast was something less than 5d. per head. (Applause.)

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[*] *From the Vegetarian.*

The second reform was scarcely less important than the last named, and consisted in the prevention of waste of food. The waste of food of all kinds in the houses of the wealthy was appalling, nearly one-fourth being often sacrificed. It must be candidly admitted, in regard to animal food, apart altogether from its actual effective value, that as a source of waste it was a cause of most serious loss and extravagance. Taking, in most houses, the loss in butcher's meat and that in bread and flour, there was no comparison. The loss from bone alone was a great item, to say nothing respecting the quantity of food sent away on the bones, to become decomposed, and simply a nuisance in the locker or dustbin. "Broken victuals!" Could there be a more extravagant or more offensive term? In the ideal food of the future that term must go out altogether. There must be nothing to call for its use—there must be no such thing. No morsel must fall from the plate of one man, to lie on the plate of another man. There must be no necessity for any food so low and animal-like, so indicative of wasteful want. The necessity did not exist. That was to say, it did not under the system, at once ideal and practical, which they sought to establish. (Hear.)

The third reform had regard to the belief in animal food as a daily want, and as a matter of necessity. The ignorance on this subject was dense in the extreme. A poor woman, who came to work in his household, looked at the servants' dinner of hot animal food with ravening eyes. What a treat! What a dainty! What a luxury! She told a sad story—that for weeks she had been driven to exist upon brown bread, lentils, beans, rice, a little fruit, and a few cups of weak tea. He feared they very much pitied her, and that he and his household entered into the saddest condolence with her. (Laughter.) At the same time, one particular fact could not fail to strike them—viz., that this poor woman looked in most robust health. She seemed well nourished, had an excellent complexion, was active in work, was an excellent sleeper—"Thank God," she said, "that saved her!"—and, when she got off the burning question of her starvation, her spirits were more than commonly vigorous and lively. It was a curious fact that after a short time, when her return to the animal diet had brought contentment to her mind, she did not particularly improve in health or activity; she seemed to him to grow pallid and languid, and her good looks faded. Indeed, he was quite sure that, if there had been a prize show of middle-aged female beauty at that time (fortunately, there was not), she would have had a better chance of taking the first prize on her entering than on leaving his service. (Laughter.) This was a typical case in which the starvation of the body depended upon the starvation of the mind. The woman had faith in the one system of diet after which she craved, but had not faith in the other. It was their duty to modify this craving after animal food—to qualify it, at all events, if not reform it altogether—to educate the people to see that there were simple and pleasant forms of living, now most despised, but which were the best, as well as the cheapest. These facts were strikingly illustrated during the "cotton famine," when certain prophets predicted famine fever and every other kind of human desolation. But it was proved by elaborate figures, based upon knowledge, that there was no occasion for alarm. The people in need were furnished with abundance of wholesome vegetable food, and it was the marvel of the time how well the people kept up their strength. They were never better in their lives, affording two of the best evidences of this fact, first, in their freedom from any excessive disease, and, secondly, in a reduced death-rate, which of all others was the best test. The vegetarian who investigated the annals of this cotton famine would find some pregnant facts in connection with the subject before them.

The fourth great reform demanding attention was with reference to the utilisation of the supplies which lay at their command. To the United Kingdom this question of economy was of immense moment. By a strange fortuity, they had come to regard strong drink as food. Water formed three-fourths of their sustenance, and three-fourths, or nearly so, of their bodies. It carried the solid food into the stomach in a convenient form, and the supplies to all parts where wanted, brain, muscle, and bone, in every part of the structure. Water was food, and water was drink; therefore, drink was food; the fact could not be disputed. It was unfortunate, however, that a great portion of the so-called civilised world should suppose that another substance need be added to qualify it—a spirit, the action of which was to stimulate all vital action, and shorten life. The vegetarian movement would be of the greatest help to the temperance movement in this question of economy. It would also help the same cause in another singularly effective way. There were irresistible signs that, with a full, clear, and unperverted taste for pure food derived from the plant world, the desire for strong and stimulating drinks, by some unexplained and incomprehensible process, declined. He believed the time had come when temperance and vegetarianism should work together, in recognition of that one fact, and that the success of temperance work would be increased thereby one-third, as well as become more consolidated and secure in its results.

Coming to the last point, bearing on the study of Ideal Foods, in order to enable the nation at large to get a sound appreciation of the whole subject, it was necessary that the reform should be introduced into our system of instruction in our elementary schools. If there was one scientific subject more than another in which distinct progress had been made, it was in the subject of food. The process of digestion was now one of the best understood; the constituent parts of food were known to perfection, as also the amount of work that could be got out of any kind of food. In time the whole subject would become as an open book, which could be dealt with in our schools just as easily as reading, writing, and arithmetic.

To summarise the foregoing five reforms, they had: Reform first, of the feast, how to make the feast or festival a rational, as well as a natural, delight. Reform two, of customs, so as to prevent what was called waste, and that to such an extent that the fact of waste should never be admitted in any household. Reform three, in quantity of food, so that the body should be laden with no more than it could digest and distribute, nor be troubled by any sense of difficulty in removing what had served its purpose and required to be cast off. Reform four, of utilisation of foods, so that no article of food should be turned uselessly into toxical or intoxicating drink. Reform five, in our schools, by which the leading truths respecting food and feeding should be taught in the most simple and perfect manner, as well as the elementary branches of learning.

PRACTICAL DETAILS OF BLACKSMITHING.*

IN visiting a manufactory of monkey wrenches some time ago, I saw an arrangement for drawing out the shank, which was, in its essential points, very much the same thing as a punch press. There was a crank connection which moved the hammer head with an arbitrary motion, just so far up and down, at every revolution of the crank shaft, and the stock, placed between the dies to be worked, was forced to be reduced to such size as would permit the die to go as far as the crank would carry it, or the machine had to stop. I watched it for some time with interest. The man who was running it, who was an old hammersman, did not like it. "It rides the iron," he said. Bolt-heading machines generally work on this principle. The header, which staves up the stock, comes up just as far, and the side dies come together just so near, and the stock must yield, or the machine must take the consequences. I have seen quite a number of machines that have evidently taken the consequences.

This plan has been greatly improved upon by the later manufacturers of power hammers by interposing by various ingenious devices, springs, somewhere between the crank connection and the hammer head, so that the crank, or its equivalent eccentric, can make its revolutions, even if the resistance between the dies is too great to be overcome by the power. The spring, by this arrangement, gives, in proportion to its strength, a more or less yielding pressure.

In setting old-fashioned trip hammers, one of the objects aimed at is to make the adjustment in such a manner as to prevent the hammer die from "riding" the piece which is being worked. This means that the die is not to lay on the hot iron, but is to rise from it as soon as the full force of the blow is delivered. In welding under the hammer a little "riding" is allowable, for the same reason that a "dead" blow is sometimes called for when welding "on the anvil" pieces, which have a tendency to spring apart. The makers of the modern power hammers have generally provided for this, and the provision they have made should, with great surety, be brought to the attention of the workmen who are to run the hammers. It sometimes happens that this information is sent to their customers, who, not thinking it of any great importance, consign it to the waste basket, and the workman is left to evolve from his own inner consciousness the inventor's design. He sets about this task with a spirit of investigation, a big wrench, and a sledge hammer. Failing to compass it, he finds a world of fault, which is not in the machine itself, but in his want of information concerning it. This could be avoided easily, and with much satisfaction all round.

Even the matter of settling the countershaft at the right distance from the hammer, which any one who paid no attention to it would think of no great consequence, is a thing which the makers well know should be done right, to have the hammer work well. If they do not insist upon such points strenuously it is because they have a reluctance about doing so, lest their customers may run away with the idea that they have no use for a machine which requires to be set up and taken care of with such nicety. It is always the best way to follow, as closely as possible, the builders' directions about their machines. If they do not know about them, who does?

I think that the first machine that I ever noticed particularly, which was absolute and unyielding in its treatment of hot iron, was in Northbridge, Mass. It formed one of a system of machines for the manufacture of scythes, designed by one of the best and most original mechanics New England ever produced—Harvey Waters. The edge of a scythe is very thin in proportion to its back, and the process of thinning it naturally tends to make that side the longest, and gives the blade a curve like a sword, concave in the back. Mr. Waters' method of bending it towards the thin edge was by crimping this edge, thus contracting its length, making it shorter, on much the same plan, although for a different purpose, that more recently has been adopted to reduce the circumference of the entering end of a joint of stove pipe. The edge of the scythe blade being shortened, it became the innermost, and the back the outermost of two concentric circles, forming a circular ring, of which the blade was a sector. The whole length of this crimped scythe was put between a pair of dies in a very large and powerful press, where the crimps were strengthened by pressure, while the dies did not allow the curve to change. The surplus length was thus taken up, having been by this means "upset" or "stove up." The question was asked of Mr. Waters what he thought the effect would be if he should happen to get more between the dies than the machine could compress? The idea that the machine might break seemed not to enter his mind, he was so sure of its strength. His reply was that the belt would slip.

A manufacturer, having named a rate of speed at which a certain press of their construction should run, the question was asked him if the machine, running at that rate, would stall, or would break, in case more resistance was offered to it than it could overcome. He said the machine would stop, if its blow was not sufficient to carry it through. As it had a large balance-wheel, which revolved with sufficient momentum at a considerable speed, to keep it running a quarter of an hour after the belt was thrown off, I never felt as though I should like to try the experiment. This is a kind of experiment, however, that sometimes tries itself. I heard of its doing so with another machine of the same construction in a neighbouring shop, and the result verified the manufacturer's prediction. It stopped, without breaking.

Very powerful power presses have been used for cold pressing sewing-machine shuttles. A friend of mine related to me that he was once in a shop in Hartford, Conn., looking on to see a man doing this work. When the shuttle, just pressed, stuck to the upper die, the man did not notice it, and neglected to take it off, and put another into the right place in the lower die to receive the blow. The punch responded to the treadle and came down. There was a sound heard, as of a low, dull explosion. The punch went up again. Everything looked as usual. Nothing seemed disturbed; but examination showed that the press had cracked across the throat, and the top had lifted from the bottom by the amount of the thickness of the shuttle. This machine might not have broken if it had been stalled with a solid piece of steel at half its stroke; but on that last $\frac{1}{16}$ in. its whole enormous power was thrown through an extent of the circular motion of the balance wheel which very much exceeded that which would have been taken up to carry the punch the same distance at the half-stroke, and exerted a force commensurate with this difference. It would appear that some arrangement might be made on these powerful machines, so that, if the burden put upon them was greater than they could bear, they could yield and immediately recover. By this, their efficiency would be increased, for there would then be no risk of putting upon them more than they could bear. It would serve the same purpose as the safety valve on an engine. It should be on the pop valve order; to stand not upon the order of going, but when it is forced to go, go at once, and come right back.

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* By B. F. SPALDING, in the *American Machinist*.

In speaking of the effect of straightening the crimps, and by throwing the crooked into a straight line, upsetting the stock, I am reminded of some eye-bolts which were to be made of ¾in. round iron, as in Fig. 1.

The stock was not large enough to make the eye without upsetting about half an inch, and it was not convenient to use the bolt machine for this purpose. With the bolt header once set for the work, we could probably have headed 3,000 in half a day, and this would have been an economical method, although it would have still been necessary to heat them again to shape the eye. The plan adopted was as shown in the sketch, Fig. 2.

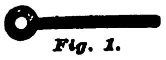


Fig. 1.

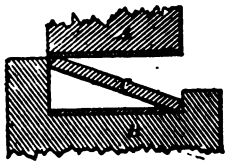


Fig. 2.

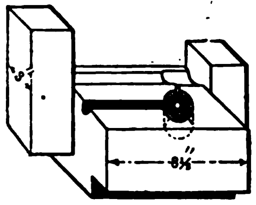


Fig. 3.

Here A represents the upper die in the drop, B the lower die, and C the piece to be upset. The principle is much the same as that on which the scythe edge was upset. "The shortest distance between two points is a straight line" was the familiar axiom, illustrated by pressing the crimps straight. The crimp would analyse down to two right-angled triangles, and the edge was upset to the sum of the amount of the differences in each between the lengths of the base and hypothenuse of these angles. In the case of the bolts to be made, they were to be 8½in. long, after they were upset, and were cut 9in. long. We had the base 8½in., the hypotheneuse 9¼in.—allowing for expansion, &c. To find the height of the perpendicular, it was not necessary to figure; for a quicker way was to take a piece of ¾in. round iron, and put it inside the blacksmith's square, so that one end did not extend beyond the 8½in. mark, and notice how high up the other end extended on the square. By this primitive method it was determined that the backing post should be about 5in. high. A half-round groove was cut in each die, so that when they were face and face together, the ¾in. iron would lay in it, and this groove was enlarged at the end, to allow for the increase in the thickness of the end of the bolt, when it was stove up. As it was desirable to finish two bolts at one heat, the impressions to form the eye in the right shape were made in the same dies. As it was necessary that these impressions should match each other very perfectly to strike the eyes with sufficient accuracy to be easily trimmed, they had to be made in steel, while the bodies of the dies were easier made, and, to all intents and purposes, just as good, of cast iron.

Fig. 3 shows the lower die, made of cast iron. The steel in which the impression for the eye was sunk is shown at D. A hole, 2in. deep and 2½in. diameter, was made to receive it. The cast-iron die was heated nearly red for its reception. The contraction of the cast iron should take place before the steel has become hot, or, instead of getting tight by cooling, it will get loose, because steel expands nearly twice as much as cast iron, with the same increment of heat. The post shown at the right-hand side of the figure was for the hot end of the iron to abut against. The top die was of the same shape as the bottom die, minus the posts, which were left off in casting.

The manner of working the eye bolts with these dies was this: A short heat was taken at one end of a piece of round iron, of the right size and length—¾in. round by 9in.—and it was placed in the die, as shown in Fig. 2, the lower end being the hot end. The top die coming down, drove the 9in. piece into the 8½in. space, thus staving up the hot end ½in. The piece was then lifted over into the steel die and received its impression, leaving a thin fin all around and also across the hole in the middle. They were then thrown down, and, when cool, were taken to the trimming punch, and there the fins were removed.

Thus dressed, they made very good-looking eye bolts, and were uniform with their fellows. In this respect, as in all others, they were a great improvement over those which had previously been made by hand.

SCIENTIFIC SOCIETIES.

ROYAL ASTRONOMICAL SOCIETY.

THE first meeting of the new session was held on Friday evening, March the 9th, W. H. M. Christie, Esq., Astronomer Royal, and President of the Society, in the chair.

Mr. Arthur Berry, B.A., of King's College, Cambridge, and the Rev. Walter Edward Stewart, M.A., of 1, Banks-terrace, Croft-on-Tees, Darlington, were duly elected Fellows of the Society.

Mr. Knobel: We have a large number of papers on observations of the total lunar eclipse of January 28. A paper by Dr. Dyer contains observations made at the Armagh Observatory. He recorded seven disappearances and two reappearances of stars at the limb of the totally eclipsed moon, and calls attention to the fact that about the middle of the eclipse the moon appeared to the naked eye as a fairly bright disc with a dark isosceles triangular shadow on it, having the base to the north. That triangular patch on the moon's disc seems to have been noticed by others. Mr. Backhouse sends us a paper with a diagram showing the triangular patch about the centre of the disc, with a long description of the physical appearances which he noticed. Mr. Rambone, of the Dunsink Observatory, sends us a very carefully made series of observations. He succeeded in observing 17 disappearances and 18 reappearances, and the observations appear mostly to be very good.

Mr. Denning sends us a paper upon the total eclipse, which is confined to a discussion of the cause of the red colour visible upon the moon's disc, and in which he suggests that the saturated air strata absorbed the violet rays and left the red, and hence the vivid colour observed.

Capt. Noble: I was particularly struck with the fact that the body of the moon was of an almost chocolate-red colour. The limb at no period of the eclipse was at all red; but it seemed to me to be of a silvery green colour. I do not see the theoretical reason of this, unless it was due to contrast. The shadow in the middle, which has been described as a triangle, seemed to me to be a kind of amorphous mass, as though it had been smoked, or as if one were looking through smoked glass. I may mention as an illustration of the exceedingly local character of English weather, that up to the time of totality and during the whole of the eclipse, the sky was most brilliant with me, while Mr. Prince, whose observatory is situated only four miles and two-tenths of a mile as the crow flies from mine, and is 500ft. higher above the sea-level than mine, had his sky covered with a mass of impenetrable cloud. If my sky had been covered with cloud, and he at 500ft. higher had seen the eclipse, there would have been a very simple explanation; but that I should see it and he not seems to me a little curious.

Mr. Turner: I think the absence of the C line in the spectrum of the light from the dark moon was confirmed by observations made by Prof. Beattie Smith, and also by Dr. Copeland, and the only observations of bright lines in the spectrum of the moon during eclipse that I have heard of were, I think, made by Dr. Huggins. I am not sure whether he is here; but he was mentioning to me this afternoon that he had noticed the brightening of the spectrum in three places which seemed to him fairly to accord with coronal lines, showing that the illumination must be due to coronal light. He was saying that he had drawn the attention of Mrs. Huggins to the spectrum, and she had independently, without his mentioning it, noticed these three brightenings.

Mr. Chambers: I can confirm Captain Noble's observations as to the patch in the centre, and I think his comparison of it with the surface of a piece of smoked glass is a very good one. Nothing that I saw was at all capable of being twisted into the triangle spoken of by two or three writers. Another remark occurs to me as opposed to what Mr. Denning has said in reference to Kepler's theory of the atmospheric cause or supposed atmospheric cause of that colour. Captain Noble, I observed, described it as chocolate; a deep red, coppery chocolate would, no doubt, be a description that would accord with many previous records, but on this particular occasion it struck me as very remarkable that the colour was by no means of the customary deep colour. I should prefer to describe it as pink or pinkish.

Mr. Ranyard: I think there can be very little doubt that the light upon the moon's surface was not uniform. There was certainly an irregular patch, and during other total lunar eclipses the irregularity of the light on the eclipsed moon has been frequently noticed. That, I think, is sufficient proof that the light is not coronal light. The bright part of the corona is not very large compared with the sun's disc. It would not be visible all round the earth's disc, which, as seen from the moon, would appear about a couple of degrees in diameter; and if the illumination was derived from the corona you would expect the light to be much more uniform within the eclipsed area. There is another physical reason which, I think, also makes this theory quite out of the question. The light of the corona must be very small compared with the direct light of the sun, or even with the light of the terrestrial atmosphere round the earth. But the brightness of the eclipsed moon does not correspond, to thousandths of parts, of the light of the uneclipsed moon. It is evident that in the region of total shadow the light of the sun must be seen through the earth's atmosphere. We know this from the amount of refraction at the earth's limb. As far as I remember, the total shadow of the moon is about $\frac{19}{20}$ths of what it ought to be, if a geometrical shadow of the earth were thrown and there were no refraction. That would give a refraction in the earth's atmosphere of about a minute and a half on either side, for the light is doubly refracted on going through the earth's atmosphere at each limb, and there is the encroachment on either side of the shadow to take into account. Let us take the diameter of the total shadow as 2°, or something less (of course, it differs from eclipse to eclipse); the twentieth part of that would be six minutes, or three minutes on either side, and that would give the refraction, on entering and leaving the earth's atmosphere, as one and a half minutes, which would correspond to the refraction at a very great height in the earth's atmosphere. The grazing refraction would decrease the area of total shadow by over 2°, for the refraction at the horizon would be doubled for light going through the earth's atmosphere and grazing by the limb of the earth. We therefore know that the light which illumines the dark moon just inside the total shadow must have passed through our atmosphere at a great height, and there is no part of the lunar shadow which is a whole degree away from the edge of the circle of total shadow. Therefore an observer on the moon's surface would see the sun through the earth's atmosphere from every point within the total shadow, and he would see a rim of red light round the earth; we see the sun's light very red when the sun is near to the horizon, and after coming in and passing out of the earth's atmosphere, it would be still redder. If this is the light which lights up the total shadow on the moon, we can conceive that it might be very irregularly distributed, and such a triangular marking would probably mean that there was some irregularity of refraction at different parts of the earth's limb, or rather an irregularity of absorption, which would give the same effect. At one part of the earth's limb there might be a greater absorption, due to dust floating in the higher atmosphere, or to some other cause varying the absorption far above the region of cloud. We should thus have patches of brighter and darker light within the region of what we ordinarily call total shadow.

Mr. Knobel: I do not find in any of the papers we have received any remark about the limb being of a greenish colour. The observers generally seem to give the tint of the limb as yellow, or red and coppery.

The Astronomer Royal: Perhaps I may be allowed to suggest a possible explanation of this green light round the moon which occurs to me. It is well known that the edge of the moon is brighter than any other portion, by virtue of the light being scattered over a rough surface. Anyone who looks at one of these photographs will see that the moon has a narrow bright ring round it, as it were. The edge is bright, and there are also variations of brightness of the surface which must largely affect the appearances during an eclipse of the moon. A thing which struck me during this eclipse particularly, and also during previous ones, was that the first symptom of totality did not occur at the limb; but there was a sort of diffused cloud within the limb, and the limb was quite distinctly bright with a bright ring round, and that ring was visible for some time. Now, if the obscured part is of a coppery or pinkish colour, according to circumstances or to the eye of the observer, it seems natural that the brighter light round the edge will be fringed with the complementary colour green.

The following papers were taken as read:—J. E. Gore, "On the Orbit of 70 (*p*) Ophiuchi"; W. Doberck, "Telegraphic Determination of the Longitude of Haiphong"; J. E. Gore, "Observations of the Variable Star, S (10) Sagittæ"; Prof. S. Glasenapp, "Orbits of the Double Star λ Ophiuchi"; Rev. S. J. Johnson, "Southern Double Stars"; A. Martin, "Ephemeris for Physical Observations of the Moon for the Nine Lunations from April 12 to the end of December, 1888."

MANCHESTER MICROSCOPICAL SOCIETY.

AT the last meeting of the Mounting Section the examination of the blood of the newt occupied the attention of the members taking part n the systematic course in continuation of the vork undertaken at the last meeting. The blood f the newt is exceedingly favourable for microcopic examination, by reason of the relatively arge size of the red corpuscles, which are about $_{0}$th of an inch in diameter, or four times greater han the red corpuscles of human blood; and also n account of the normal temperature of the blood f the newt being but little beyond that of the tmosphere (hence the term cold-blooded). The orpuscles thus retain their vitality for a considerble length of time, so that, if precautions be taken o prevent evaporation of the blood-plasma, any hanges in form which the corpuscles undergo can e observed without the aid of hot stages or other rtificial means for preventing the temperature of he blood falling. In vertebrate animals, in addiion to the blood vascular system, there is another ystem of vessels containing a clear colourless iquid with numerous corpuscles, the lymph; and s in the newt and all amphibians the lymph vessels re relatively large and abundant, in order to obviate he admixture of the lymph with the blood and the onsequent confusion of lymph corpuscles with hite corpuscles, the blood for examination should e taken direct from the heart. The blood having een so obtained, and evaporation having been revented by the application of melted paraffin to he edges of the cover-slip, the members were able o observe the amœboid movements of the white orpuscles, which are essentially similar to those reviously noted in the blood corpuscles of the nussel.

The white corpuscles, which were somewhat maller than the red corpuscles, varied in appearnce as well as in size. They were all nucleated nd granular, but some were more finely granulated han others, and the pseudopodia in the coarsely ranulated corpuscles were more blunt and rounded han in the finely granulated one. The red coruscles were all uniform in size and oval in outline, ut when viewed upon edge presented a somewhat pindle-like or fusiform appearance. Each was of faint yellow colour, owing to the presence of æmaglobin, a substance peculiar tc blood coruscles, and forming the greater portion of them, he remaining proteid matter being known as the troma. A lighter-coloured nucleus was distinctly isible in each, which, though faint at first, became radually more distinct. Another drop of blood eing treated with magenta stain exhibited the resence of the nuclei in the corpuscles much more istinctly. In a red corpuscle the peri-nuclear ortion was scarcely affected, whilst the nucleus as stained a deep red and revealed a still darker ortion within the nucleolus, and each red corpuscle as evidently limited by a thin firmer membrane r envelope. The white corpuscles were stained ore uniformly, but the nucleus was much more istinct than before staining, and in some cases as seen to be two or three partite. When treated ith dilute solutions of hydrochloric acid and acetic cid, the red corpuscles became much more transarent and colourless, the nuclei darker aud more efinite, presenting a beaded outline, and, with areful observation, a distinctly fibrillar structure as visible, the appearance being somewhat similar o that previously observed in the nuclei of young egetable cells.

In the case of the specimen treated with hydrohloric acid, rupture of the limiting envelope took lace in many of the corpuscles, the hæmaglobin scaping into the surrounding liquid, showing the esidual stroma in the form of bands extending rom the nucleus to the limiting membrane.

When a sack or bag made of an animal or vegetble membrane, and containing a liquid, is imnersed in another liquid of different density, it is vell known that the liquids tend to diffuse into ach other through the membrane, and as usually he liquid of less density passes more rapidly hrough the membrane than the one of greater ensity, the bag may become swollen or may shrink ccording to the nature of the liquid it contains. A red blood corpuscle represents such a microscopic ack, so that when a drop of water was added to the lood under examination, the water passing into he corpuscles more rapidly than the hæmaglobin assed out caused them to swell, and thus lose their val outline and become globular, this passage nwards of a liquid to an animal cell being known s endosmosis. Upon adding a strong solution of ugar to another drop of blood the reverse action ook place. The hæmaglobin was now seen to pass ut into the liquid more rapidly than the syrup assed in, causing the corpuscle to shrink or collapse nd present the appearance of a misshapen sack. he process is known as exosmosis. These latter xperiments are of value in demonstrating the laws f osmosis, by which the various liquids diffuse hemselves through the tissues, both of animals nd of plants, and are also interesting to the ractical microscopist by showing why it is that r microscopic examination animal and vegetable ssues should be mounted in fluids as nearly as ssible of the same density as the liquids that rrounded them in their living state, if the cells e to preserve their true form and appearance.

In the next demonstration of the systematic course, which seems to be growing in favour with the members, it is proposed to proceed with the examination of the blood of birds and of mammals, including human blood; after which the microscopic examination of the chemistry and physics of the vegetable cell will be undertaken.

WESTERN MICROSCOPICAL CLUB.

ON Monday week the members of this club and their lady friends, to the number of about fifty, assembled, at the invitation of Mr. and Mrs. H. V. Tebbs, at 1, St. John's-gardens, Notting-hill.

In the dining-room were found displayed under some thirty microscopes numerous specimens of the beautiful organisms known as Radiolaria, which include the family Polycistinidæ.

Mr. Tebbs gave a short history of these minute and beautiful objects, not the least important part being the remarkable evidence pointing to the action of natural selection in the formation of even the most ornamental of the shells of the Radiolaria. Up till 1862 the only English account we had of them was a small atlas of 26 plates by Mrs. Bury; now, thanks to the work of the *Challenger* Expedition, as reported on by Dr. Haeckel, we have pretty full knowledge of the Radiolaria. They are exclusively marine, being found in all parts, though most abundant in the warmer seas. They float on the surface, and are found as deep down as 4,500 fathoms, though they do not seem actually to live on the floor of the ocean. When dead, their remains sink and form a soft mud at the bottom of the ocean. At Barbados their remains have become fossilised, and were for a long time the only source of supply. Though not far removed from the vegetable kingdom they are distinctly animals. It is a curious and newly-discovered fact that some of them have embedded in their substance a minute vegetable (Zanthella); each individual in such case supplies the wants of the other, and removes what would be harmful to its fellow. As living beings they consist of a single cell. Each cell is separated into two parts by a membrane. There is, first, a central internal capsule containing nucleus, and then an external hood or calymma. From this latter radiate threads or pseudopodia; strengthening all is usually some sort of skeleton or framework. This generally consists of silex, sometimes mixed with carbon or with chitin. The central capsule contains the analogue of the ganglion cell, and is also the spore organ. Till Haeckel's report we knew only of about 800 species; now they amount to 4,000.

In variety of form and in beautiful symmetry the Radiolaria probably surpass all other organisms. Having to swim at the surface and at all depths of the ocean, their form must be one of stable equilibrium. This requirement is best met by a sphere; this form is found in the simplest of these organisms. To vary its depth of immersion a silicious skeleton is developed, which is balanced by the lighter fatty globules and vacuoles that are found in the calymma. This last can contract as a whole or retract its pseudopodia, thus altering the density of the creature and so varying its depth of immersion in the ocean. Some are in equilibrium only in one position; such have a vertical main axis of silex; from this may radiate transverse axes in almost endless complications and beauty of form. These marvellous varieties of structure are probably due to the primitive form being exposed to altered conditions of life, such as light and temperature and the use or disuse of organs. The lattice-like skeletons serve as protective coverings, the radial spines are defensive, the anchor-hooks form organs of prehension. The regularity and symmetry of the skeleton is necessary to maintain the creature's equilibrium. In some of the highest we recognise pigment bodies and a foot-cone having bands of contractile substance almost functioning a muscle.

After a few words from Prof. Ray-Lankester, a cordial vote of thanks was presented to Mr. Tebbs for his most interesting display and explanation, so well illustrated by specimens and diagrams.

Rev. N. Brady showed some beautiful effects of diffraction, and Mr. Cole exhibited some curious gizzards found in some of the smaller beetles. At the next meeting Dr. Thudichum will introduce the subject of "The Chemistry of the Brain."

Light-tight Stop.—Messrs. Taylor, of Leicester, send us a whole-plate lens-tube fitted with their new light-tight stop, as exhibited at the Crystal Palace. The stops are lined with cloth, and thus form a perfectly light-tight fitting round the diaphragm, and make it possible as a further precaution to have the slot at the bottom, instead of at the top when the mount is screwed into the flange. The black of the diaphragm cannot be worn off, and the cloth is fixed in such a way that the insertion of the diaphragm cannot tear the cloth from its seating. The device is certainly a refinement which even a novice can appreciate.

SCIENTIFIC NEWS.

THE observation of occultations during the eclipse of the moon on Jan. 28 seems to have been fairly successful after all, considering the season. Many reports have yet to come in; but at Pulkova 50 observations were made; at Marseilles, 39; at Kiel, 36; at Turin, 32; at Bothkamp, 33; at Geneva, 23; at Bordeaux and Tashkent, 21; at Paris, 12; and at Liverpool, 11. Successful observations were made at many other stations; but the above, in addition to those already known, should provide sufficient data to accomplish the object.

In the annual report by Prof. Pickering, as the director of the Harvard College Observatory, it is stated that special attention has been devoted to stellar photometry, and the wedge photometer, constructed under the superintendence of Prof. Pritchard (Oxford), has been employed on zones of stars. Comets and other occasional phenomena have been observed, but meridian work has been confined to observations of time stars. Experiments have been made to determine the most suitable application of the funds left by the late Mr. Boyden for making astronomical observations, as far as possible, free from atmospherical influences; but nothing definite seems to have been decided. A telescope of 13in. aperture and 15ft. focus, so constructed that it can be used for either visual or photographic purposes, has been nearly completed by Alvan Clark and Sons. A second telescope of 8in. aperture and 11ft. focus will be mounted on the same stand. They will be employed under the Boyden Fund for observations at high altitudes.

Comet α, 1888 (Sawerthal), may perhaps be picked up now, low down, and early in the morning twilight.

During the late eclipse of the moon Dr. Boedicker made a series of experiments on the variations of the lunar heat measured with a Thomson's galvanometer in connection with the Rosse 3ft. reflector at Parsonstown. He concludes that the heat radiated by the moon decreased long before the first contact with the penumbra, and twenty-two minutes before totality commenced it was reduced to less than 5 per cent. of that measured twenty minutes before the first contact with the penumbra. That, it will be observed, was rapid cooling, but the recovery after the last contact with the penumbra was not nearly so rapid.

The *Journal* of the Liverpool Astronomical Society for March contains as usual a variety of matter interesting to astronomical observers, and a letter by Sir W. Herschel relating to the discovery of Uranus, which, it is believed, has never before been published. The letter is addressed to Sir Joseph Banks, president of the Royal Society, and is dated Bath, Nov. 19, 1781. In it Sir William praises the "goodness" of his telescope.

According to some accounts there are serious defects in the construction of the Lick Observatory which will, it is said, delay the time for fully demonstrating the powers of the great telescope. The most serious of these is the mounting of the telescope on a hollow iron pier, 30ft. high, which is externally susceptible to variations of temperature, the mere placing of the hand on one side of the column being sufficient to throw a star out of the field of view [!] It will be necessary to replace this metallic pier with one of solid masonry. It is not unlikely that these rumours are "trade balloons."

The Council of the British Association have nominated the following presidents of sections for the Bath Meeting in September next, and we understand they have accepted the offices respectively:—Prof. Schuster, Section A, Mathematics and Physics; Prof. Tilden, Section B, Chemistry; Prof. W. Boyd-Dawkins, Section C, Geology; Mr. Thiselton-Dyer, Section D, Biology; Col. Sir C. Wilson, Section E, Geography; Lord Bramwell, Section F., Economic Science; Mr. W. H. Preece, Section G., Mechanical Science; General Pitt-Rivers, Section H., Anthropology.

The Institution of Naval Architects meets at the Society of Arts on March 21, 22, 23.

At a meeting of the Liverpool Geological

Association last week, Mr. Norman Tate, the president, read a paper on "The Genesis, Growth, and Decay of Minerals." Referring to a paper read by Prof. Judd before the Geological Society, London, and to what has been termed the biology and physiology of minerals, he pointed out the chief differences noticeable between the formation, development, and decay of minerals, and the life-history of plants and animals, but said that the clearest and best definitions of "life" as given by the late G. H. Lewes and by Herbert Spencer quite embraced the phenomena of mineral existence. He spoke of the desirability of studying the laws of mineralogical evolution, and noticed the chemical and physical changes that bring about the formation of crystalline minerals by solution and fusion, by the action of heated water alone, and in combination with gaseous and other substances under different circumstances of temperature and pressure, and how the different modes of formation resulted in different characters affecting permanence and decay. He condemned the present unsystematic nomenclature and arrangement of minerals, and urged the careful study of mineral evolution would aid much in raising the standard of mineralogical science and greatly aid geological inquiry.

In a paper by Mr. Percy Frankland, recently read before the Chemical Society, the author gave an account of some observations he had made on the action of 32 micro-organisms on nitric acid contained as nitrates in nutritive solutions. About half of the forms (all of which were obtained from air and water, and cultivated in a state of purity), reduced the nitrates to a greater or less extent to nitrites. No effect was produced by the exclusion of air. The author suggested that the difference in reducing power may, in certain cases, be available as a means of distinguishing micro-organisms morphologically very similar.

At the Parkes Museum, Dr. G. Sims Woodhead lectured the other day on "Milk and Disease," and in the course of his remarks said, that milk is a typical food, containing all that is necessary for the growth of the tissues; and not only for those of the higher organisms, but also for the growth of micro-organisms, all necessary elements being present in an easily assimilable form. Various forms of fermentation and other changes were brought about in milk by growth, proliferation, and development of different forms of micro-organisms—namely, lactic acid fermentation, butyric fermentation, alcoholic (koumiss) and ropy fermentations. Changes in colour by a kind of colour fermentation were brought about by micro-organisms, as in blue milk and red milk. Pathogenic organisms can also grow in this splendid nutrient medium. In this way we may account for the spread of diphtheria, scarlatina, typhoid fever, summer diarrhœa, tuberculosis, anthrax, &c. Bacilli have been demonstrated to be the cause of two of these diseases, and it is very probable that others are similarly caused. These bacilli can grow in milk, and so milk may be a medium for their distribution and of the spread of disease. Dr. Woodhead gave examples of dissemination of scarlet fever in St. Andrew's and Edinburgh by milk from infected farms or dairies, and described channels by which milk may be infected. Milk is the one animal food which in this country is not usually cooked, and even when an attempt is made to cook it this is done imperfectly. Tuberculosis in children frequently commences in connection with the alimentary tract and the glands associated with that area; sometimes it is confined to this tract. The probability is that virus has been introduced along with food-milk. Koch and Baug record experiments in which milk from tuberculous cows produced tuberculosis in animals inoculated or fed with it. These have been repeated, and always with the same result, if the udder of the cow affected has been tuberculous. Mr. Woodhead pointed out that, though tubercle was so common in cattle, the udders are comparatively rarely affected; but when they are, the milk is a great source of danger to delicate children.

Considerable progress is being made in fish culture. More than three millions of ova have been already laid down in the hatchery of the Midland Counties Fish Culture establishment at Malvern Wells, which has been formed by Mr. William Burgess, with the view of propagating fish for the benefit of the country. Large quantities of ova have been imported from Lake Garda, Italy, where, it is stated, very large trout are occasionally captured. So far, the ova are hatching out well.

A remarkable achievement in transportation of live fish a great distance is described by M. Jousset de Bellesme in a recent number of the *Revue Scientifique*. A selection of fish were despatched from Paris in September last to stock the waters of Chili. The voyage, of about a month, was a trying one, especially as regards variation of temperature. Care was taken to lessen the activity of the functions of the fish by refrigeration and starvation (a carp will live fifty days without food), and a continuous air circulation was kept up in the water (which was not renewed). There was some loss among the salmon, but several were successfully installed at Santiago; and the other groups were mostly intact. Only the gudgeon, lotes, and barbs suffered severe loss. The experiment seems to prove the possibility of carrying alive the most delicate fish from any point of the globe to any other point. It was also ascertained that a temperature of 23° C. is not hurtful to the health of alevins of *Salmo quinat*, as might have been feared. It is rather singular that the Chilian Government should have imported fish from Paris, when they could get them much more easily from the United States.

It is stated that two lords, a baronet, and others have "boldly thrown down the gauntlet to the gas people." They have, it appears, taken ground at Deptford on which they are going to establish plant for supplying the electric light or the current to London at a price equivalent to 4s. 2d. per thousand cubic feet of gas. The installation is to be capable of supplying 200,000 lamps.

It is stated that a process of producing pure zinc by electrolytic methods, devised by Mr. Alex. Watt, is about to be taken up and worked by a company. Really pure zinc would be useful for many purposes, and if it can be produced, as is stated, more cheaply than the ordinary commercial metal of the smelter, electricians at any rate will rejoice.

Extensive alterations are being carried out by the Compagnie Continentale Edison, in the electric lighting of the Grand Hotel at Paris; forty of the Jablochkoff candles are to be removed, and replaced by 800 incandescent lamps, which will be worked from two Edison dynamos.

Eggs of the Great Auk must be very valuable when good specimens reach the enormous price of £225 at public auction. It is safe to assert that no really scientific student paid such a price.

The *Gardeners' Chronicle* answering the question, Which plant shows its leaves earliest? says the common elder is one of the very earliest to unfold its leaves. On this account we turned to Prof. Hoffmann's "Phenological Charts," just published, and found that the elder occurs wild throughout the whole of Europe, including the southern parts of Sweden and Norway, but not in Russia, extending thus ever almost precisely the same area as the blackthorn, Prunus spinosa, which, however, is much later coming into leaf. Honeysuckles, which belong to the same order as the elder, expand their leaves very early; and Lonicera tartarica, either wild or as a cultivated plant, has nearly the same area as the elder. The birch, bird cherry, red currant, raspberry, grow all over Europe and up to the North Cape, but they are not so early as some of the plants already mentioned. Deutzia scabra, Ribes, Solanum crispum from Chile, Photina, many of the Spiræas, and other rosaceous plants may be mentioned as plants which unfold their leaves early. It is hence clear that this precocity is not an affair of latitude or altitude only. The subject is one of practical importance as regards stocks for grafting.

THE Chinese Government have at length definitely agreed to dredge the Woosung bar at the mouth of the Yangtsze river. The task, when accomplished, will add largely to the importance of Shanghai and its accessibility by large steamers.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, *332, Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

⁂ *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

THE MOON.

[28498.]—DISCUSSIONS that have a tendency to lead to a better knowledge of the nature and conditions of the moon are always interesting. I do not doubt that, along with myself, many of your readers will have been considerably interested in the correspondence in your recent issues as to whether the moon, in past ages, may have had her complement of seas and atmosphere, and if so, what may have become of them. This is a subject that has been frequently discussed; but much has yet to be deduced before any decided conclusions can be arrived at, and these conclusions can only result from careful consideration of not some only, but of all, the conditions of our planetary system. To discuss these with any degree of fulness would probably require more space than you could reasonably be expected to provide; but there are matters that might, perhaps, be profitably mentioned, and as these appear to me to be of first importance, and not to have been considered by your correspondents, or not sufficiently so, I have thought that I might add some little interest by a quota to the discussion.

Modern science leads us to infer that nature, or rather the Omnipotent Creator of nature, has not been variable and fickle, but systematic; that our planetary system has had one common origin, developed from one source, continuing still in conformity with this development. From these premises, and from what can be seen of the sun and planets, and what we know of our own earth, it may be inferred that what is true of one will be true of the others; that during the course of ages the conditions that have obtained will not have been dissimilar. Our earth is now in the fulness of life, possessing all the varied conditions that render life endurable; but it has been "without form and void." It has cooled down; but the larger planets and the sun are still seething, surrounded by enormous, heated atmospheres. The smaller ones are more or less advanced in the cooling down; some, from their much smaller size and the consequent proportional greater rapidity of cooling, already apparently dead and cold, without remnants even of their life's blood, water and air.

Your correspondents (it is common with most writers on this subject) speak of the moon as subject to great extremes of heat and cold. Do these conditions prevail to the extent assumed? Have they always prevailed? May there not be too literal a comparison with the sun's action upon the lower levels of our earth where our atmosphere is densest? As the higher altitudes of our earth are reached, the atmosphere becomes less dense, and the sun's heat proportionally less intense. By the comparatively small altitudes that can be reached by ballooning the sun's heat is found to be almost inappreciable. What amount of heat consequently can be estimated to be given to the moon where now, as is believed, not even the most perfect vacuum that could be produced on our earth would equal the moon's surroundings?

The first consideration, however, is, has the moon ever had seas and vaporous atmospheres? To this question it may be stated that by comparative analogy with the conditions on our earth, if the moon's craters, or any portion of them, are the result of volcanic action, that action could not have obtained without the elements of water without considerable proportions; and as these elements are known to exist on all the planets that are not yet figuratively dead, it may be inferred that the moon has had its quota. Other theories have been propounded for the building-up of the moon's craters; but that of volcanic action is still most generally accepted.

It is believed that the moon is an offspring of our earth; that all the planets are offsprings from one source, each, in turn, or partly simultaneous at first, developing and resulting in time to present conditions; and that at first our moon would be a protuberance attached to our earth, revolving round with it, forming a spheroidal shape, and dually separating; that this separation would, l has, extended with the gradual cooling and sequent gradual contraction until the present ditions have been attained. That from its nparatively much smaller size, the moon would l down much more rapidly than our earth, and t thus the moon would be in the fulness of life, ile our earth would be still a molten mass, ithout form and void." Under these conditions the moon would not have one only, but two s—at least, that part of the surface turned wards us, and our earth at the time to that part ald be a permanent sun. To what influences ald the moon and its seas then be subject? know what the moon's influence is on seas of our earth, while her mass is y an eightieth part of our earth's. What, n, would our earth's influence amount to? estimate that it must be considered what the n's influence would be if the mass of the two e equal, that is the moon's mass 80 times more, not only this, but if our earth's mass were 80 es less. By this consideration it can be underd that, irrespective of the sun's influence on two, our earth's influence on the moon would must still be enormously more than the moon's uence on our earth. How far, then, would the n's waters and atmosphere be attracted towards And, given the sun's influence in addition to own, when our earth would be between the , how enormously more would the attraction be ended! The questions may consequently be sonably asked if the moon has had her seas and osphere, whence could they go—whence may y have gone? These questions may be considered in more ways than one. Would the waters drawn and dissipated into space? May our th have absorbed them, or any portion of them; , if so, may there have been any exceptional cirstances at any special time for an abnormal accelerated absorption, or could the moon orb them into her own self?

F.R.A.S." asked (28425), "Would Mr. Caine that the elements of water exist in space?" uld "F.R.A.S." assert that minute particles of h elements do not exist in space? Heat that uired the elements of water for its propagation l existence is continuously being given off by the . Does not this pass through space? Is none t absorbed by space? Is it all directly attracted l absorbed by the sun's planets? But even if must it not exist in space to pass through? The dency as can be inferred from the moon itself, or universal dissipation of heat, and not of heat y, but of the elements of its propagation and port—the elements of aqueous vapour. Whence they go?

onfining our consideration to atmosphere and eous vapour and the elements producing these, ess space is an absolute vacuum, which is denied, ich cannot be conceived, there must be friction, this ever so minute, between the elements of e and our atmosphere as we whirl round and s through space. Do the constituents of our h produce atmosphere, and we imperceptibly any portion by our enormous rate of travel! do we gather any elements from space by our action as we gather meteorites? Or may both ditions obtain at the same time? It can scarcely said that the moon has given off and attracted portionally. Can it be so said of our earth? nay it not be inferred, on the contrary, that we give off and lose particles, whatever we may or e gained? If the moon has lost her elements his way, is it too much to suppose that from our h's greater attraction we may have absorbed , if even losing from ourselves at the same e? Further, if our earth has grown, as is now g supposed, through the absorption of meteor- , whence has come our enormous proportion of er? If our earth has been of so much less mass imes past the waters surrounding it must surely e been much in excess of present relative proions.

F.R.A.S." further asked, Did Mr. Caine bear nind that any particles to be given off by the n would have to be 24,000 miles distant from centre of attraction before she would lose her l of them? This distance may seem great, but t does it represent in point of time? Rela- ly very little. At the earth and moon's speed ugh space, the distance only amounts to a little : 20 minutes. But in point of fact, this dise would be considerably less, for as the moon ld be losing her hold at a rate of more than 0 miles a minute, the power of our earth's action would be gaining proportionally. Bearin mind the fact that we are travelling at a rate 8,000 miles an hour, and that the distance been our earth and moon is only 239,000 miles, it be understood that when the moon is before ve have only to travel for 3½ hours to reach occupy the same position in space! **Nemo.**

E GLACIAL PERIOD AND THE MOON'S WATER.

8499.]—In reply to questions put by "E.L.G." 93) on page 35, perhaps you will kindly allow me to express myself more fully. What could cause a glacial period is exactly the question I want answered. A shifting of the earth's axis or orbital inclination would not cause it, because the change would bring an alternating increased heat to compensate for the increased cold; but the evidence is that the ice caps, both north and south of the Equator, suddenly extended from at least their present limits to about the borders of the tropics. It was many hundreds of feet thick in our latitudes. Put at the present day 600ft. of ice over the British Isles with an accompanying fleet of icebergs in the Atlantic, and, leaving Europe out of the question, how many summers would it take to thaw away the ice, especially as such a mass would bring earlier, colder, and longer winters to delay the process? All England is full of traditions when heavy snowfalls during the last fifty years left wreaths unmelted through a following warm summer on such low elevations as Pendle Hill in Lancashire, and the Hambledon Hills in North-East Yorkshire. The great Swiss and other glaciers are slowly receding. The levels of the Baltic and Caspian Seas are probably getting less. There is abundant evidence that before the glacial period tropical animals and plants flourished numerously in our northern latitudes, but so sudden was the change that all manner of tropical animals were driven into caves and other places of refuge where they perished, in herds together. At the end of the last century, a Tungusian chief discovered a complete hairy mammoth at the mouth of the river Lena, in Siberia. It was so perfectly preserved in the middle of an iceberg, that some years later, when it was thawed out, both man and beasts partook of its flesh.

In 1846, Lieutenant Benkendorf, on the banks of the Indigirka, discovered another perfectly-preserved mammoth in an iceberg. These animals, thousands of years before, must have been suddenly overtaken by a tremendous fall of snow. Reduce the level of the ocean by only one hundred fathoms, and the land surface of the globe at once assumes a curious triple divergence or "manx legs" formation from a great central mass around the North Pole. The Gulf of Mexico and the Caribbean Sea would be obliterated. Behring's Straits, Behring's Sea, the Sea of Okhotsk, and the Sea of Japan would have no existence, North-Western America being continuous with North-Eastern Asia, and Africa being two of the Manx legs, the third would be formed by the Eastern Peninsula becoming continuous with Borneo, the Philippines, New Guinea, and Australia. This was the time when our islands were joined to Europe, and when the fossil trees of the North Sea were living vegetation. At the present day snow is formed by the aqueous vapours of the earth and ocean ascending to the colder regions above. But what would be the effect of passing the aqueous vapours from above downwards in the reverse manner of the usual order? It would have to pass through tens of miles of frigid atmosphere, and would of necessity reach the earth in the form of snow except over a limited Equatorial region. Its first impact with our atmosphere would develop heat; but that heat would be completely dissipated long before it reached the earth, from sixty to a hundred miles below. The addition from outside of a sufficiently large quantity of water to our atmosphere would, therefore, account for the glacial period. Where did the water come from? Would it be possible for volcanic disturbances to burst such a planet as Mars? If so, on the supposition that the Asteroids are the remains of a burst planet, what orbit would its air and water take, and could it come our way? I know of no comet whose spectrum gives evidence of water, but several show the presence of hydrogen gas. Now, I quite see the scientific possibility of a hydrogen comet mixing with the oxygen of our atmosphere where electrical or meteoric heat would cause chemical combination, and a resulting downpour of snow and rain. On the other surmise, supposing it were possible for our earth in former times to draw off the moon's water, would that water revolve around us like little Phobos, who travels thrice around Mars in twenty-three hours? or would it form a ring of ice "brickbats" two-and-a-half times our radius away, like the wonderful rings of Saturn?

Such a ring would probably soon fall in as our earth grew stronger from meteoric addition, unless electrical repulsion or other influences had a counteracting effect. Considering the Martian satellites and the Saturnian rings, is it not curious how direct the meteors come to us? If a comet brought water in its natural chemical combination, how comes it that the moon, with her retaining pull of 24,000 miles, did not receive any?

"E. L. G." supposes that the earth was gradually cooling up to the glacial period; but that a watery comet warmed it so much that it has remained quite comfortable in these latitudes up to the present time. Does not such a warming look more like fire than flood? That the moon once possessed water is evident from her volcanoes, and by the theory which accounts for her rate of rotation being retarded by the friction of tides.

In conclusion, I would like to tell "E. L. G." that when I said I would be more pleased if there were less of the Noachian Deluge in his letter, I simply meant that I did not care to have my little train run into his little siding.

Francis E. Cane.

R.M.S. *Bothnia*, March 12.

LUNAR ECLIPSES.

[28500.]—The theory attributed by Mr. J. H. Jones (letter 28450, p. 7) to Dr. F. Burder, of Bristol, seems ingenious and simple, and there can be no doubt that the light received by the moon from the solar corona during a lunar eclipse must contribute in some degree to illuminate her surface.

It is, I think, generally admitted that the amount of light we receive from the corona during a total eclipse of the sun considerably exceeds that derived from the full moon. Owing, however, to the much larger size of the earth, the greater portion of this would be obscured in the case of a lunar eclipse.

Admitting, however, for a moment, that sufficient would be left to cause the strong illumination sometimes observed, it seems difficult to account for the peculiar coppery hue, as well as for the somewhat rapid changes of colour often observed during its progress, as the colour of the corona is generally described as of a pearly-greenish tint.

Spectroscopic examination would, no doubt, be competent to settle the question, as if the illumination be mainly derived from this source, the bright lines of the inner corona ought to be discoverable on those portions of the disc just within the shadow which would be mostly exposed to its influence. On the other hand, if the special dark lines due to absorption by aqueous vapour in our atmosphere are present with the other lines of the solar spectrum, it may be taken as proved that the usual explanation is correct. **W. T. N.**

[28501.]—The theory, built on the fact that during an eclipse of the moon both sun and moon have been above the horizon at the same time, was originated by a writer with the *nom de plume* of "Parallax" (now dead). This theory has been ably refuted by Mr. J. Dyer in a series of "Letters to a Friend," published by Trübner and Co. He says that the flat-earth theorists "are very careful not to say *how far above* the horizon the sun and eclipsed moon were" at the time of the eclipse, and ascribes the phenomenon to refraction. Science shows that when the sun appears just above the horizon it is actually below it; so with the moon. Hence when the sun and moon are seen together during an eclipse of the latter, it is because it is only *apparently* above the horizon. This is in accordance with observed facts and the laws of nature. As to the appearance of light on the moon during an eclipse, it is probably due to electrical conditions, or to the diffusion of light from sources outside the area of the shadow. At any rate, the fact of the moon being fully eclipsed, so as to be perfectly invisible, is a proof that some solid body has passed between it and its light-source; and as the shadow of that body is circular, and could only be thrown by a spherical orb, what other than the earth is there to produce such results?

"Parallax" says that "a well-defined and semi-transparent body" passing over the moon's disc would be sufficient to account for the eclipse! But such a thing has escaped the penetration of most powerful telescopes, and, therefore, has existence except in the Zetetic imagination. If the moon were "self-luminous" it could not be eclipsed by any *shadow*, though it might be hid from view by a solid body. But such a body could not escape observation during its transit, or after it had passed over into space.

Everything, however, is made to give way before the magic wand of the Zetetic philosopher; the result is a burlesque of science such as the world has never before seen. **Ithuriel.**

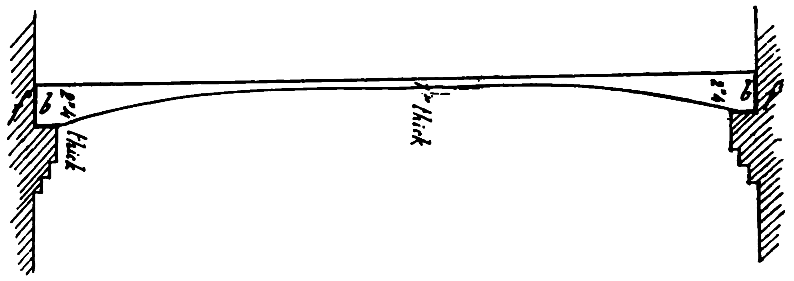
FIREPROOF FLOORING.

[28502.]—In reply to query 64665, the best material is good Portland cement, not less than one month old, and tested at that age to a breaking tension of not less than 650lb. on the briquette. For the body of the floor this cement should be mixed with aggregate of good hard, well-burnt, broken brick, broken small enough to pass through a screen with 2¼in. mesh, one of cement to three of aggregate, by a proper purpose-made measure. The concrete must be thoroughly well mixed by turning over on the mixing-board twice dry, and twice wet. The water must be added in small quantities, so as not to drown the cement. It should, in fact, be applied through a watering-can with a rose. And the concrete, when mixed, should not be liquid, like a grout, but should be of a spongy-wet character. It is best to mix, on one board, only one bag of cement at a time; so the wooden measure for aggregate should be made just large enough for three bags of cement to fill it to the brim. It is a mistake to use, as aggregate for fireproof flooring, any material which has not been vitrified. Sea-shore shingle, or broken stones of any kind, are, therefore, extremely unsuitable. On the other hand, sherds and "scarr" from the potteries, or from glassworks, are often extremely suitable for aggregate, especially if mixed with ordinary brick rubbish. In the body of the floors intended to be fireproof no sand should be used. The body of the floor being cast and beaten well down on the wood centring, the finishing surface-coat must be added before the body is set; the finishing coat should, in fact, be done within a period not exceeding twelve hours from the body casting. The finishing coat should be of very fine, hard, crushed brick or granite, with a little coarse sand, constituting an aggregate, which should be mixed two to one with Portland cement. This finishing coat should be about an inch thick, and must be done in one heat for each section of the floor.

I am assuming throughout that "W.'s" fireproof floor is an upper floor. If it be a ground floor, all he needs is a 6in. bed of dry, broken brick, spread over the ground and levelled up; and then a concrete top-skin on the same, 2½in. to 8in. thick, mixed one of aggregate to two of cement, and finished in one heat, as above named.

Cement concrete, if the cement be old, contracts in setting and drying, in almost precisely the same way as cast-iron contracts in the mould when cooling. This fact constitutes the chief difficulty, limiting the application of concrete to masses of not exceeding a certain size, unless special provision for contraction be made. No better practical proof of this can be adduced than the fact that in the paving of street side-walks and railway-station platforms with cement concrete (which is now coming more and more into use for these purposes), experienced paviors divide their slabs from each other by very thin wood strips or joints about 7ft. apart. When these joints are not supplied, the contraction of the pavement cracks it across in a very unsightly fashion. From personal experience and observation, I am able to state that, where street side-walks, &c., are left to form their own contraction joints, they do so about every three or four yards apart. But this distance will vary, according to the material composing the bottoming and the concrete, and also according to the proportions of admixture, &c. I have also found that, in upper floors, where slabs are cast from four to five yards square in one homogeneous mass of concrete about 1ft. thick, resting all round the four edges on iron girders or walls, but having no intermediate iron girders embedded, in such cases the contraction occurs at the edges, and though it is very considerable, it leaves the body of the slab intact. But, while this is true in the majority of cases, I may add that occasionally slabs of this class do exhibit cracks across the underneath surface of a diagonal irregular direction; but where I have observed such exceptional cracks I have generally been able to trace their cause to some unequal settlement of the foundations of the building, or of the temporary centring which has occurred during the period of concrete-setting and contracting. Moreover, I have also proved that where diagonal cracks of that exceptional nature have appeared they have made no appreciable difference to the enormous strength of such warehouse floors. The reason for this maintenance of strength, in spite of cracks, appears to be the same as the reason for the fact that a vertical saw-cut on the top of a wood beam to a considerable depth makes no appreciable difference to its strength. The wood beam and the concrete slab alike experience compression at the top and tension at the bottom. The resistance of the wood fibre to tension is prodigiously in excess of its resistance to compression, while the resistance of cement concrete to compression vastly exceeds its resistance to tension. And as the saw-cut may (subject to certain conditions) really help the beam to employ its tensional strength to greater advantage, so the diagonal crack on the underside of concrete slab (seldom or never extending up through the entire thickness) may help the slab to so adjust its stresses as to make the greater use of its compressional resistance.

It is a very noteworthy and fortunate fact that the under seams or thicknesses of a concrete floor possess a far greater tensional resistance per inch of sectional area than the upper seams or thicknesses of the same slab. For, during the process of casting and ramming or beating, the greater portion of the cement itself settles towards the bottom, hard on the wood centring, leaving the top of the slab comparatively denuded of cement. This, I say, is a lucky circumstance; for the top aggregate, with its comparatively small quantum of cement, possesses an enormous surplus of compressional resistance, and thus the tensional strength of the cement gathers most at the bottom, where it is most wanted. There is also another advantage in this circumstance—viz., this: that for warehouses, workshops, and rooms not requiring a superfine ceiling, the concrete forms its own ceiling in a most remarkable way. The fine cement at the bottom, under the pressure of the superincumbent thickness of concrete, and under the blows of the workmen's rammers imprints itself upon the wood boards which form the centring, so that eventually, when the centring is removed, the underside of the concrete floor exhibits so astonishingly minute an impression of the grain and knots and joints of the wooden centring, that most persons, on looking up, believe that they are under a wooden ceiling, and are amazed when they are informed it is concrete. For this reason, where sightliness is an object, and where there is no finished ceiling to be eventually added, the centring should be of clean-dressed floor-boarding, and not of rude battens and planks, especially as the same floor boarding may be afterwards used (turned upside down) for flooring, being little, if any, worse for its use as centring. Moreover, if floor-board centring has (as it preferably should have) tongued and grooved joints, the water does not drip so readily through the concrete during casting and setting; and the water being thus longer retained, the setting is slower, and the concrete floor is correspondingly stronger at last.

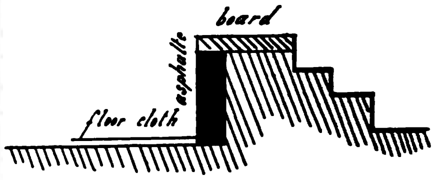


Under no circumstances should the centring be removed or in the least degree disturbed till a clear five weeks have elapsed from the completion of the top surface of the floors. While the concrete is wet it casts an enormous weight on the centring, and as the concrete sets it slowly relieves the centring, and finally sustains its own weight. It is of the very utmost consequence that both the foundations of the permanent walls and the supports of the centring should be absolutely proof against unequal settlement during the time the concrete is setting. Builders are extremely foolish who, in order to save the small expense and trouble of providing for their centring an ample number of posts and supports, run the risk of disorganising the setting process of the concrete, which cannot be perfectly performed on an unstable or unequally yielding centring.

The large experience I have had in concrete floors would enable me to proceed without misgiving to floor "W.'s" workshop with *one slab* of cement concrete, bodied and finished as above described, on secure centring and foundations. I should make the floor 7in. thick at the crown and 24in. at the haunches. When the slab is set and centring removed, there will be no thrust on the walls. The slab will act as a dead weight, and should be set on strong courses of brick corbelling round the side and end walls of workshop. The strength of this floor will continue to rapidly increase from one month old till three months old, after which it will still increase, though less rapidly, till about twelve months old, when it will have attained its full strength. All other things being equal, the strength of slabs varies as their surface area divided by the square of their thickness. A slab is distinguishable from a beam by the fact that a slab is supported round its four edges, while a beam is supported at its two ends. There are also circular slabs, and also square or rectangular slabs, with less than four and more than two edges supported. But I am at present dealing only with slabs supported round all edges. If there are any trap-doors or apertures, they should have their vertical angles rounded to prevent cracking during setting; and their horizontal angles should be protected by wood or iron casing against blows from goods, &c., passing through after completion.

Some time after the floor is set "W." will observe some shrinkage all round the top edges next the walls; and this shrinkage will (if the whole length be in one slab), be double as much at the end gables as at the side walls, provided the material is left free to contract longitudinally as well as transversely without resistance.

But (unless specially counteracted) frictional resistance to contraction will be experienced at the vertical edges *f f*, and such greater frictional resistance on the horizontal bearings *b b*. And unless this can be eliminated there can be no sufficient guarantee that contraction will not make some ugly cracks across the floor. All that the floor needs is freedom to *slide* on its supports. Therefore, against the walls, at *f f*, before the concrete is cast, let "W." tack lightly a strip of floorcloth well saturated with a boiling mixture of three parts pitch (with a little sand and quicklime added) to one part tar; these strips to be put up in short lengths, with open joints of about ¼in. wide. Also on the ledges *b b*, before the concrete is cast, let "W." pour on a boiling mixture of the same tar and pitch (the same kind as is used for ordinary damp-courses), and not less than ⅝in. thick. In order that this may be done properly, a temporary board should be fixed against the face of brick corbelling, standing up ⅝in., thus: the top edge being set absolutely level, and the asphalte being floated up to it, and allowed to set before the board is removed. On the surfaces thus provided, the great slab when contracting can slide freely, and no crack will appear, for by this simple and cheap means "W.'s" floor slab would be almost as free of frictional resistance to contraction as a long-span railway-bridge set upon rollers.



But it must also be remembered that the wood centring must be made in short lengths (not exceeding 15ft.), and with plenty of free play at butt ends: though most of the observed effects of contraction will take place *after* the centring is removed.

If, instead of making the slab in one length, "W." prefers to subdivide it by a strong transverse girder embedded at the half-length, then the contraction will be equal on each of the two slabs transversely and longitudinally; that is to say, the shrinkage next the side walls will be equal to the shrinkage next the end walls; and there will be ultimately a wide transverse straight-crack right across the floor directly over the transverse girder.

Of course, if "W." doubts the strength of concrete without iron, or if he wishes to make the floor thinner than I have advised, he can use iron girders to his heart's content. In that case (always assuming there is an objection to have columns in the lower shops) "W." can place across the shop transverse and strong girders 10ft. apart; and across these he can fix lighter girders in two longitudinal rows 10ft. apart. Then he can cast his slabs in 10ft. squares flat underneath as well as on top, and embedding the lighter girders.

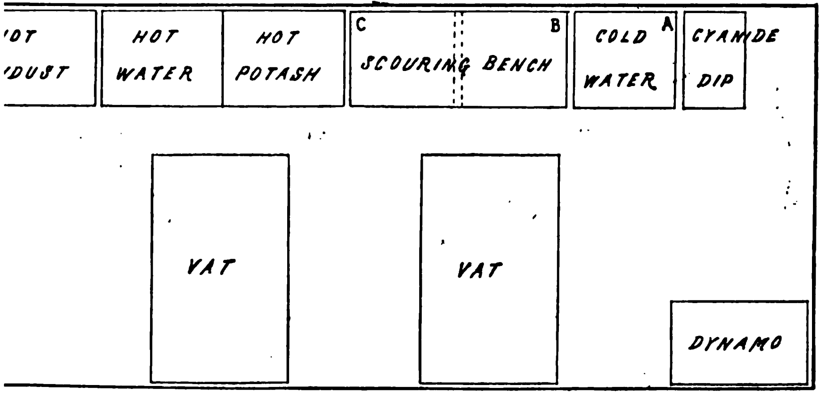
The six raked cross girders could then be encased with plaster work to protect them from fire. By this plan the thickness of the floor should be about 8in., and the longitudinal girders should be 8in. deep, showing their top and bottom flanges bare flush with top and bottom of floor, which for workshops or warehouses is unobjectionable.

If four columns underneath are admissible, they might be placed so as to divide the bearings of a longitudinal girder into 15ft. spans. Transverse girders at 15ft. apart might, each at one end rest on the same column heads; and that would enable "W." to form a floor consisting of eight slabs of concrete each 15ft. square by 12in. thick, all the iron girders being embedded. Floors which I have had built of this class are carrying at the present time, in addition to their own weight, 4 and 5cwt. per square foot of warehouse floor space, without exhibiting the slightest signs of weakness.

There are, of course, many other ways of solving "W.'s" problem, and also other kinds of material. For example, there are Dennett's concrete and Doulton's hollow terracotta fireproof flooring, admirable for its lightness, and other materials and methods. But my remarks have been written with a view to enable "W." to see his way to do the work himself with Portland cement and broken brick, which, I presume, are the materials most ready to his hand; and also, if necessary, without iron, which is in itself far from fireproof, though it becomes almost fireproof when totally imbedded in concrete.

Sunderland. **Frank Caws.**

Fig. 7



ING AND NICKEL-PLATING.

(*Continued from p.* 9.)

]—BRASS, copper, German silver, and alloys are mostly polished without the iery. There are exceptions, as has been d, of plumber's work, but if it is for will receive a finishing polish.

pare stamped or spun brass for nickelling, irst with the walrus bob and Trent sand. ixed the bob between the plate on lathe, article (say a brass tray) in the right ith the left take up a handful of sand heap on the bench directly under the bob. tray on to the bob and gradually feed on so that it finds its way between the bob

pert would not only use his right hand for but would make great use of his left hand , although making most of his opportuni- icking up and feeding the sand on. In ese bobs the work is mostly held on the e at an angle of about 45°. A word about nd. This can be bought in the rough for 23s. per ton. It must then be sifted in a gradually increasing fineness till it has ough one of not less than 90 meshes to the on't attempt to sieve it through a fine st, or the stones will spoil the sieve at f course, it must be perfectly dry to pass the fine one at all.

time this process is finished, nearly half n has been thrown out as waste, and the r is now worth 5s. to 7s. per cwt. Before mix in enough oil to make it *heavy*, or it ff the bob like dust, and will soon be lost. ring gone over the tray till all marks have hed out, get a calico mop on, and with s composition go over it again, cutting all in this case, and it should finish with a urface.

case of work with corners and hollows, lrus bobs must be used, some of them large enough to cover the point of the others shaped on the edge to fit intricacies n or surface. These small bobs are out e walrus hide; they have no wooden core. eat thing to remember is that the better is polished, the better it will look after ed, and the less finishing the plated sur- require.

l goods are prepared for nickelling with mop and crocus only, and very little of Coffee-pots, cycle lamps, &c., made of tinplate, are "mopped up" and plated by and, and are greatly improved in appear- t. One would hardly recognise a cycle seen before it was plated—the tin-pot ce, solder marks, soldering solution (or stains, brass wire, copper top, dirty glasses, olours and all shades; but it gets mopped akes its turn for the plating shop. (Some lamps are, of course, japanned, in which do not come to our shops.)

efore leaving the polishing shop, a few the dangers. Shafting and pulleys under where they cannot readily be seen, is a in itself, more especially as polishers a long blouse of the night-shirt pattern short sleeves). If this "pinner," as we omes in contact with the generally dirty, aft, it goes round with it for a certainty es the tug of war, Arms v. Pinner, and y recollection arms have come off best for and pinner has parted; but it is an anxious to see a man exerting every muscle to save from being wound into almost certain Another danger is the lathe band. Tra- t a great speed, tight as a drum, a joint inches, and the pinner flying about it. o the factory inspector, these dangers are getting boxed up, but in some so-called shops, shafting, pulleys, and bands are still exposed to the danger of every one who has cause to go near them.

The other chief danger is the fire risk. Fluff from cotton mops hangs on everything. The bearings of lathes and shafting get completely hidden by it. It is occasionally taken off and thrown under the bench. Sheffield lime, compo, dust, oil, greasy sand, emery, iron, and steel dust cover the floor, and it is a common thing to "draw this together" every morning and let it lie in a heap for a week or more.

To convince a man of the danger of this, I once took a cigar-box full of this dirt, and having sprinkled it with water (as is done once or twice a day) covered it with glass, and put it full in the sunshine. In two hours the box was in full blaze.

Well, he "knew all about that," but did not see his way to keep the place clean. "Polishers are such a dirty lot!" and note, all his polishers *were on piecework.*

The Nickel-plating Shop.—In planning a plating shop study convenience; but do not have the cleaning utensils too far from the plating vats, as besides the extra walking there is the risk of getting a film of oxide on the work while being carried about. The plain sketch, Fig. 7, is a good arrangement, but can be altered to suit the shape of the particular shop.

The hot potash, water, and sawdust can be fixed over a flue, having the fire under the potash tank, as this requires the greatest heat and the sawdust the least; but undoubtedly the best and cleanest is good Bunsen gas-burners in the place of the fire. Steam-jacketed tanks or steam coils in the tanks are also first-class things where steam is plentiful; but this necessitates joints, and no matter whether made with rubber or red and white lead, the boiling potash soon fetches it out.

The hot water and potash are generally in one tank, divided by a tight partition. This is a convenience in heating and also in making up for evaporation, as the potash tank can easily be supplied with hot water and the water tank filled up with cold. Many platers use galvanised iron tanks; but I am in favour of ordinary black iron ones, no paint inside, as hot potash dissolves the zinc and gives brass a black oxidised appearance when boiled in it, which is sometimes difficult to get off.

The scouring-bench is best made of wood, well bolted together and lined with lead, and if made with a partition in the middle the water is used to better advantage. Have the water supply at A, Fig. 7, in the cold-water tank. A siphon overflow to connect to B in the first part of scouring bench, then a one-inch hole near top of partition allows it to run into the other half of bench. At C an overflow pipe stands up from the bottom. This pipe should fit into a taper plughole, so that by lifting it out the whole of the water in that part of tank can be run off. If all the scouring is done on a board lodged across the C end of bench, the water in the B end can be kept fairly clean and useful.

The usual materials for scouring are powdered pumice-stone, rotten-stone, and whiting; hard, six row, bristle plate (or scouring) brushes, ditto 3 row, ditto 1 row, and soft bristle brushes, 6, 3, and 1 row (Fig. 8).

Fig. 8

Fig. 9

Never put a bristle brush in the hot potash, as it will get turned into a glutinous mass. Use one made of cotton (i.e., ordinary round lamp-cotton); it will last better than a dozen fibre ones (Fig. 9).

Use nothing but boxwood sawdust—others stain the work. The cyanide of potassium dip can be made of 6oz. of cyanide to the gallon of water. A common cyanide of 50 per cent. strength can be used; if a better one, use less; if a white cake cyanide of about 80 per cent. strength, use 8 or 9oz. to the gallon.

An acid dip will be required for some work; but this, on account of its fumes, is best kept outside. Use commercial *aqua fortis*, or "dipping ackey." The nickel-plating vats should be made of 2in. or 3in. deal, according to size; planed, grooved, tongued, with the ends cut ½in. into the sides, well nailed, and then punched together with ⅝in. bolts through plates 2in. by ½in. iron. It must then be lead-lined (6lb. lead makes the most satisfactory job); the joints must be burned—soldering is no use whatever—and to finish it should be match-boarded inside the lead, to prevent holes getting knocked through in the case of heavy anodes or work falling to the bottom. This matchboarding must not be nailed through the lead, but neatly fitted in and fastened above the solution to the top edge of the vat.

The most satisfactory nickel solution to use is the sulphate of nickel and ammonia. I will not enter into details of the composition of this double salt, as it can be bought "at all *respectable* druggists and drysalters" (as they say in the advertisements), merely dissolving in water (12oz. to the gallon) to be made ready for use; but I must say a word about the quality of the salt: Some commercial double nickel salts contain quite a quantity of copper, and are of a deep green-blue colour. A pure nickel salt is much paler, or, as I might describe it, a whitey emerald-green tint, and more opaque. Of course the quality of the salt has a lot to do with the whiteness of the deposit.

Anodes: Use cast nickel anodes—let me impress this upon the readers, as I have seen in a recent publication rolled nickel anodes glorified, and cast nickel anathematised. Let me say a word for and against. An anode should be soluble in the solution; if it is not, the solution is soon spoilt. The ammonia evaporates, the nickel is deposited, and we have nothing left but weak sulphuric acid! This free acid, instead of attacking the anode, attacks the work, and partly redissolves the deposit, in all cases blackening it and making it useless. I could show a rolled nickel anode that has been in a vat three years, and is now invoice weight! Cast ones by the dozen have been worn out, tumbled to pieces, re-cast with new nickel, and worn out again seven or eight times in the three years. **Bijli.**

(*To be continued.*)

REVERSIBILITY OF THE WIMSHURST ELECTRIC MACHINE.

[28504.]—ALTHOUGH during the last three or four years so many letters have appeared in the ENGLISH MECHANIC on the subject of the Wimshurst electric machine, there does not appear to have been any mention of the important fact that this machine is, like the Holtz machine, reversible in its action—that is to say, if two machines, properly arranged for the experiment, are connected together by means of wires, one may be made to drive the other. As this very interesting circumstance would seem to be not generally, if at all, known, I venture to offer an account of some experiments which I have recently made with a view to investigate the phenomenon.

It may be well to state, preliminarily, that throughout these experiments an 18in. Wimshurst of the ordinary construction has been made use of to furnish the necessary supply of electricity; while for exhibiting the reversible effect, I have, for the most part, employed the double-sectored machine described in my letter 27030, p. 102, Vol. XLV. As therein stated, this machine has 16in. plates, with 14 sectors on both sides of each, the inner and outer sectors being connected together in pairs by strips of tinfoil passing over the edge of the glass. To insulate the plates from each other a fixed intermediate disc of plain varnished glass is used; though equally good, if not superior, results may be obtained, so far as the reversible action is concerned, by employing two circles of thin vulcanite. One of these is affixed to the back of each plate, and, of course, partakes of its motion. It may also be observed that instead of combs of the usual pattern, it is much simpler, and appears to answer equally well, to deliver the current to the plates by means of single points only. These are easily arranged; all that is necessary being two lengths of wire pointed at the ends and bent so as to embrace the plates; they are attached to the pillar balls by soldering. In some instances fine wire brushes in actual contact with the plates have been substituted for pointed wires, the effect being practically the same. Finally, in all these experiments, discharging terminals are superfluous, and are, consequently, dispensed with. For the sake of convenience I shall make use of the designation "terminals" to denote the pillar balls to which the discharging terminals are usually affixed. The reversible machine is, of course, divested of its driving-bands.

(1) Let the machine intended for exhibiting the reversible action have its terminals joined by stout wires to the terminals of the driving machine. The electricity produced by the latter is discharged on to the plates of the former, causing them to rotate briskly in an opposite sense to the usual one. The position of the neutralising rods governs the direction of the rotation. If these be reversed, the direction of the rotation is reversed also. The discs nearly always require a slight touch with the hand in order to start them. One plate may be made to rotate while the other is stationary. This, as well as the succeeding experiments, is not peculiar to the double-sectored machine; but may be performed also with the ordinary type.

(2) If the neutralising rods are removed altogether the rotation takes place with greater vigour than before. In this case, the plates, under all circumstances, require a starting turn with the hand, in order that all the sectors may become charged. As before, one plate may be made to revolve while the other is stationary. The direction in which the plates are started is immaterial—that is, it may be either from left to right, or right to left, but one plate invariably revolves in the opposite direction to the other. If both be started in the same direction one quickly stops and starts of itself the contrary way. It is important to observe that both in this experiment and in the last rotation does not take place if electricity is supplied to one terminal only, but it does if the disengaged terminal is connected to earth, or if it is furnished with a length of wire terminating in a point. In the latter case the point exhibits a brush or a bead, according to whether it is collecting or discharging electricity. The experiment has also been tried of supplying electricity to the discs through the neutralising rods, these being, of course, properly insulated. The result was negative.

(3) The fact that one plate will rotate while its companion is stationary suggested the idea of mounting a disc horizontally in such a manner as to reduce friction to a minimum. This may be done by inserting a pivot of brass or glass in the boss and suspending the disc, compass fashion, on the point of a stout needle driven into the top of a turned wood pillar. The pillar also supports a lower fixed plate, which should either be quite plain or have sectors on the under side only. The distance between the plates is regulated so as to avoid clashing. On connecting this apparatus with a Wimshurst machine, as already explained, the movable plate is made to revolve very rapidly; indeed, care must be taken that the glass is free from flaws, otherwise there is considerable danger of its flying into pieces. The plate will not, as before, start without an initial touch of the hand, which may be in either direction. Electricity may be supplied to both plates, or to the upper one alone; as a matter of fact, the rotation appears to be more rapid in the latter case than in the former. If the movable disc does not balance well—which it rarely does when first mounted—the fault may be remedied by making one of the sectors of thin lead of the requisite weight, and affixing it to the lighter side with Prout's glue. There is no particular limit as to size of disc. I have tried two sizes—namely, 16in. and 7in., both of which perform beautifully. Double sectors seem to be preferable, in which case the lower fixed disc should be 1in. larger than the upper one.

(4) There is a variation of the last experiment which may, perhaps, be of use for lecture purposes and to those possessors of Wimshurst machines who desire a pretty experiment to show their friends. Instead of suspending the upper plate on a needle, it may be made to rotate like a top. In order to effect this, a polished steel peg is firmly fixed in the boss, its lower extremity projecting about an eighth of an inch beyond the surface of the glass. A brass plug, with a small cup-like indentation at its upper end, is let into the wooden pillar, with the top of which it comes flush. The steel pin rests in the little cup, thereby keeping the upper disc, or top, in a central position on the stand. On giving a starting spin, and, if I may use the expression, "turning on" the electricity, the disc quickly attains a high speed, and remains spinning as long as desired. If small patches of variously coloured sealing-wax (red does not show well on shellac) are affixed to the plate, they appear as well-defined colour bands during the rotation. In constructing this apparatus it is convenient to fix the wooden pillar centrally on an oblong base-board, which should also support a pair of insulating glass cones surmounted by terminal balls. The pointed wires attached to the latter are best made removable, so as the more easily to observe the effect of supplying electricity to both plates together or to the upper one only. The wooden pillar should be about 10in. high and 1in. in diameter. Both plates require piercing with central holes.

(5) Two sets of horizontally-suspended plates may be joined up in series with the driving machine and both made to rotate at the same time. Here we have what are practically two Wimshurst machines (minus neutralising brushes) driven by a third. The current may be said to flow from one terminal of the driving machine to the first horizontal plate; from it to the second; and thence, by a return wire, to the second terminal of the driver. I have not succeeded in obtaining the reversible action with two ordinary machines in series, friction apparently being the obstacle to success. Very probably the experiment may succeed with lighter and more delicately-balanced plates.

(6) It is worthy of mention that a single plate suspended horizontally may be made to rotate without the aid of a lower fixed plate. At first sight the cause of this is not very apparent. Suspecting the motion might be due to the currents of electrified air "blowing" off the points and impinging on the glass, fine wire brushes were substituted for points, without, however, altering the result. Further investigation showed the phenomenon was really due to induction between the plates and the table beneath—a fact which may very well be demonstrated as follows:—Let a single plate be mounted perpendicularly in the usual way, the apparatus being placed on a table in the middle of the room. Rotation does not now take place; but if a large, flat object—say a drawing board—is placed parallel to the disc, and as near to it as possible (within 7 or 8in.), it will be found the plate rotates slowly, the motion being due to induction between the wood and the glass. From this it follows that in the horizontal plate experiments already detailed it is not absolutely necessary for the second (fixed) plate to be of a non-conducting material. Actual trial shows that instead of glass a disc of wood, cardboard, or even metal, may be employed with but little detriment to the speed of the rotation. Glass, however, is advantageous in allowing the use of double sectors and in permitting electricity to be supplied to both plates.

It may not be out of place to suggest that any machine furnishing the two electricities—even the old-fashioned cylinder machine with insulated rubber—is capable of producing power sufficient to perform these reversible experiments. It would also be interesting to try the effect of a good induction coil in this direction. I have not as yet been able to make either of these experiments.

H. W. L.

WORM-WHEEL DIVIDING — BACK LATHE — NORTHCOTT LATHE — CURVE TURNING.

[28505.]—THE worm-wheel dividing attachment, as shown on the fine Birch lathe in *Mechanical World*, Oct., 1887, certainly possesses the advantage claimed by the maker (letter 28230), on page 391, No. 1,187. It should be remembered, though, that there was much difficulty in altering the Holtzapffel lathe, in No. 1,182 of "E. M." (letter 28120), because of the contracted limit of space. The dividing train could not be placed as it was in the Birch lathe, as the segment stop was there, and the reverser gears had to be put aside, or displace the "star" guide for traversing the mandrel. With a new lathe these parts would have been better arranged. Cutting recently wheels of 252, 256, and 270 teeth, it was often necessary to free the worm from wheel for inspection. The stop wheel is not slid away; on its boss is mounted an arm for change wheels; a retaining screw being loosened, the arm and worm go down together, and are replaced precisely as before. The worm wheel has 288 teeth; the worm single-thread screw and 11 wheels, 28 to 64 teeth, give very many numbers. Three sockets, planed round, with solid keys left on, take all wheels equally. This use of intermediate wheels seems not provided for on the Birch lathe, but may, nevertheless, exist. It is pleasant to learn from Messrs. Birch and Co. (28280) that the writer's amateur efforts were on the same lines as Mr. Lowe's, of whose results "we" have had so little information, save tantalising allusions. No claim has been made for originality in making loops or rosettes by gearing, that process being at least fifty years old—at which time some account of it appeared in a magazine. It was revived and extended by the author of that masterly work the "Index to the Geometric Chuck," and the writer only followed in his path. If Mr. Lowe used the Epicycloidal Cutting Frame, no account of it seems to have appeared. The drawings given 18th Nov., 1887 (letter 28120) might seem to have an unnecessary amount of gearing, but a separate diagram would have been needed to show the making of simple loop work; therefore, although the E.C.F. was allowed to remain, its neutrality in such cases was explained (page 281, No. 1,182).

Were loops only required, the movement to and fro of the slide across the bearers would be better made by an eccentric working preferably in a vertically-mounted sliding frame, as there could then be provision for quick return when desired, but there could then be no combination of "loop and ripple" figures; and it is by using such combinations as initial curves and superimposing the small figure of the E.C.F. that the best effects are obtained. These E.C.F. figures could not be drawn in ink until the contrivance of the penholder (Holtzapffel, Vol. V. page 584).

Much labour is saved when cutting compound curves by first drawing on paper, and with coloured inks many beautiful figures are produced, of which many hundred have been mounted in albums, and form an attractive collection. Cutting, however, particularly with a wide-angle point, gives fine effects, owing to the play of light on the facets. The addition of a two-part geometric chuck has given more interest to the work, as all the complicated curves in the "Index" are easily drawn or cut. One feature of this chuck, believed to be original, will be described soon.

The first incentive to this work was given by the perusal of Northcott's "Lathes and Turning"; but the construction of the fine lathe there described, and the elaborate gearing at back, seemed far too difficult a task for an amateur, and other ways were tried to produce the same results. After many trials of rocking-head, crank-plate throw, and lever movements, the plan illustrated in "E. M.," No. 1,182, was adopted, comprising the extra lathe at back, because that would take any length of spindle for curve or copying work, and the long saddle cradle to hold the different sole plates necessary, with the power of locking and unlocking the nut. The general conversion (would Mr. Holtzapffel call it perversion?) of the beautiful Holtzapffel lathe to a complete engine lathe followed. In favour of the second lathe, it may be said that a lighter one will do; it is easily added, more so than any of the plans as yet published—never in the way, and can be connected instantly. The double lathe, as made 20 years ago by W. Goyen, and now by Birch and Co., is beyond the reach of most of us; but a light second lathe, with a wider range of uses, is of easy and cheap attainment. The purpose of recurring to the not sufficiently popular subject of compound lathe work is in the hope of awakening interest among your large body of amateurs who have worked over the better-known fields, some of whom may be induced to construct the simple apparatus necessary.

Just as simple turning is more attractive than any other mechanic art, so does complex turning far exceed that in fascination. Mathematical knowledge, never to be despised, is not needed in making geometric apparatus, and, while a chuck for this work taxes the powers of a skilled artisan, its substitutes are easily constructed. The study and practice of curve-turning leads on and up more than any other branch of the delightful art. Should some practical result come from any such pursuit, the manufacturer stands ready to take it up commercially, as witness the process of engraving looped figures on drinking glasses, and the lobed rolls used for forming rectangular iron bands, two extreme examples, both the direct outcome of curve-turning. As to original features (shown 18th Nov.), it is believed that, as yet, no one has proposed the separate lathe behind, the long dovetailed cradle with its grip, nor the use of the split nut in the surface slide, the last two of which are so useful that no one who has once had them would be without them.

It was in the hope that these features might be of use to others that the perhaps too elaborate drawings were undertaken. It is, indeed, gratifying to meet the approval of so high an authority as is Mr. Birch in these amateur attempts to facilitate the working of our favourite instrument, the king of tools.

Feb. **F. N. Massa.**

THE STEPHONIUM.

[28506.]—THE Stephonium is the name give to an "electric music interpreter," devised by Mr. J. C. M'Gee, of Edinburgh. It is an attempt to put within the reach of those not possessing knowledge of music a ready and easy means o playing simple airs upon the harmonium, piano bells, or other instrument having hammer or lever valve action. It is well known the great difficult learners have in their first efforts to play any of th instruments we have mentioned, is the task o placing the fingers upon the proper keys and, at th same time, following the music in front of them To meet this difficulty, a keyboard is dispensed wit altogether, or, rather, the Stephonium takes th place of the keyboard, thus enabling eye and han to travel together, from note to note, until the ai is completed. From purely pecuniary reasons th inventor has not been able to finish his piano player; but the principle being the same, he ha substituted thirteen tuned bells to illustrate hi idea. To a baseboard, upon which the bells ar placed, is attached a flat cable, carrying thirtee wires, which cable can be laid under room carpe or up or down stairs. To this cable the Stephoniu is also connected. Provisional protection has been secured for the Stephonium; but the inventor makes no claim as to bells or player, as the invention can be put to any player actuated by electricity. The Stephonium under notice consists of a baseboard 22in. in length by 5in. in breadth, and, resting upon a table, or other level surface; two supports at back give it an angle of nearly 45°. Across the surface of this board are wires, at equal distances apart, corresponding in number to those in the cable, which take their rise from screw-pins at right-hand side of board. Here they cross over a low bridge and pass on until they reach the left-hand side of the board, where they are carried over another bridge, and through the board to the back, where each wire ends in a brass terminal. To those brass terminals one end of the cable is connected. The use of the two bridges will be readily seen when we explain that the sheet of music or card is slipped under those wires; and as the distance between the wires is regulated by the size or scale to which the music is copied, it will be seen that a wire cuts or covers each note (line and space), including two ledger lines—one above staff and one below. Practically there is no limit as to number of wires, or to size of Stephonium. The latter may be as large as a school black-board, or so small as to go into the pocket; and the number of wires is also regulated by the compass of the music to be played. The cable (of any length) being now connected to Stephonium and instrument, it will thus be apparent that every wire of the thirteen on Stephonium is continued on through cable, round bobbins of electro-magnet, and on to negative pole of battery home. From positive pole of battery is carried a wire to hand of person playing, and to this is attached a small metallic pointer, not larger than a sewing needle, let into a small wooden handle, which gives the player purchase in holding it. The music being now placed in position, all that is required is to *touch the wire* covering the first note, the electrical circuit is completed, and the note indicated played, and so on, hand and eye keeping company until the end of the music. Another feature is the ease with which the music can be adjusted to suit the key. By raising or lowering the card or sheet of music, one line or space up or down, the whole range of notes is transposed, thus obviating the drawbacks of mechanical players, as it gives full scope to each individual's taste, and complete control over every note. Another advantage not to be slighted is the dispensing with the tortures of the music-stool, as the stephonium can be taken to easy chair or couch, and the "music," being simply crosses (or any mark) upon and between the lines, any child can copy the tune desired and play it.

Scotia Yet.

CHEAP PETROLEUM.

[28507.]—We have been promised cheap petroleum for several years, but we seem no nearer than we were, although many vessels to carry it in bulk instead of casks have been built. The pipe line from Baku to Batoum is not yet complete, so Russian petroleum at 2d. a gallon is still something to long for. Still many readers will be interested in reading the following description of vessels built expressly for carrying the oil in bulk, especially as the earlier attempts were not quite successful:—

Latterly great improvements have been made, the most recent of which are embodied in the *Ocean* and the *Chester*, sister ships, recently launched by Messrs. Russell and Co., Port Glasgow, to the order of Messrs. Hermann Stursberg and Co., of New York, and the first of the kind which have been built on the Clyde. These vessels are each 310ft. long, and are capable of carrying 3,500 tons of oil and 300 tons of bunker coal. They are built of steel throughout, and furnished with triple expansion engines. The machinery space is kept aft, in order that the boilers and furnaces may be shut off entirely from the oil spaces. Immediately forward of the machinery space is a very strong bulkhead, capable of withstanding greater pressure than those built in vessels of the ordinary character, and 2ft. forward of this again is another equally strong bulkhead. The intervening space is kept clear, so that it may always be accessible for examination, and for detection of any leakage of oil which may accidentally occur. The remaining length of the vessel, about 200ft., is divided into 16 compartments, each capable of containing about 220 tons of oil. The whole structure of the ship is triple riveted, by way of preventing leakage, and above the tanks, and running along the 'tween deck spaces, are eight large towers constructed of triple riveted steel, each containing about 30 tons of oil. These towers are necessary to keep the tanks closely filled, because of the expansion and contraction of petroleum, due to variations of temperature. The pumping arrangements for discharging and filling the tanks are very complicated, and consist of a duplicate series of pipes running fore and aft, and having branches to each of the petroleum tanks. A very powerful Worthington pump is situated in the after part of the ship, and this is capable of discharging (taken in in connection with the duplicate pipes already referred to) the whole 3,500 tons of oil in little more than 24 hours. During the voyage from this country to New York some of the tanks will be filled with water for the purpose of ballasting the vessel, as it cannot be used for cargo. Oil and water must equally be pumped up so as to fill the tanks to their utmost capacity. Otherwise the washing about of the liquid would introduce a dangerous element of instability, and for this reason glass gauges are placed in the towers so as to insure that a sufficient quantity of liquid is always in each tank. The problem of stability in connection with large masses of liquid on board ship is one of much greater difficulty and intricacy than usual, and in these circumstances Prof. Jenkins, of Glasgow University, has calculated the stability and trim of the vessel under varying conditions, and especially with liquids partially filling the tanks during loading and discharging. The calculations show that the vessel is thoroughly stable under loading and discharging, if these operations are conducted with ordinary care. An interesting application of the scientific results thus obtained takes the form of a series of plain rules prepared by Mr. Flannery, the designer of the vessel, and posted in the chart-room of the *Chester* for the guidance of the captain and officers in deciding which tanks may be filled and which left empty; which coal-bunkers are to be used and which kept full under the varying circumstances of the trade in which the vessel is engaged. The electric light, it may be added, has been fitted up throughout the ship, and for the first time electricity has been applied to the binnacle. The difficulty of keeping the compass free from error, to which it is liable in consequence of the electric current passing close to it, has been obviated by a very ingenious arrangement under which the light is conveyed upward to the compass by a tube and a series of reflectors from the place where it is generated below deck. The trial trip of the *Chester* was in all respects satisfactory. The engines, working at 160lb. boiler pressure, and indicating 1,250H.P., drove the ship a true mean speed of a little under 10½ knots. In a vessel of such large tonnage this was regarded by the practical gentlemen on board as an unexpectedly good result. In the case of the *Ocean* and the *Chester* alike, the ships and machinery are from the specifications and under the superintendence of Messrs. Flannery and Blakiston, London and Liverpool.

Kerosen.

ORGAN MATTERS.

[28508.]—In pursuance of the cause of right, and also of the right of one person to reply to the assertions made use of by others, I most willingly break through the rule I made of not replying to any letters signed by a "nom de plume"; but my excuse arises simply from a desire to let "ink slingers," as Mr. Audsley aptly names them, know that *I*, personally, do not desire in any way to carry on a correspondence with those who know nothing of what they write about.

It is very much against my will that I take up my pen to indite these few lines on my own behalf; but, as "J. E. M.'s" letter is, to a certain extent, directed personally to me, I beg to say, both to him and another Latin correspondent, by name "Video," that their arguments are worthless as far as the adoption of "noms de plume" go.

In their reference to certain articles of great worth by "Adept," they ignore, or rather, don't see—"Video" especially ought to, as he chose such a suitable signature—that "Adept" did not in anyway enter the pages of the "E.M." as a critic, or even as a disputant. He came as a teacher, and no one molested him; therefore, reference to his excellent articles as proving anything in favour of "nonentity" is "bosh."

Another writer of worth in the "E.M." was "J. D.—W." I consider his articles on the "Organ Built" far in advance of "Adept's"; not that I desire to run down "Adept's" valuable articles, for they are treasures in their way that no other periodical yet has published, and stamp him as one equal to his "nom de plume;" but "J. D. — W." wrote under his own initials, and the initial of the town he lived in—John Dresser, Walsall—besides, he advertised at the same time, and no secret was thought of it by any person.

This gentleman, if I am rightly informed, was not originally an organ builder; but I say he ought to have been one, for I saw several instruments by him, or, perhaps I may say, planned by him, and executed by his men, that any firm would be proud of. The finish and correctness of the mechanism was perfection; yet I saw, in one of his letters to the "E.M.," that he used the modest words "I'm but an amateur myself," and I add that he was one of no mean order. So much for "noms de plume."

Now comes forth a gentleman of the genuine sort, with correct and advanced views of the "craft," and directly he sets forth his views, and even not being let finish them so that they could be criticised as a whole, he meets with a regular theatrical storm, which however terrific and appalling, brings forth no results beyond exposing the ignorance of the "Jupiters" who commenced the din. The dilapidated trumpery that was used as argument has, no doubt, been stored away until the next pantomime is ready, and it will then be "faked" up for another attempt. Well, "R. I. P." I say over it.

I find my opponent, "J. E. M.," says he does not care to dispute the point about the superficial area of the soundboard. Perhaps he has good reasons for it. I am pretty well aware of the number of bunglers, tinkers, and clock-jobbers that have crept into the trade—one of the latter, I am informed, *became* an organ-builder about five years ago, and by the help of a friendly organist got some work, and handed over the "perks" for all he got him. One *job* mustered £150, and after being *completed* (?) six *whole* months, demanded £50 for additional repairs. This party, whose address was forwarded to me, describes himself as an employer of labour—which, by the way, he borrows from the neighbouring joiners' shops—and also an employer of "power," the latter being a lathe and band saw worked by a mill-stream. Oh! ye departed shades of bygone craftsmen, ye have escaped a terribly deluded lot of "duffers"! True, ye have escaped the long string of "self-opinioned" and "brainless" ones—but ye ought to be thankful! If converse can be held with you all, I say, let your genius be bestowed on the "men" who now stand up for the improvement and excellency of your cherished art. Of the others we have no fear, as they will dissolve when the focus of truth and honesty is centred on them.

How on earth did "J. E. M." come to know that "Uranium" only asked me about his soundboard for a joke, or a "goak" (as Artemus Ward would say)? It is about as good as his "knowing all about" Mr. Ingram's business. If "J. E. M." will send me his address, I will inclose another "goak" I got last week: it is the address of a *noted* bungler. As he also anticipates such a lot of pneumatics, &c., I beg to inform him that I intend to write for amateurs—*not* "professionals"; but I am confident that the articles will be of great service to him, especially the article on the "Bourdon" and the article on the "Swell."

I have the matter in hand, and will be very much pleased if I have been instrumental in helping the earnest amateur to elicit sweet sounds for his own and others' gratification. I now bid good-bye to the opponents I have contended with, and hope they will get more convinced of their misjudged views and perhaps thoughtless errors. I wish them well, and bear no unkindly feeling towards them.

Preston. **Wm. Robinson.**

STEAM-ENGINE ECONOMY.

[28509.]—What is the possible economy of steam-engines, and what is the efficiency of a good steam boiler? I read in one of our papers over here that many boilers returned 50 per cent., while others gave 75 per cent. of the theoretical value of the fuel. As this statement was made in correction of a "contemporary" (no name, for fear of advertising), I suppose it must be correct; but I doubt it muchly. Here is a way of putting the matter which appeals to all steam-users. A good stationary engine, connected to a modern boiler, will return to the owner one horse-power for one hour, with an expenditure of two pounds of coal. One horse-power is an exertion of 30,000ft.lb. of work per minute. For one hour the energy expended is 33,000 × 60 minutes = 1,980,000ft.lb. Each pound of good coal will, when fully burned, give out 15,000 heat units. Two pounds will generate 30,000 heat units. Each heat unit will, when fully utilised, perform 772ft.lb. of work. The work in two pounds of coal is, therefore, 30,000 × 772 = 23,160,000ft.lb. Of this 23,160,000ft.lb. of work only 1,980,000 is utilised in the steam plant. The loss, therefore, is 23,160,000 − 1,980,000 = 22,180,000ft.lb. This in percentage is 21,180 ÷ 23,160 = 91·4 per cent.

This is the actual loss due to (1) the inefficiency of the apparatus, and (2) the necessary losses due to causes which cannot be removed. To draw the line between 1 and 2 is impossible. If it could be determined just how much heat could be, with the best possible apparatus, turned into useful work, we could then give the percentage of unnecessary loss. The question is a good one, and the 91·4 per cent. loss has misled many experimenters, although it seems on the face of such an expression that our steam engineers were hardly doing their duty by future generations in wasting stored energy. Yet when this high percentage is reduced to show the unnecessary loss, there is no doubt that the criticism of their ability will be to their credit. If it were possible, we should like to state an approximation of the best possible economy of a steam plant. The recent developments in ocean steamers, where a horse-power has been obtained for an hour from 1·4lb. of coal, while many engineers had previously thought the limit to be not far from 2lb. per hour, undermines all estimates and prevents any definite statement of the highest attainable economy.

Looking at it this way, I am at a loss to know how the *American Machinist* can say there are boilers which give even 50 per cent. of efficiency, and that is the paper which "corrected" a contemporary.

Beaver Falls, Pa. J. G.

BAND SAWS.

[28510.]—IN France and on your side of the Atlantic generally the band saw has certainly always held its own with the circular; but in this country they are only beginning to appreciate it. I believe some Americans claim the circular saw as a native invention; but, be that as it may, not a few are beginning to see that it must give way to the band. Thus I find an able writer acknowledging that the band sawmill has undoubtedly come to stay. Its advantages over the circular mill are as great, everything being considered, as those which the circular mill possessed over the old up-and-down sawmill; not so much in the rapidity as in the economy and in the quality of lumber sawed. With a circular saw, a kerf of not less than ¼in. is taken, which means a loss of 1in. of board in every four. Now with a band saw there is no trouble in working with ⅛in. kerf, thus saving 1in. of board in every eight sawed by the circular mill. On the supposition that a portion of the lumber sawed is over 1in. in thickness, we are even then safe in assuming a saving of 1,000ft. in every 10,000ft. cut. With a mill of a capacity of 40,000ft. per day, and lumber at an average price of 10dol. per 1,000ft., this means a saving of 40dol. per day, which is enough to pay the entire daily operating expense of an ordinary mill. Besides this, the band mill occupies no more room than a circular mill; the saws cost about the same, and require about the same amount of care; and the band mill takes but little more than one-half the power required by a circular mill. A few years ago a band sawmill was a novelty, and very few good operators were to be found; but now there is no more trouble in getting operators for the band mill than for the circular.

In the more settled portion of the country timber is becoming more scarce and valuable every year, and yet there are thousands of square miles of timber from which a tree is yet to be cut, and it is in these localities that the band mill is to do its work. It is now known that band-saw blades of good material, well tempered, do not crystallise in running over their wheels, and if the mill is properly built the saws will run without breaking until they are worn down so narrow that their friction on the driving wheel is insufficient to drive them through the timber. For the larger class of good timber, such as the redwood of California, the sugar pine, fir, and spruce, white pine, poplar, and black walnut, a larger band mill is needed than has yet been made. The wheels over which the saw runs should not be less than 12ft. in diameter to carry a blade 12in. wide. In cutting such large logs where the guides are from 8ft. to 10ft. apart, the saw must be under a heavy strain in order to hold it up to its work. When these wide saws are worn down too narrow for such large work, they may be used upon smaller mills for smaller timber, if the wheels of the first mill have been large enough not to crystallise the steel.

A portable band sawmill is an article which is much needed; one that can be moved and set up as readily as a portable circular mill. The wheels in such a mill should be so arranged that the lower or driving wheel will not be directly underneath where the sawdust falls, and a wheel pit must be avoided, for the reason that much of the ground on which portable mills must work is so flat that it would be necessary either to have a cemented waterproof pit, or else to set the mill up on framework, so as to bring the wheel above the ground, thus adding too much to the expense. It might be possible to arrange the saw so as to operate at an angle of 45° with the run of the carriage, using the circular mill machinery with the mandrel for a countershaft, and have it interchangeable with a circular saw, which might be used for sawing the rougher class of logs and large square timbers, railroad ties and the like, where the reduction in the kerf would nearly all come off the slab. Such a mill is very desirable, and must in a very short time be in the market. The band mill has come to stay, and in time the circular mill will be a thing of the past.

I send this because you have recently had some letters on circular saws. They may be useful for cutting boards into pieces, but for slicing up timber and planks they are not in it with band saws to my notion. Just think where the strain comes in a circular saw, and compare with the direct pull on a band. I know that some years ago band saws were not made of their present quality. I supppose that accounts for the use of the circular.

Worcester, Mass. T. F.

MAGIC SQUARES, CUBES, AND QUADRICS — MAGIC SQUARE FOR 1888 — ODDLY EVEN ROOTS—ANSWER TO "W. T. P." (QUERY 64688) — NASIK AND PLY-SQUARES.

[28511.]—THE magic square given by Mr. Hampden (letter 28488, p. 34), is merely an adaptation of an ordinary magic to the summation 1888, which can easily be accomplished, since 1888 is divisible by four. This square is not by any means perfect, since it has diagonal summations only on the central diagonals, and is "ply" only as regards the four principal subsidiary squares. Below is the perfect form of this square—

457	485	463	483
479	467	473	469
481	461	487	459
471	475	465	477

In this form the square is "magic," "nasik," and "four-ply." It is magic because every row and column and the two central diagonals give the magic summation $\left(\frac{457 + 487}{2} \times 4\right) = 1888$. It is nasik, because every ex-central diagonal gives the same summation. The ex-central diagonals are determined by imagining the square repeated in all directions. Thus the following numbers form ex-central diagonals—479, 461, 465, 483, or again, 459, 465, 485, 479, &c. Further, this square is 4-ply, because any square of four numbers, cut out of any part of the square, gives the magic summation. It should be noticed that these square bunches can be taken in sixteen different ways, for when we overstep the border of the square we have only to imagine the square repeated in the same way as when determining the ex-central diagonals. Thus

469	479
459	481

is a magic bunch, and so is

477	471
483	457

There are, therefore, in all, thirty-two magic summations.

The above square, and all nasik squares of the form $(2^n)^2$, can be written down at once by a method of my own, and a similar method will give all nasik squares whose root is a prime number; but nasik squares whose root is the product of odd factors (9, 15, 21, 25, &c. . . . .) can only be satisfactorily approached by the La Hireian method of superposition, though all *crude* magics with odd roots can be easily constructed by Bachêt's process.

When applied to a square whose root is a square number greater than 4, a modification of La Hire's method will make the principal subsidiary squares magic, as the following will show:—

71	4	48	35	76	12	26	40	57
28	81	14	19	45	59	64	9	50
24	38	61	69	2	52	33	74	16
67	3	53	31	75	17	22	39	62
36	77	10	27	41	55	72	5	46
20	43	60	65	7	51	29	79	15
66	8	49	30	80	13	21	44	58
32	73	18	23	37	63	68	1	54
25	42	56	70	6	47	34	78	11

This square contains the first 81 natural numbers without repetition or omission, is nasik as to its 9 rows, 9 columns, and 18 diagonals, and is also nine-ply—i.e., any square bunch of nine numbers taken at random will give the magic summation 369. There are 81 such bunches. Further, each of the nine principal subsidiary squares divided by the heavy lines is magic as to rows and columns, giving one-third of the summation of the great square. Again, if any three of these nine small squares which lie on a diagonal of squares (central or ex-central) be taken, and placed one upon another, we get a magic cube, giving the magic summation 123, along any one of its 27 rows, lines and columns, and in the cubes formed from either central diagonal or squares, the four great diagonals are also magic. For example, consider the cube formed from the squares which have the numbers 26, 31, and 66 in their top left-hand corners. If these three squares be placed one upon another, in their proper order, then, in the resulting solid we shall find the numbers 16 and 66 at opposite corners, and the great diagonal joining those corners will contain the numbers 16, 41, and 66, whose sum equals 123, and similarly for the other three great diagonals of the cube. So, for every column of the cube measured downwards, 50 + 55 + 18 = 123, 74 + 7 + 42 = 123, &c. Lastly, if three parallel diagonals of squares be taken, the three resulting magic cubes will together form a magic quadric, such that any number in one cube, together with the numbers in the corresponding squares of the two other cubes will give the magic summation. The faces of the cubes must be taken in the proper manner to form this quadric; if we denote each small square by its central number, then the squares 9, 41, 73 will form the *central* cube of the quadric, and the squares 77, 1, 45, and 37, 81, 5, taken in the order indicated, will form the two outside cubes of the quadric. The quadric has eight great diagonals, all of which give the magic summation. They are determined by taking the first number on a great diagonal of the first cube, plus the second number of the *corresponding* great diagonal of the middle cube, plus the third number on the same diagonal of the last cube, and similarly commencing at any one of the eight corners of the first cube.

This method can be easily extended to higher roots, and, in fact, I have lying before me the great nasik 25-ply square, containing the first 625 natural numbers, and leading to five cubes constituting the quadric, whose root is 5. This great square has the additional property that each of the 25 principal small squares is not only magic but nasik as to all its 10 diagonals, a property which cannot be introduced into the square 9^2 on account of the incapacity of the square of 3, which cannot be nasik.

In answer to "W. T. P." (query 64688), there are several methods for the construction of oddly-even-root crude magics (root $= 4n + 2$), but such squares cannot be made nasik. Unfortunately, the two best methods I know of are recent discoveries by a friend, and as yet unpublished, and consequently I cannot divulge them. Perhaps the best known method is that of bordering. For example, to make the square of 14, take the first 196 numbers, and rejecting the first 26 and last 26 we have 144 numbers left, commencing with 27, and running up to 170; these 144 numbers can be easily put into a magic of 12^2 by merely adding 26 to every number in the ordinary magic of 12^2. We have then only to border this square with the remaining 52 numbers to obtain the magic of 14. This can be effected by a method of procedure which may be formulated, and no doubt "W. T. P." will be able to discover for himself. Should he find any further difficulty, if he will advertise his address in the Sixpenny Sale column I will forward him the method gratis. Another method is that of pseudo-squares, invented by Thompson—vide Cram on "Magic Squares. C. P.

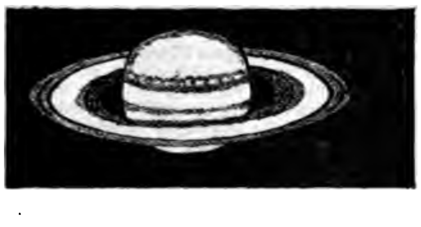
TURBINE v. WATERWHEEL.

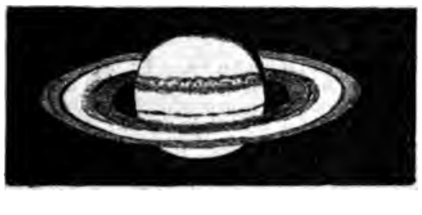
[28512.]—IN looking over last week's I was much pleased with the remarks of "Engineer, Govan," in reference to the above. I hope he will be successful in obtaining their relative merits and demerits demonstrated by some experienced and disinterested persons. No doubt there are a large number of people who would be both interested and benefited by the information. As the number of different makers of turbines are numerous, and all of them, according to their illustrated catalogues, are the best, it behoves all who are pecuniarily interested to get the most reliable information possible before he decides whether it shall be turbine or water-wheel. If the water-wheel will do as much work, and the repairs cost as little as represented, how is it the Americans have such a large number of powerful turbines at work? As in one mill, called the Spilsbury A. Mill, there are two 55in. Victor turbines, which are, according to catalogue, calculated to be driving 1,400 horse-power each; and another firm have got thirty-two 25in. Victor turbines at work. Then there is the Hercules, which the makers consider superior to any yet made, of which there are a large number working, and a host of other makers. If the water-wheel is as powerful a motor, and cheaper to keep in order, than the turbine, surely there would have been water-wheel engineers found to have competed with the turbine engineers before now if they had any chance of success at all.

If two water-wheels were erected of over a 1,000 horse-power each, it looks very probable that both a little skilled as well as unskilled attendance would be advisable. **Bolton-le-Moors.**

SATURN.

[28513.]—J'AI le plaisir de vous envoyer deux petits dessins de Saturne, exécutés à l'aide de mon huit pouces de Grubb, le 8 février, 1888, à 9 heures, et le 8 mars, 1888, à 8h. 32m., avec des grossissements de 250, de 420, et de 450 fois, dessins qui, s'ils sont bien reproduits *dans tous leurs détails*, diront mieux ce que je vois que toute description, pour satisfaire vos lecteurs et spécialement MM. Elger et Jones. J'appelle l'attention sur les points suivants :—





(*a*) L'aspect *moutonné* qui surmonte la bande sombre la plus marquée du disque.

(*b*) La visibilité plus grande de la bande d'Encke sur l'anse occidentale.

(*c*) Le 8 février la division d'Encke était le plus visible sur cette anse, et était manifestement plus près du bord extérieur de l'anneau A ; entre elle et le bord intérieur l'anneau A était plus brillant.

(*d*) Le grand éclat de B qui s'obscurcit seulement dans une zone très étroite voisine de la bande de Struve, cet obscurcissement étant très léger, tandisque lors de l'opposition de 1886 il était très marqué, et occupait une grande partie de la largeur de B ; sous ce rapport l'aspect de B est la même que celui que j'ai signalé dans "l'E.M.," No. 1,156, p. 268, pour le mois de mai, 1887.

(*e*) La visibilité de la bande de Struve surtout dans l'anse orientale à l'occident, au contraire, elle ne parait occuper q'une moitié de l'anse ; le grand éclat de B rend probablement l'observation de cette bande plus difficile qu'en 1886, et aussi celle de l'anneau obscur.

(*f*) La visibilité plus facile de l'anneau obscur dans l'anse orientale. Son bord interne y étant mieux définé que dans l'anse occidentale. Les contradictions qui se manifestent à ce sujet chez les divers observateurs permettent de demander si elles ne sont pas un indice de la rotation de l'anneau.

(*g*) Quant aux taches sombres dans l'anneau obscur, aux dentelures de son bord interne, aux dentelures du bord externe de la division Cassinienne, et à d'autres apparences du même genre, je dois dire, après mures réflexions et après un examen attentif, qu'il est nécessaire avant d'affirmer irrévocablement leur réalité, d'attendre le verdict des instruments les plus puissants, comme celui de Lick, par exemple ; trop souvent, en effet, des apparences de ce genre, soupçonnées d'abord, s'effacent complétement un instant après dans les moments fugitifs de calme irréprochable de l'image ; c'est du moins ce qui m'arrive pendant cette opposition. N'a-t-on pas fréquemment représenté au bord de la phase de Vénus d'enormes ondulations dont la réalité est restée fort problématique ?

Vos lecteurs savent que mon réfracteur de Grubb montre presque chaque jour Encelade ; j'ai tenté déjà plusieurs fois de voir Mimas en élongation, mais sans succès certain ; mon grossissement le plus favorable pour découvrir Encelade est celui de 150 fois. Je serais charmé de lire dans "l'E. M." quelques renseignements de vos correspondants possédant de grands instruments ou des instruments suffisamment grands, concernant la visibilité de Mimas. **Dr. F. Terby.**

THE FIFTH STAR IN TRAPEZIUM, &c., AS SEEN THROUGH A 3⅞in. REFRACTOR.

[28514.]—IN reply to Mr. A. Southgate's letter (28471), although I do not consider that this winter has been at all a good one for the detection of faint stars through the telescope, I am certainly surprised that Mr. Southgate should have failed to see the fifth star in the Trapezium with a 6½in. reflector. Using a very fine 3⅞in. refractor by Browning, I have seen this star on four nights this winter (the moonlight being bright on three of these occasions), and I shall not be quite satisfied till I have glimpsed the sixth star.

Perhaps, with "our" good Editor's permission, Mr. Southgate may not object to enter into a friendly competition, and examine the following objects, which I can see through my glass—viz.:

1. *Comes* to Polaris just divorced with a power of 27 times.
2. *Comes* A to Vega visible 40 minutes after sunset.
3. *Comes* to Aldebaran visible just one hour after sunset.
4. Titan and Rhea seen respectively 19 minutes and 31 minutes after sunset.
5. Furthermore, Dione and Tethys as a rule *readily seen*, even in bright moonlight, and Iapetus occasionally, though latter very variable.
6. *Cassini's* division and crape ring to Saturn both *very easy* objects, but no trace of Encke's division. (I presume Mr. Southgate has not confounded Cassini's division with Encke's.)
7. 13th-magnitude companion to ι Ursæ Majoris seen, but difficult.

I may perhaps here mention that I have occasionally seen easily Rhea, and *glimpsed* Dione and Tethys (of course, in addition to Titan) through a beautiful 2½in. refractor by the late Wm. Wray, though never all four at the same time as with my larger glass.

Jersey, March 10. **Wm. Locke Lancaster.**

[28515.]—IN answer to "A., Southgate" (28471), I have also looked for the 5th star, but have failed to see it. Last year I could see it very distinctly with 4¼in. Cook, power 120. I have found the best time to look for it—as soon as the three stars in the belt are visible to naked eye.

Alvechurch, March 12. **J. Wykes.**

ACCIDENT AT EUSTON—DOMES.

[28516.]—I HAVE been looking for some account of the accident at Euston about three weeks ago, when the Scotchman due at 8 a.m. was not subject to her brakes, and ran into the buffer stops.

Can anyone say what special advantages are found in a dome? The G.N.R. have none, and yet are never found to prime. On the G.W.R. it seems a matter of perfect indifference whether there be a dome or not. Do any engines exist in which, by an arrangement connected with the springs, the whole weight of the engine can be thrown on to the drivers? I have heard it talked about, but never saw a loco. where it existed. **John T. Lawrence, M.A.**

THE HOYLAKE RAILWAY COLLISION.

[28517.]—THE result of the trial at Chester Assizes last week most conclusively proved the correctness of my letter (p. 32) relating to the loose system of working the Seacombe, Hoylake, and Deeside Railway. The trial lasted two full days, and was practically one long history showing that every person connected with the accident, from the highest to the lowest, "did wrong."

A special train was sent over the single line without the officials making any proper arrangements; no notice of the train was even sent by telegraph to the Hoylake Station; no extra red tail lamp was attached to the previous train; the distant signal was not put "on"; and the look-out kept by drivers was not good, although the locomotive foreman himself was riding upon the engine of the special train.

The Hoylake station-master kept the single-line *tickets* outside the ticket-box, and issued a ticket without being in possession of the train staff, and the driver started with the ticket without *seeing* the staff.

When I first examined the facts of the case, it was clear that the death of the fireman was due to the tickets being kept outside the box and issued without the staff. Mr. Justice Wills sentenced the station-master to six months' imprisonment for this breach of regulations: and it certainly does appear a severe sentence considering the loose system of working the line and the large number of persons who contributed to the disaster.

Previously to the year 1886, it appears that only one engine was employed upon the line, and there can be no question that with an increase of trains and engines the Company should have instituted a more strict system of working, and also have adopted the absolute block system, under which such a collision could not have resulted.

Clement E. Stretton.

Queen's Hotel, Chester.

ORGAN MATTERS.

[28518.]—CLARENCE EDDY in his letter (28495, page 35) speaks of Messrs. Steere and Turner inclosing the great organ reeds, mixtures, &c., in *the* swell-box. I should like to know a little on this point, as I have been under the impression that the portion of the great inclosed in a swell-box was either in a separate box to that of the swell-organ or inclosed with the choir organ-stops. A clergyman who is having a small organ built for his church, tells me that the specification provides that out of three stops on the Great, two of them are to be inclosed *in the swell-box* with the three stops of the swell-organ. Can any of our organ friends say if this will be satisfactory? The organ only has these six (speaking) stops.

Assistant Organist.

"ABBE-SCHOTT" NEW OPTICAL GLASS.

[28519.]—IN the *Engineer* of March 2 mention is made of this glass, which, as there stated, "largely abolishes the secondary spectrum, and by it the focal distance is so increased that it can be used when with an ordinary Hugyhenian eyepiece of equal power the loss of light would be so great that the detail the objective would be capable of picking up would not be seen."

Newcombe, in his article on the "Telescope," says: "This secondary spectrum constitutes a most serious optical defect which no art can diminish." And it would be interesting to know something of the nature of this apparently important discovery.

The *Engineer* gives drawings of two applications for the microscope, and I should have written there; but it seems to me to lie more in the technology of the "World of Science." **W. S.**

PARAFFIN-OIL LAMPS.

[28520.]—MR. SAMUEL RAY wishes to know whether I can support the statements about lamp explosions in Charles Marvin's pamphlet.

Two lamp accidents have happened amongst my own relations; one of these must, I think, have been a genuine explosion. The chimney of the safety-lamp having been broken, the servant had lighted one of the old lamps. It suddenly exploded whilst the gentleman was sitting quietly by; the burning oil flew over the table and blazed up, but did not reach him.

I think there is no need to multiply instances of this sort while they are appearing so constantly in the newspapers. S. R. will see them if he looks out for them, and the evidence given at the inquests will be more convincing than anything I can say. I only wish there was more "alarm" raised on the subject. **F. A. M.**

[28521.]—BENZOLINE having been, through carelessness, mistaken for paraffin oil, and poured into the lamp, has probably caused accidents with these lamps: hence some people are afraid of them. To obtain an explosion with paraffin, the oil must be heated very considerably. I doubt if there are more accidents with this oil than there are with gas.

John Henry Knight.

Thumblands, Farnham, March 9.

THE DEAD-CENTRE LATHE.

[28522.]—I HOPE the writer of the interesting article on the "Dead-Centre Lathe" in this week's "E. M." will forgive my impertinence in putting him a question which, though suggested by his paper, is altogether outside of its subject. He refers incidentally to the twisted arrangement of fibre in certain trees producing what is technically known as a "rolled core." Though he mentions only the wild crab-apple, I do not understand him to mean that he knows of no other species similarly affected. I have myself observed others. What I would like to ask is whether he knows of any uniformity as to the *direction* of the twist—either general uniformity without regard to species or locality, or partial—i.e., limited to particular species or localities? To explain my object in making this inquiry, I may say that some time ago when travelling in Kashmir I was struck, not so much with the twist, though that was remarkable enough, as with the uniformity of the twist of the stems of the apple-trees which grow there in great profusion. In every instance the twist was left-handed. Before trying to explain to myself the cause of this peculiarity, it seemed prudent to make sure of the extent of its prevalence, and to this end during subsequent wanderings in the Himalayas and elsewhere in India, I took notes of the locality, the species (as far as my ignorance of botany permitted), and the direction of the helix in every twisted stem I came across, with the result of finding almost absolute uniformity—the only exceptions to the left-hand rule being a few doubtful cases, in which I could not be positive that there was any twist at all. I will not enlarge upon the Shandean speculations on the cause of the phenomenon into which I was tempted; but the nature of perhaps the most alluring of these speculations might be guessed from my anxiety to learn something of the behaviour of twisted trees in the opposite hemisphere; or rather, if the truth must be confessed, my hope that in southern latitudes the twist would prove to be *right*-handed. Unfortunately, I have never succeeded in obtaining any definite information on this point; nor indeed have I had any opportunity of learning anything about the twist of trees in any other country than India. The question has no practical importance, still, my curiosity being aroused, I should feel much obliged to any of your correspondents who could enlighten me further.

Kingstown, March 8. **H. A. G.**

BURNS.

[28523.]—In a blacksmith's shop it is a well-known fact that "black-hot" burns are far worse than red or white-hot burns, provided always that contact with the skin is momentary only, as to the *rationale* of which many theories have been advanced. Amongst the barbarities—useless as cruel—recently in full practice amongst village farriers (a class fortunately fast becoming extinct) was that of "firing" the legs of lame horses, under the supposition that consequent and permanent contraction of the skin (*cutis vera*) would prevent swelling of the subjacent muscles, tendons, périosteum, &c.; while within the memory of many M.D.'s now living, cautery, with hot irons and other beneficent devices, called forth shrieks of agony hourly during every day in each of our great city hospitals from their inmates.

If you had simply moistened the burnt surface with the tip of your tongue, or kept a wet rag on it, or taken a lesson from the dog, who always is most energetic in licking the seat of his pain or injury, you would have found prompt and permanent relief, radiation of the heat of inflammation (or of animal heat generally) being more rapid under the evaporisation of water than of any other known application.

Many a month's "on the sick list" of relief clubs; many a loss of a human limb; many a valuable horse's unsoundness, &c., may be averted by the judicious and prompt application of the dog's remedy—i.e., a constant moist, rapidly-evaporating surface.

Of the cautery with iron—of the moxa and their kindred—nothing is even now heard in hospital or practice; but cold-water dressings are fast becoming a universally recognised institution, the spread of which beneficent knowledge is rapidly extending. **The Lydney Dispenser.**

HUGE AEROLITE.

[28524.]—One of the Mogul Emperors (I think it was Baher) somehow managed to forge two swordblades from a mass of meteoric iron, as he describes it, superstitious motives prompting him to the experiment. He describes them as very superior weapons, both in quality and beauty. I have not the book now for reference. I send you an account of an aërolite which lately fell in the East:—

"The *North China Daily News* of December 19 contains an account of a monstrous aërolite, estimated to weigh 3,000 tons, that fell in Cochin China: An enormous aërolite, over 100ft. in length, and nearly 30ft. in diameter, and calculated to weigh nearly 3,000 tons, struck the ground in Cochin China on October 29, and ricocheted, after ploughing up a trench 100ft. long, 20ft. wide, and about 6ft. at its greatest depth. It struck a place called Than-duc, but was seen by French officers who were three miles from each other, and thirteen miles from where the aërolite struck, so that they were able to calculate its trajectory and speed. It rebounded at a depth of about one and a quarter miles a second, and it is calculated that it must have ultimately fallen about 440 miles from where it touched the ground, or in the middle of the China Sea." **Eos.**

SUNDIALS.

[28525.]—As I did not introduce the subject, I hope I may be forgiven if I offer a few remarks on an instrument for which I have always had a peculiar interest.

In the first place, it is the very first scientific instrument of which any mention is made, for I do not include the "harp and the organ," of which Jubal was said to be the inventor, as mentioned in the 4th chapter of Genesis. But now I am wishing to show the readers of the "E.M." that the author of the article quoted in last week's issue either did not understand the true conditions of this simple instrument, or else he used special pains to conceal the consequences of the principles involved.

I do not envy the intelligence of that man who can read the author's "Theory of Sundials," especially the first paragraph, without discovering the palpable fallacy of associating this instrument with the superficial surface of a spherical earth. His wording is certainly most ingenious—I will not use a severer term. He says: "Let us, in imagination, divide the globe that we inhabit, remove a section in the plane of its equator, and allow it to retain its ideal axis, which is to be our gnomon."

Now, what is the common-sense of those words? *He says we must* divide the globe into two hemi*spheres, take away the upper one,* and leave a perfectly flat surface, as the dial-plate of his instrument! Why had he not the honesty and courage to confess that, except on a perfectly *flat* surface, the instrument would not work? Then, if he pretends to understand what he is writing about, why did he not further confess that the *shape* of the shadows on a flat and motionless dial-plate could *only* be *radial* with a revolving sun round a fixed and motionless gnomon? On a spherical earth revolving on an axis before a fixed sun, all the shadows from an upright staff or gnomon must be in *straight*, and not in radial, lines, just as we see on the seam of a cricket ball. Would this be so or not? But there is no such thing as a *straight* shadow on the face of a sundial *east* and *west* of the gnomon! When the sundial was first invented, people did not believe in globes, or we should never have heard of this beautiful and most simple instrument. I defy all the opticians in the world to use or construct the "Universal Clock" (as marked Fig. 5) on the *outside* of a spherical, rotating, and revolving earth; and those who believe it possible should endeavour to explain the process in the "E.M.," and show how it is to be done.

John Hampden.

A MONSTER OF THE DEEP.

[28526.]—I inclose an account of the capture of an unusually large shark. The Mutlah floating light is moored at the mouth of the Ganges—a very highly-paid employment, as these vessels frequently disappear for ever in those awful hurricanes which haunt the Bay of Bengal. Sharks in shoals infest the waters (laden with the carrion of all Bengal); hence they are so gorged with food as to shun a baited hook. In this case the fish rose boldly to an *artificial man*, and was thereby bagged. I have known half a sheep rejected as a bait by those aquatic gluttons.

"Mr. Beaham, in command of the Mutlah floating light-vessel *Canopus*, killed, on January 22, probably the largest shark that has ever been destroyed in Hugli waters. A Calcutta paper says:—'The shark was seen swimming in the vicinity of the lightship for some months, and Mr. Beaham attracted him close to the vessel's side by hanging a bundle of old clothes overboard; he then waited his chance, and eventually drove a harpoon right through his head, when the fish was captured, the harpoon subsequently being withdrawn only to be found to be bent and useless. The measurements of the fish when hoisted on board were found to be—total length, 21ft.; breadth across the back from fin-tip to fin-tip, 14ft.; circumference round the mouth, 8ft.; circumference round the body, 15ft.; breadth of tail, 6ft. 10in. The weight was about two tons, and the biggest man on board got in through his jaws. A shark of these dimensions is, we imagine, very rare in these waters, though the ground-sharks in the West Indies and on the African coast run to this size and more.'" **Eos.**

Securite.—The dangers arising from the use of ordinary blasting powder in fiery coal mines have long been recognised. A desirable blasting agent has, however, now been produced, as was shown by some recent experiments at Hendon. The new explosive is a variety of "securite," which belongs to the class of high explosives, and has been in use in Germany for the past two years. Securite consists of nitrated hydrocarbons in admixture with certain oxidising agents. It is the invention of Herr Schoeneweg, who has rendered it flameless when exploded by the addition of an organic salt in certain proportions. There is, it is said, still a spark given off on its explosion, but it is not a spark *per se* that will explode inflammable gases and dust. The spark does not possess sufficient energy for this, and as soon as it is formed it is at once damped down, so to speak, by the action of the organic salt. This salt does not reduce the power of securite, but increases the volume of the gases and adds to the explosive force of the compound. In appearance the new securite is a finely granulated substance of bright yellow colour, and it is said to be non-hygroscopic—an important quality not possessed by the ordinary securite. Its power is said to be equal with that of dynamite No. 1, while its cost is much less.

American Factories.—Findlay, Ohio, is remarkable for its wonderful supply of natural gas, and has, therefore, rapidly increased in manufacturing importance. This growth is, however, not sufficiently rapid to please local landowners, who have lately held a convention to the number of 300, in which they resolved to place one-tenth of their land, or an equivalent in money, in the hands of a common pool to be used as a bonus in securing new manufactories. The capitalists interested in the place will, it is said, also be prepared to subscribe to the stock of new enterprises, which further have the benefit of free fuel, as the city gas trustees have decided to give gas to manufacturers absolutely free, only requiring that they pay the cost of laying pipes to their works.

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[63484.]—**Paper Organ Pipes.**—Unfortunately I live too far away to visit either of the organ friends (p. 216, last volume), but trust they will be good enough to reply through these columns to the query in full; the organ builders here are painfully mean about giving information. Could not one of "our" correspondents give instructions for tuning the organ in plain language, like Mr. Davies's on the piano? Mr. Dresser promised to, but so far as I can see, has not done so. Original query will be 12 months old before I see reply.—R. L. Driver, Queenstown, South Australia, Jan. 29.

[64071.]—**Limestone.**—I beg to thank "W. H. L. S." for his answer, and will he kindly say if the acid used is hydrochloric or nitric? The limestone is of a blue-black colour, and occurs, I believe, only in Somerset, near Bristol and Taunton; the lime obtained from it is used for agricultural purposes, but is no good for building. It is white, and very hard and stony. The stone is found underlying a bed of shale about four or five feet thick, and is interspersed with veins of spar ($Ca\,CO_3$). I can find no mention of it in the books which I possess. Can anyone say what the colouring matter is composed of?—Principia.

[64114.]—**Peel Towers.**—There are many works on Border antiquities, out of which "H. A." might extract the information he requires. Those of the Eastern border are summarised in the "Historical Guide to Carlisle and Neighbourhood," published by Moss, of English-street, Carlisle, who would probably give further information if requested.—Nephesh.

[64128.]—**Mercurial Poisoning.**—The late Dr. Bayes, of Bath, when co-editor of the *Homœopathic Review*, published, in 1867, his "Impressions and Facts drawn from a Ten Years' Homœopathic Practice." From this I extract, as being as instructive as it is amusing:—"*Mercurius.*—No medicine better illustrates the practical value of the small and infinitesimal dose of medicine than mercurius. In its crude form the metal may be taken by the ounce without any effect, either medicinal or poisonous. Many years back a chemist in a large country town assured me that on the eve of every aristocratic or public ball he sold many pounds' weight of quicksilver or crude mercury, the ladies having a belief that when taken in large doses it made them look fair—i.e., attractive. This chemist added that he had never heard of any evil results, but that a very considerable amount of the metal was always found in an unchanged condition on the floor of the ball-room after every ball. Now this same harmless metal, when mechanically treated so as to indefinitely extend its surface by subdivision, or chemically treated so as to cause its solubility in the animal fluids, or vaporised by heat, &c., then becomes a powerful poison, as every one knows. Blue-pill and grey powder present us with the mercury simply in a state of minute division. The metal has undergone no chemical change whatever; but five grains of the metal has now become a powerful poison, while five hundred grains or five thousand grains in an undivided, crude state would prove innocuous. Mercury has for generations been quoted as one of the few specifics known to the medical world. Quinine, mercury, sulphur—each was lauded as the specific remedy for its own special disease. Hahnemann may be said to have rested the whole fabric of homœopathy upon the basis of the well-known curative sphere of these three medicines, and from the demonstrations that each of these medicines, when given in long-continued over-doses, will cause a specific medicinal disease of its own which closely simulates the natural disease it cures."—The Lydney Dispenser.

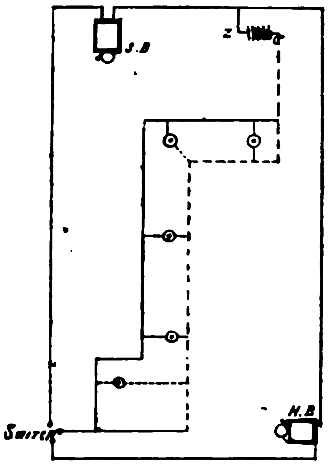
[64347.]—**Power of Solenoids (U.Q.)**—Information on such a subject would be most likely in papers by Prof. Ewing or Mr. Shelford Bidwell. A good piece of soft Swedish iron, well annealed, would be drawn into a solenoid with more force than a magnetised bar.—W. Perren-Maycock.

[64359.]—**Wheatmeal Bread.**—In answer to "Elementary Chemist," I would first ask him to understand we had been discussing "whole meal" bread,—the seed or grain being simply ground down to a proper degree of fineness, nothing being taken away. In that case it would be a perfect food, when the greater part of mineral matter, nitrogen, and (what is required for hygienic purposes) the bulky and innutritious substance is retained. Why I said white bread was almost worse than useless is because it is a delusive food, and not a real staff of life, as the poor think it to be. And they not being in a position to purchase other expensive articles, which are necessary to make up what white bread is deficient in, are in consequence starved and ill-fed without knowing the reason.—HYGIENIST.

[64385.]—**Osmunda Regalis.**—The royal fern is like other ferns—takes time to grow. Mix up some peat mould with yellow loam, about half and half, and lay the ripened fronds on it, or scatter the spores over it. In a suitable temperature, with plenty of moisture, they will germinate.—S. C.

[64461.] — **Altering Bell Circuit.** — Since erratum explained, "E. M.," March 2nd, your sketch is quite right, and will work well if you use insulated wires and make your joints tight and firm. Staple the wires separate, connect wires from carbon of battery to all the pushes, and from pushes to switch, as you show in sketch dotted lines, from switch to bells. Connect wire to the left terminal screw on bell from the right-hand screw to zinc of battery. Since Mr. R. T. Lewis's reply stating that everything is wrong, I have worked out your sketch, and find it works well through 230 yards wire, four pushes, two 2½in. bells, and switch with three No. 2 Leclanché cells, and if you take the switch out and connect all the wires together, both bells will ring at the same time.—PRACTICAL.

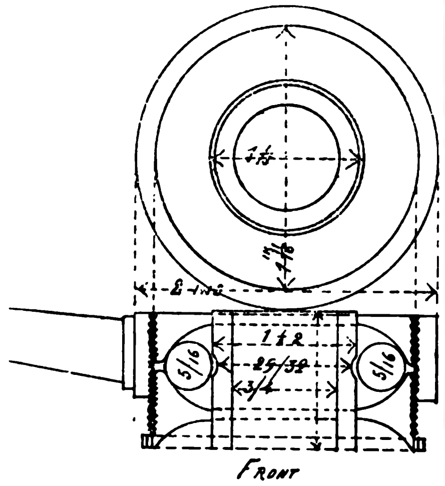
[64461.] — **Altering Bell Circuit.** — The appended sketch will show "A. I. E. E." how his bells must be connected so that any of the press buttons will ring either bell, whichever may be switched on. The dotted line represents the battery wire, which must be good insulated wire, and must be connected to the carbon of the battery. The querist has apparently used uncovered wire for part of the circuits. This is the absurdest of false economy. The efficiency of electric bells is ruined by such practices, and the bells or the battery are blamed when the fault rests with the wiring. Use good insulated wire all through: it will well repay the small additional cost. With regard to the switch, you will understand that A represents the centre on which the switch turns, B is the terminal for shop bell, C the terminal for house bell. Your sketch and description are not clear; but with the above particulars, you should be able to turn the job out satisfactorily. N.B.—Don't omit to solder all the joints of the wires.—WEBER.



[64461.]—**Altering Bell Circuit.**—To MR. R. T. LEWIS.—As already stated, I have no copy of the sketch by "C. T." to which you refer, and am therefore obviously unable to make the comparison requested; and as you will not give the simple particulars asked for, it is still doubtful if I yet understand what you wish to do. However, having corrected the errors pointed out in the engraving, I infer that it represents an arrangement by which either of two bells can be rung as desired from each of four pushes, the current being diverted from H.B. to S.B. by means of a two-way switch. Theoretically, the arrangement of your wires, &c., is correct; therefore, any failure to act must be due to some practical fault in some part of the circuit, which does not fulfil its requirements. As S.B. rings perfectly when the current witched into that half of the outer circuit, it ear that the fault lies somewhere on the other f which includes H.B.; and I have little doubt t if you test this carefully from its connection h the battery to that with the switch, you will d out the cause of the interruption. It is pos-le that there may be a bad connection at either l, or a faulty joint or unsuspected break in the wires connecting H.B. to battery and switch; . it is more probable that the fault is in the l itself, and that you will find it at the contact aker, if not at the internal connections of bind- screws or coils. With a cell and a galvanometer detection and localisation of the fault should be the work of a few minutes only. Apart from this, there is no reason why H.B. should not ring just as well as S.B does under conditions which are identical, or, for the matter of that, why both bells should not ring simultaneously if you substitute a close connection or a simple switch in place of one working in two directions.—R. T. LEWIS.

[64489.]—**Cores for Brass Castings.**—Ordinary Belfast red sand moistened with thin clay-water will suit any class of small brass casting. Loam and sand mixed with about equal parts will make a strong core; but you must blackwash the core, otherwise it won't "skin."—MOULDER.

[64559.]—**Cycle Wheels.**—I have sent a rough sketch of a front bearing, which I hope will be of some use. There are twelve 5-16 balls used. They do not bear on a perfectly round surface, but as shown in sketch. The back of the bearing case is shown. The spindle of hub is turned at the end a trifle smaller, about 1-16in., for the crank. I believe most bearings are made to the same size for roadsters; racers usually have ¼ balls, with ⅝ instead of ¾ sleeves. Tricycle bearings are in some cases larger, especially axle bearings. The same sized bearings are used for different heights of machines.—A. M. M. A.



[64562.] — **Rudder.**—The word "normal" in "C.'s" query escaped my notice on first reading. I wrote my reply without having the question at hand, and believed it was the resistance of the rudder to the ship's speed which was in question, which is as sin. θ, as I stated. On reading "M.I.C.E.'s" note, and again referring to "C.'s" query, I see it was the pressure on rudder normal to rudder blade which was in question. That pressure is, of course, as sin. $^2\theta$; and I humbly beg the book's pardon.—FRANK CAWS, Sunderland.

[64575.]—**Stamping Iron Sheet.**—Put several specifications of your wants into your pocket; take a walk through Upper Thames-street, London, and leave said inquiries at some of the wholesale galvanised iron or other warehouses, and then you will get your article at a far less price than you can possibly produce it yourself; or apply to some of the metal stampers in Birmingham, Wolverhampton, &c., where the American stamping machines are now revolutionising the tin and sheet-iron ware trades. By the bye, how is it that English mechanics allow Americans to invent such simple devices accomplishing such feats, knocking the besotted English artisans, master manufacturers, and merchants down into the gutter?—THE LYDNEY DISPENSER.

[64583.]—**Strength of Material.**—The formula I gave is used in place of the B D^2 of rectangular beams, and would be put above L, as is usual with B D^2.—T. C., Bristol.

[64603.]—**Engine to Lathe.**—I meant an electric motor.—T. C., Bristol.

[64604.]—**Heating Small Boiler by Gas or Paraffin.**—I am often annoyed at seeing the waste of space taken up in the "E. M." by the useless recriminations of bitter correspondents, and I would gladly avoid even a repartee merely as such. But in self-defence I must ask leave to reply to the severe scarifying Mr. Fletcher so unjustly and mistakenly inflicts on me. I did not "draw on my imagination." Realising as keenly as he does the meagre information given by many querists, I carefully sent him full details of my requirements. I did not ask about a "2 or 3H.P. steam-engine," but about an air-engine, which is nominally ¼H.P., but which gives out ⅓H.P. on the dynamometer. I sent him the patent specification, with fully detailed drawings, and an exact full-sized section drawing of the surface. On this sketch, which Mr. F. returned to me, he suggested an alteration which I am most grateful to acknowledge has enabled me to keep the coke fire going much better than I could formerly do; but as regards the use of coal-gas, his words were: "It would pay you better to have a boy to stand by all the time and fire with coke." His letter is dated Aug. 3, 1886.—T. F. S. T.

[This ends the matter. It is a pity both correspondents have not more regard for our space than to fancy readers value their private squabbles as replies.—ED.]

[64617.]—**Canoe.**—Having waited anxiously to see a reply to this inquiry, I was at last gratified, if not further instructed, last week. I think "Golden Slippers" is probably right when he says that most canoeists use a battened lug; but I feel morally certain that most do not use the type he quotes: it is without doubt an excellent arrangement, but from the amount of tackle it requires it turns a canoe into what I have heard aptly termed a string-box. I examined the *Nautilus* canoe in the Liverpool Exhibition, and thought the sobriquet most appropriate. If I might suggest a battened lug, at once simple and effective in arrangement, I would say, Try that on the *Severn* canoe; it is fully described with drawings in the *Field* newspaper of Nov. 26th, 1887. If necessary, I can describe the sail, &c.—PAT.

[64618.]—**Red Concrete.**—I am obliged to E. M. Pel for his reply to this question in "Ours" of the 9th; but the matrix he recommends will not make a good surface, and when dry it has rather a grey appearance. I want a concrete with the face as smooth, and the colour as red, as the best terracotta.—CONCRETE.

[Better go and see some of Lascelles' red concrete at 121, Bunhill-row, E.C.: that is about the best made; but whether you will succeed in getting the patentees to part with their methods which are the result of years' experiments, and the subject of several patents, is another question.—ED. "E. M."]

[64619.] — **Chemical Balances.**—L. Sidney tells us that balance-beams are now made of aluminium. I should feel very much obliged to the above gentleman if he could give me particulars as to where a balance with such a beam may be found. He also states—The longer the beam, the more accurate the balance. Theoretically, this statement holds perfectly true; but practically, certainly not. The sensibility of a balance depends—assuming good knife-edges, &c.—upon the weight of the beam, the rigidity of the beam, and the length of the arms. Now, it is found in practice that, although a long beam should be most accurate, it is really not so; this fact be explained by the great increase in weight, and loss of rigidity as the beam becomes longer. There is another point, and an extremely important one—that is, the longer the beam the slower the oscillation. Hence, by having a long beam the time taken to weigh is greatly increased. The best balances are now made with beams as short as 6in., whereas the old Oertling balances (still made, I am sorry to say), have beams as long as 14in. To really weigh accurately with a long beam-balance requires an extremely large amount of patience, and I believe that it is only on rare occasions that a chemist goes to the trouble, and expends time over an accurate weighing with a long beam. A gentleman of my acquaintance who was fitting up a laboratory, and who has never used anything else but a long beam, decided against a short beam for the simple reason that indications were so delicate that it was absolutely necessary to weigh to the fraction of a milligram in order to get anything like equilibrium. The opinion of all the authorities bears me out, that a short beam is more accurate in all ways than a long beam. I may state, in conclusion, for Mr. Sidney's benefit, that balance-beams are now made of aluminium-bronze.—CHEMIST.

[64622.] — **Screw-Cutting.** — "Sydenham" seems to have got in a fog. Suppose he puts the odd ⅛ out of the question in the first instance, then, if his screw were of 1in. pitch, it would require 107 turns of screw to one of mandrel. But the leading screw being of ½in. pitch, twice the number of turns, or 214 to 1, will be required, or 856 to 4. What he can possibly mean by 10·6⅛ is beyond imagination.—J. K. P.

[64626.]—**Model Loco. Boiler.**—If "Amateur" (in his answer to query) will be so kind as to fulfil his offer, he will greatly oblige—G. W., Moors Lea, Winchmore-hill, N.

[64627.]—**Caustic Potash.**—If caustic potash is dear, it is probable that the carbonate from which you must prepare it is still dearer. Will not caustic soda serve your turn? If so, follow the method given in the "Brit. Pharmacopœia"—viz., dissolve 28oz. soda carbonate in 1gal. water; heat to boiling, and gradually mix 12oz. slaked lime. Remove, allow to settle, and decant clear liquid by siphon into bottles, which keep closely stopped. Evaporation will yield the solid.—SM.

[64627.]—**Caustic Potash.**—The simplest and cheapest way of making this is to take 3oz. of carbonate of potash, in two pints of clean water, and boil it in a clean tinned saucepan. While it is heating (with a cover on) slake 2 or 3oz. of good lime, and add this in small quantities to the boiling liquid, stirring and covering it up. Do not do this on a cindry or charcoal fire, as it will carbonise. When all the lime is added, boil for a couple of minutes, and cover up carefully. Decant it from the sediment and evaporate to dryness in a porcelain vessel. The fused mass is caustic potash.—L. SIDNEY.

[64627.]—**Caustic Potash, How to Make.**—Procure some good pearl-ash; dissolve in the proportion of 2oz. to every pint of boiling water. Place this in a clean iron pot, and bring it quickly to a boil; now add 1oz. of quicklime, which must have previously been slaked and rubbed up to a cream with a little boiling water. Do not add the slaked lime all at once, but about a teaspoonful at a time, bringing the liquor to a boil after each addition. When all the lime has been added, give a final boil-up, taking care to keep up the original amount of water, since, if the water boils away, the potash actually takes back the carbonic acid from the lime. The vessel (which should be more deep than wide) should then be tightly covered with a well-fitting lid and set aside for twenty-four hours. At the end of that time $\frac{19}{20}$ths of the liquid may be decanted off clear and colourless. To obtain the solid caustic potash from this, boil it down quickly in a clean iron or silver pot till it flows like oil, and then pour it on a silver plate to set. Keep it in well-stoppered bottles. Caustic potash does not crystallise.—S. BOTTONE.

[64627.]—**How to Make Caustic Potash.**—You will find it difficult (I might say impossible) to obtain your desire. The best way for you to obtain caustic potash would be as follows. Make up a solution of pearlash to about a sp. gr. of 1·15. To this solution add caustic lime in the proportion of 56 parts lime to 138 of pearlash. The liquor must then be kept at the boiling temperature, either by direct heat, or by passing steam through, until a small quantity of the liquor (separated from lime) does not effervesce when treated with acid. When this point is reached allow to cool, and decant the clear liquor. This must then be evaporated down to dryness, and the residual caustic potash fused, which is then run into some convenient receptacle, which must prevent access of air and moisture.—CHEMIST.

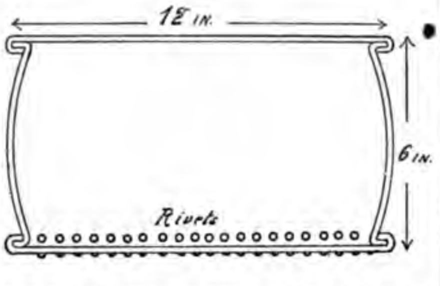
[64627.]—**How to Make Caustic Potash.**—Boil together in a cast-iron vessel one gallon of water, 1lb. pearlash, and $\frac{1}{2}$lb. quicklime, previously slaked by a small quantity of water; allow the white sediment to settle, pour off the clear liquid into an iron pan, and evaporate to the consistence of oil, and allow it to cool. The result will be a solid cake of a dirty white colour, which must be quickly broken into pieces, and well stoppered or corked up in a bottle. Instead of allowing the pan to cool, perhaps it would be better to pour the oily liquid out on a marble or iron slab. You could get a pound of it for about 9d. in London; it will keep indefinitely if kept from the air (i.e., in a stoppered bottle). The above is the crude caustic potash, which I suppose is what you require.—PRINCIPIA.

[64627.]—**How to Make Caustic Potash.**—Take 50 grains of quicklime (CaO) and slake it with water, little by little, until a voluminous white powder is formed. Then pour the mass into about 250cc. of water and agitate. Then dissolve 100 grains of potass. bicarb. in 1 litre of water in a clean iron dish, and boil. Now add the milky liquor first made so slowly as not to stop ebullition, and keep the mixture well stirred, and add water to take the place of that evaporated. To find if the action is complete, remove the flame and allow the powder to settle down, then take a few drops of the clear solution out, and drop into this a little HCl (muriatic acid). No effervescence should occur. When this is the case, filter through linen, and evaporate down in a very clean iron basin (on the cleanliness of this depends the purity of the KHO). Heat the solid formed to redness, and pour the fused mass on to a clean copper sheet. This is crude KHO. If desired pure this must be dissolved cold in alcohol or methylated spirit by allowing it to stand two days in a flask of alcohol. A syrup collects in the bottom of the flask. This is impurities. Pour off the pure liquor, and heat it in a retort with a condenser; collect the alcohol distilled over in a receiver until the solution gets syrupy. Pour it into a very clean iron (or silver, if possible) basin, and heat to redness, and let it cool, and bottle it. Commercial lime and potass. bicarb. may be used, and all apparatus must be very clean. Glass must not be used to evaporate strong solutions of KHO, as it is attacked. Iron or silver are the only permissible basins.—DELTA.

[64633.]—**Scotch Putty.**—I am much obliged to "T. W. B." for his reply to my query; but I would thank him to inform me of what the "Vulcan" cement is made, which he says is generally used for hot pipe joints; also of what the Purimachos cement is made, as both would often be very useful to me and many other readers of your paper.—FERRO.

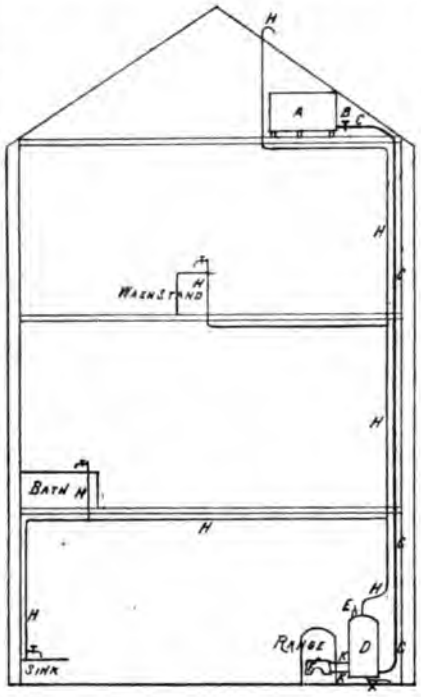
[64628.]—**Screw-Cutting.**—The following train of wheels was sent last week. It is an approximation, and a close one. $\frac{75 \times 90 \times 65}{55 \times 55 \times 20}$ ratio 14·504. Why not get a 145 wheel?—W. M. I., Dublin.

[64632.]—**Copper Boiler.**—Don't bother to rivet such a small boiler except where shown in sketch.



Make it of No. 18 sheet copper, and put in the ends as in sketch. It will be quite safe at 40lb. pressure.—CHAS. PROVIS.

[64642.]—**Hot-Water System.**—To "NEW SUBSCRIBER."—A, cold-water cistern; B, stop tap; C, cold-water supply-pipe to cylinder; D, hot-water circulating cylinder, galvanised iron or copper, about 36in. by 20in., containing 42 gallons;



E, safety-valve; F, wrought-iron welded boiler with arched flue and manhole at top (no flue should pass over manhole); H, hot-water draw-off pipe; K, flow and return-pipes from boiler to cylinder; X, pipe with screwed plug (not tap) to empty the arrangement in case of repairs. The whole of the pipes to be 1in. galvanised steam tube, with the exception of the flow and return pipes K, which should be 1$\frac{1}{4}$in. The hot-water draw-off pipe is carried up through the roof, of course to a higher level than the cold-supply cistern, and serves as an expansion-pipe. The fittings to the cylinder should be by brass unions to allow for removal. The emptying-pipe X should be for this purpose alone, and never as a draw-off. The position of the circulating cylinder may be varied to suit the building, but the nearer to the boiler the better, and on a higher level. The cylinder should be quite as large as the size given, or larger if much hot water is likely to be required at one time, as hot baths one after the other in quick succession. The boiler as small as the range will conveniently allow, but of the best make that can be procured, and fixed in the best possible manner. All hot-water pipes and branches to be laid with easy bends, and with fall towards the cylinder. The cold-supply pipe C may be bent to form a trap, where it enters the cylinders, or, better still, have a ball valve (marble valve) at that point if there is any fear of back circulation; this, however depends on the height of cold-supply cistern.—R. W. T.

[64644.]—**Cleaning Gloves.**—Camphene (spirits of turpentine) is what they use for cleaning gloves. I have never seen them do it, but I think it is only a brush or rubber wetted with the spirit and then rubbed briskly on; they are then hung out in the open air for the smell to go off.—GEORGE.

[64647.]—**Delivery of Water from a Pipe.**—If there were no friction in the 13in. main, or in the water-gauge itself, the latter would have registered for 130ft. head, 130ft. × 12in. × ·036lb. = 56·16lb. pressure per inch. The water-gauge pressure giving 50lb. leaves 6·16lb. frictional head in main. Providing the 50lb. pressure can be always relied on (?) it forms the basis of calculation for the delivery of the "Sprinkler" as follows:—Length of 5in. pipe = 47 yards × 3 + 40ft. = 181ft.; mean hydraulic depth of 5in. pipe $= \frac{5}{12 \times 4} = {\cdot}1$ft.; "sine of slope" of 5in. pipe $= \frac{-\ 40\text{ft. high}}{181\text{ft. long}} = -{\cdot}221$. Then, if there were no "sprinkler" attached to the upper end of the 5in. pipe, the water would flow from that upper end at the following velocity (adopting Neville's formula), less than the velocity at which it would enter the 5in. pipe at its junction with the 13in. main: that is to say, the minus velocity $= -(140\sqrt{{\cdot}1 \times {\cdot}221} - 11\sqrt[3]{{\cdot}1 \times {\cdot}221}) = -14{\cdot}208$ft. per sec. The velocity due to the 50lb. pressure is as follows: $\frac{50\text{lb.}}{{\cdot}0361\text{b.} \times 12\text{in.}} = 115{\cdot}75$ft. = theoretical head due to 50lb. per inch pressure $644\sqrt{\frac{115{\cdot}74}{64{\cdot}4}} = 86{\cdot}296$ft. per second velocity due 50lb. pressure. Then $86{\cdot}296 - 14{\cdot}208 = 72{\cdot}088$ft. per second velocity, at which water would flow from upper end of 5in. pipe, if there were no "sprinkler" attached. In order to carry the calculation with proper accuracy beyond this point the exact respective heights and lengths of the tubes which form the "sprinkler," as relating to the height of the upper end of 5in. supply pipe, must be known. But "Irwell" has omitted to give these necessary data. If he will give them I will complete the calculation. Meanwhile, all I can say is that the 5in. pipe, if there were no "sprinkler" attached, would discharge water at a velocity of 72·088 × 60 = 4,325ft. per minute. One foot-length of 5in. pipe contains $\frac{5^2 \times {\cdot}7854}{144} \times 6{\cdot}2355 = {\cdot}8517$ gallons. So that the upper end of 5in. pipe would discharge 4,325 × ·8517 = 3,684 gallons per minute. Then there still remain not only the respective heads, but also the diameters of the sprinkler tubes to allow for, and also the question of mean coefficient of orifice, which last is the question of the problem, and a very interesting one too.—FRANK CAWS, Sunderland.

[64650.]—**Designing Machine.**—The correspondents who have answered above have, I think, omitted one very important matter about the instrument, which I have always heard called a pendulograph. The table upon which the paper to be drawn on is placed, revolves by clockwork; otherwise the tracings would overlap each other. If "Alphard" will advertise his address, I will give him the name of a gentleman from whom he can obtain full information about it.—DOCTOR MED.

[64659.]—**Model.**—The packing is merely hemp wound round tightly and firmly. It must be kept well lubricated.—W. PERREN-MAYCOCK.

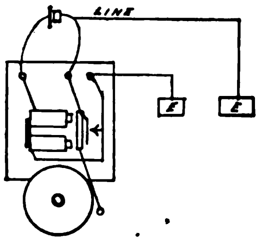
[64663.]—**Deceptive Boiler.**—The communications between the gauge and the interior of the boiler must have been clogged up. There could be no other cause.—W. PERREN-MAYCOCK.

[64666.]—**Jointing Thick Wood.**—Having marked the face, sides, and edges of your boards, dress the edges, and square them from the face side; place the edges to be jointed together, and apply a straight-edge across, to find that they will be straight when jointed. This done, lay the one board on the top of the other, and mark on their edges, say, four lines; run a gauge-line (from face side) so as to find the centre, then at the eight centres bore a $\frac{3}{4}$in. hole, say, 2in. In one of the boards drive in tight four hard wood pins, joi with good strong glue, cramp up till close, leave it in a warm place to settle.—B. GRANT.

[64672.]—**Polishing Tortoiseshell.**—
works should be scraped to a smooth surface
a cabinetmaker's scraper, or, perhaps better,
a fine scraper made by grinding a razor bl
holding it at right angles to the oil-stone so
produce a square edge. The tortoiseshell is
polished with rottenstone and oil, and fini
with putty powder. Works turned in a lathe
be finished with a slight touch of finest s
paper, and then polished with rottenstone and
as before.—R. R. N.

]—**Closed Circuit Bell Ringing.**—circuit" bell ringing is mainly adopted ı purposes. Its superiority over the open stem lies in the fact that notice is given opening" of the circuit, which is the of the usual practice. In the ordinary it becomes necessary to have a contact-iffering in form for various purposes and ı, and which has to be artfully concealed, the leading wires. All this entails great besides which, one can never be certain contacts and wires are in proper order ctually trying each. On the other hand, "closed circuit" system, one has merely the wire in any convenient position, it tter seen than hidden. The very fact m is given on the breaking of contact he method applicable in circumstances r conditions that would render the "open" ifficult and expensive, if not impossible. always be certain that everything is in 'he modern burglar, electrically educated a common practice of such matters, would make a point of cutting all wires that is path. From these and other obvious tions, it is evident how perfect, yet protection such a system provides. I will eed to explain the manner of application. used differs from the ordinary only in gement of its internal connections (see Fig. 1 represents a single-alarm circuit.

Fig. 1



ntact is unbroken externally, there is a rcuit, in which are the battery and bell onsequently the armature is drawn away contact stud close up to the coils, and is When a break occurs, the armature flies npletes the local circuit, and rings so long ternal circuit is broken. There is a switch hen the alarm is not required. Fig. 2 repre-

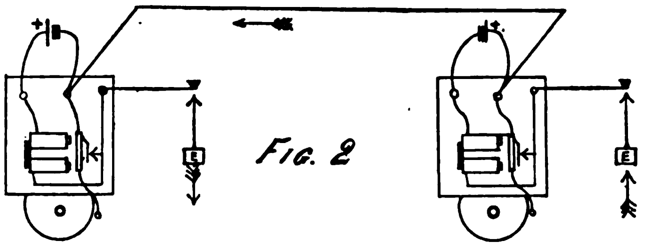


Fig. 2

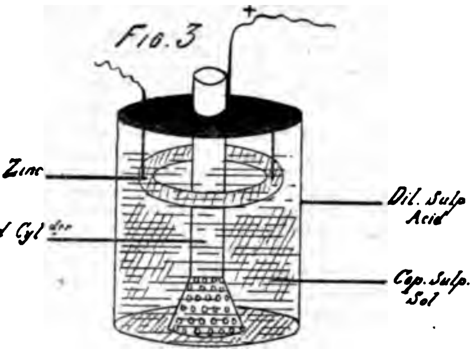


Fig. 3

se in which notice is given at two places. ing keys as shown, reply signalling can be n between the points at which the bells d. A special gravity Daniell modification or this class of work (Fig. 3); a narrow der (dia. about 2in.), watertight, except n, where it opens out into an inverted surface of which is pierced with holes. nds immersed in dil. sulph. acid. A sol. of cop. sulph. is next carefully in-as to displace the acid upwards. Crystals luced in the cylinder to fill the perforated t the bottom. From the wooden cover of k flat ring of amalgamated zinc is sus-n the dilute acid. Care should be taken roduce the zinc till the two solutions are well separated. In course of action the lead becomes coppered where in contact with the sulph. cop., but is not attacked by the acid. It is preferable, though, to paint that portion of the lead that is surrounded by the acid. The height of the cell is about 14in.—W. PERREN-MAYCOCK, A.S.T.E.

[64677.]—**Cleaning Scale from Castings.**—Dip castings in nitric acid, afterwards rinsing in water. This will effectually take off the scale.—W. PERREN-MAYCOCK.

[64677.]—**Cleaning Scale from Castings.**—Iron castings should be immersed for a day or two in a dilute solution of sulphuric acid. Proportions: 3 parts water, 1 part acid. On removal from the bath they should be washed and scrubbed to remove the sand. If too large for immersion they may be wetted with a mop dipped in the acid. Brass castings should be scraped with an old file, and then hammered all over with a light hand-hammer; heavy blows are not necessary, but care should be taken that they are equally distributed, and that no part of the casting, however small, escapes treatment.—R. R. N.

[64679.]—**Knife-Boards.**—Glue on a strip of linoleum or kamptulicon.—T. C., Bristol.

[64679.]—**Knife-Boards.**—Mine were always covered with thick leather, which seemed to wear out quickly. A firm has sent me sheet guttapercha, which they tell me is preferable, but I have not yet tried it.—EOS.

[64681.]—**Pit for Tender Plants.**—The cheapest, and at the same time most effective, in my experience is an excavation in any dry soil lined inside with good stiff pugged clay. The walls above like a lean-to greenhouse, of thick dry turfs cemented with wet clay, and plastered without with cowdung and clay, in which some pulverised oil cake has been mixed to render the plaster waterproof. Then roof it over with tight sash frames, make an entrance-door when building up the walls, taking due care there shall be no entry for frost or wind when shut up. In severe weather throw mats or worn-out carpets over the glass. This is a "cold pit," in which you can safely protect a multiplicity of tender plants. A "forcing pit" is more expensive and troublesome to manage: even fine grapes can be raised in them. The floors of all pits should have three or four inches deep of coal-ashes to check the slugs and worms. These pits, hot or cold, should always face the south, and lean to a wall for strength and protection.—EOS.

[64681.]—**Pit for Tender Plants.**—To combine economy with efficiency, I have found the following about the cheapest way of making a pit for growing tender stuff. A good-sized place can be erected at little cost, and all the work can be done by rough carpenter and bricklayer. The bars can be bought ready run, and the glass in cases ready cut to size, and this is the cheapest way to get it by far. Being only a gardener by trade, with only the crudest ideas of carpentry, and having put up an exactly similar place myself (excepting the bricklaying), I can speak from experience as to the ease of its erection and its efficiency. Take out the ground 2ft. deep, and of the size it is required to make the pit. Have 9in. brickwork run up 2ft. above ground in front, and 6ft. at back, leaving spaces for 4ft. wooden slide ventilators near top of back wall. Brick up the ends, leaving 2ft. 6in. doorways. Slope off the front part of 8in. by 11in. planking, so as to form the sill. Nail piece of wood, about 2in. by 8in., for bars to rest on, and fasten stout pieces of board to upper part of back wall for same purpose, letting the top come flush with top of brickwork. After fitting in the end pieces, and nailing on the bars, prime all the woodwork over, and then glaze. Then lay some thin slates in mortar on top of back wall, allowing them to hang 2in. or 8in. over the glass with a slight fall. On the slates, lay one course of bricks sideways to finish off with. There is an abundance of heating apparatus to choose from. For a pit like this, I prefer, myself, an upright independent boiler set in back wall, and a 4in. flow and return, put together with rubber rings, running along under stage close to front wall. Have the pathway bricked or tiled, and if the stage is a movable one, so that it can be taken out in the summer, so much the better. The pit can then be utilised for growing melons or cucumbers, and so on.—GARDENER, Fernham.

[64682.]—**Battery.**—Before being able to answer this, it is necessary to know what will be the external R. through which you wish to work.—W. PERREN-MAYCOCK.

[64682.]—**Battery.**—This query has a considerable affinity to the celebrated question as to the number of cow's tails required to reach to the moon. As the reply to this is, "One if it is long enough," so with regard to the battery, one single rod of carbon 11 millimètres in diameter will give fully 20 ampères, provided the resistance of the outer circuit is low enough. To get 20 ampères of current, since the E.M.F. of chromic acid cell is 2 volts, the entire resistance of the inner and outer resistance must not exceed $\frac{1}{10}$ ohm. We then get $\frac{F = 2 \text{ volts}}{R = \frac{1}{10} \text{ ohm}} = 20$ amps. A cell exposing 6sq.in. of carbon surface will have an internal resistance of ·07 to ·08 ohm, so that an out resistance of from ·02 to ·03 may be inserted without lowering the current below 20 ampères. But, of course, the battery soon polarises, and then good-bye to the 20 ampères.—S. BOTTONE.

[64687.] — **Roller for Drop-Scene.**—Hollow rollers are largely used in portable theatres. They consist of a wooden framework like a skeleton roller, that is to say, two flat discs are at each end joined by long flat laths very much like the wooden cages used to protect young trees, another disc is placed in the middle in long rollers. They are both light and rigid.—ITALICUS.

[64687.]—**Roller for Drop-Scene.**—I recently had one made 20ft. long for our dramatic club, and used the only available timber, a piece of 8in. by 8in. stuff, rounded. Of course, when held by the ends, it sagged in the middle, but when the scene was nailed on it rolled up perfectly even, as it is evident the canvas prevents any tendency to sag in the centre.—DOCTOR MED.

[64687.]—**Roller for Drop-Scene.**—A light roller may be made by fastening longitudinal battens—probably 1in. by ½in. would do—on the circumference of circular discs cut out of 1in. plank and 6in. or 8in. in diameter. If "Chromo" knows what is meant by the "lagging" in arch-centrings, he will understand my suggestion. The two ends should be fastened on cylinders instead of discs, not only for the ropes to wind upon, but to give the necessary stiffness, and if battens of the whole length of the roller are not available, a cylinder should be used instead of a disc, wherever the battens break joint in their length. These cylinders should be long enough to allow each batten to be secured to it by two screws. The discs (or cylinders) might be 4ft. apart.—H. A. G.

[64689.]—**Leclanche Cells.**—If the external resistance of your circuit is small, as it evidently is by your query, there is an advantage by joining the two zincs and coppers together, which is what is called joining for quantity; but if the resistance is great it is best to join in series, as shown in "E. M.," Feb. 3. The E.M.F. of a Leclanché cell is about 1·5 volt, and it has a resistance of about two ohms.; now, if you have two cells joined in parallel (or for quantity), you have only the same E.M.F. as if you had one cell—viz., 1·5 volt; but at the same time you have only half the resistance—viz., 1 ohm, because the current has double the available paths in the battery. Then, supposing you have one ohm external resistance, it would give $\frac{1\cdot5}{1+1} = \frac{1\frac{1}{2}}{2} = \frac{8}{4}$ of an ampère of current, and if you join in series, $\frac{1\cdot5 + 1\cdot5}{2 + 2 + 1} = \frac{8}{5}$ of an ampère only; but if the resistance (externally) is great, say 30 ohms, for instance, two cells would give in series $\frac{8}{4 + 30} = \frac{8}{84}$ ampère, and in parallel $\frac{1\cdot5}{1 + 30} = \frac{8}{93}$ ampère.—LEWIS.

[64689.]—**Leclanche Cells.**—Everything depends on the external circuit resistance. If this is low, a larger current is obtained by joining cells in parallel, and vice versâ.—W. PERREN-MAYCOCK.

[64689.]—**Leclanche Cells.**—The work you gave them must have been of low resistance. In series, you double the voltage, but double the resistance also; in multiple, you halve the resistance—that doubles the quantity. If your work had much resistance, the better results would have been in series. The best arrangement is when internal equals external resistance.—DADDY.

[64690.]—**Electro - Magnet.**—TO MR. BOTTONE.—In the case described by you I should use No. 20 single cotton-covered copper wire, wound over the iron after it has been taped, to insure good insulation, to the depth of nearly an inch all round on each limb. Certainly there is a rule for calculating the gauge of wire. It is as follows:—Knowing the internal resistance of the battery which it is intended to use, find by means of a table of wire resistances, what gauge of wire will give an equal resistance, if wound on to such a depth as to treble the diameter of the original iron core?—S. BOTTONE.

[64694.]—**Piston.**—Turn a ring a tight fit to cylinder, and then saw it through and fit it in a groove in the piston. You will not have half the friction as with cotton.—T. C., Bristol.

[64698.]—**Heat.**—At a certain distance below the surface external conditions cease to affect the temperature. The depth of this zone of constant temperatue is from 60ft. to 80ft. in temperate regions. In Java it is said to be at a depth of 2ft. to 3ft. only; while, on the other hand, at Yakutsk the ground is permanently frozen to a depth of 700ft., the effect of a former more rigorous climate. Below the line of constant temperature there is found to be invariably an increase of 1° Fahr. for every 50ft. to 60ft. of descent. Most careful experiments on the rate of increase were conducted in the deepest boring in the world, at Sperenberg, near Berlin (4,172ft.), and almost entirely through solid rock-salt. There are, however, important variations in the rate of increase of temperature, owing chiefly to difference in conductivity of various rocks, but partly owing to local accessions of heat arising from compression. The increase is less below mountains, as shown in the Mont Cenis tunnel, 5,280ft. below the summit of Mount Frejus. If the observed rate of increase continues, the temperature at 50 miles would be 4,600° Fahr., far above the melting point of the most infusible substance. The existence of liquid matter is proved by ejections of lava from volcanoes, and the close similarity shown by lava from widely separate vents seems to point to their origin from one common source. Earthquake shocks seem to imply a thin flexible crust. The hypothesis of a solid crust and a molten interior has, however, been disproved by Mr. Hopkins, who showed that the shell and molten interior would not have the same movements of precession and nutation, which would, therefore, be less than the observed amount; and Sir W. Thomson has shown that the crust would not support the strain exerted by the tide-producing force of the moon and sun, but would alter its form, unless the whole mass of the earth were more rigid than an equal globe of glass. The rise and fall of the tides, also, could not be explained unless the globe is practically solid, otherwise the sea and its bottom would rise and fall together. The existence of solid matter at high temperatures could be explained by enormous pressure preventing liquefaction. Any relief from pressure would then cause local liquefaction, and supply material for volcanic ejections. If the earth had a fluid interior, the present velocity of rotation would cause the elipse to be in the proportions of 230 to 231, whereas the proportion is 300 to 301.—SM.

[64699.]—**Soap Bubbles.**—I have tried all the receipts for soap solutions, but prefer a freshly-prepared solution of a good soap without glycerol. The solution must be quite fresh, and is best made by slicing some soap into a mortar; add water, and mix well with the pestle.—SM.

[64699.]—**Soap Bubbles.**—Make the ordinary solution of soap and water, and add enough glycerine to make it fairly thick. Be careful not to add too much, as the bubbles, when blown, will only expand a little, and then burst. I believe this mixture, or something akin to it, is sold by several scientific novelty and toy dealers in London, as I have frequently seen it advertised.—S. S.

[64699.]—**Soap Bubbles.**—To make those pretty objects, "rainbow bubbles," take 12 fluid ounces (half-a-pint and a wineglassful) of cold distilled water, or once boiled water; put into it ¼oz. Castile soap, cut fine; pour into a pint bottle, set in hot water in a saucepan on the hob, and shake occasionally; all will be melted in an hour. Now let the fluid stand quiet for a few hours for the impurities and colouring matter to subside; then pour off the clear fluid, and add 8oz. of glycerine. Special glass pipes are made purposely, *and used to* be sold by Bird, the chemist, Birmingham. Cover the bottle over with green baize, and play the game over a soft carpet or woollen table-cover.—EOS.

[64700.]—**Direct - Vision Spectroscope.**—There is no mirror in this instrument. The effect of direct vision is obtained by cementing together a series of prisms of different refractive powers somewhat in the position occupied by the following letters—AVAVA, where the A's represent prisms of one kind of glass and the V's the other.—S. BOTTONE.

[64700.]—**Direct - vision Spectroscope.**—These little instruments contain a combination of five or seven flint-glass and crown-glass prisms, so constructed that while the total mean refraction effected by each kind of glass is equal, and therefore neutralises the other, the former leaves an excess of dispersion over the latter uncorrected. As the principle of achromatism enables us to produce refraction without dispersion, so conversely it is equally possible by the use of two kinds of glass to obtain dispersion without refraction. But why does not "E. G. H." procure Proctor's elementary treatise on the "Spectroscope and its Work," a marvellous shillingsworth of information to any-one interested in the subject?—W. T. N.

[64701.]—**Chiretta.**—An ordinary infusion of chiretta will not long escape fermentation. A concentrated essence is prepared and sold by Messrs. Lazarus and Co., of Benares, and is widely used in India. If "J. B." has no correspondents in India to apply to, I will gladly procure him a bottle if he will communicate his address. I forget the price, but it is very moderate, especially at the existing rate of exchange.—H. A. G.

[64701.]—**Chiretta.**—I am glad to hear of another triumph of my favourite herb. I do not grudge the time and trouble of making a fresh cold infusion; but in this winter weather it keeps well. I have some in my jug a week old, but as strong as senna tea, a small dose being purgative. I think the following formula might answer:—Put a lump (the size of a walnut) of pure Stockholm tar in a quart of soft cold water; it will absorb sufficient of the antiseptic to suit your purpose in two or three days. To a pint of this add a very strong infusion of chiretta—say, a pint—quite brown. "Tar water" (the eau goudronné of our Gallic neighbours) is a most wholesome liquid; it kills animalcula, and assists digestion. The piece of tar lasts for ever.—EOS.

[64701.]—**Chiretta.**—Take 8oz. of chiretta, chop it up small, and boil it in as much water as will easily cover it in a covered vessel for half an hour, when it must be taken out, strained through muslin, and the liquid returned to the pan and boiled until its bulk is reduced to half a pint; now filter it through paper and again return it to the pan, adding 6oz. or 8oz. of lump-sugar, and boil until all the sugar is dissolved. Your medicine is now prepared, and will keep good for two years. Take a teaspoonful in a wineglassful of water thrice a day. It would do you a deal more good, however, if, at this period of the year, instead of using the chiretta alone, you tried—chiretta herb, 4oz.; dandelion root, 1½oz.; Jamaica sarsaparilla root, 1oz.; sassafras bark, ½oz.; mezereon root bark, ½oz.; burdock root, ½oz. Prepare as above. I should strongly impress upon you the necessity of obtaining the above herbs from a highly respectable dealer, if you are not acquainted with plants yourself.—BOTANIST, Liverpool.

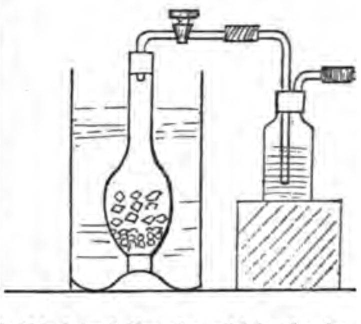
[64702.]—**Six's Thermometer.**—If this is an ordinary maxi-minimum make, the tube appears to have slipped down the scale ¾ of a degree. You will now know the remedy.—DADDY.

[64702.]—**Physical Properties of Metals.**—I notice, and am not surprised, that "Young Analyst's" query has remained among the unanswered queries. If he cares to give me any information about how he obtained the figures he gives, I will do my best to tell him if any known properties of those metals have any proportion to the numbers he gives, if I can.—L. SIDNEY.

[64704.]—**Sulphuretted Hydrogen.**—Perhaps the best and simplest mode of generating the above is to keep a stock flask with a mixture of paraffin wax and sulphur in it. On heating this H_2S is given off in abundance.—S. BOTTONE.

[64704.]—**Sulphuretted Hydrogen.**—Perhaps with a little ingenuity you could rig up an apparatus in the form of the well-known Dobereiner's hydrogen lamp, and substituting a perforated leaden cup for the zinc block, which is filled with small lumps of ferrous sulphide. Kipps' apparatus does for this very well, and does not require the acid pouring off except to supply FeS or acid when one or the other is used up. Do not have any metal fittings about the bottles, &c., or else they will very soon go wrong.—PRINCIPIA.

[64704.]—**Sulphuretted Hydrogen.**—The cheapest form of constant generator. Get a lamp chimney, close the bottom with a cork having several holes; soak it well in melted paraffin. Put a number of glass beads in bottom. On
the sulphide, close with cork and deli
with stopcock. Place in a large glass ja
ing diluted hydrochloric acid (1 : 1). The



to this form is that the acid in the jar
horribly. A Kipp is the best form. Ha
to do with movable bottles connected by
rubber tube, as the rubber perishes an
SM.

[64704.]—**Sulphuretted Hydrogen**
opinion the best apparatus for getting a
this very useful gas is the one devised by
is self-acting, and when not in use the ac
away from the FeS, which latter be
atmosphere of SH_2 does not oxidise. U
chloric acid (one part to two of water), i
more convenient than sulphuric acid
reasons. First, diluting H_2SO_4 in any q
not a pleasant operation; second, the F
duced when H_2SO_4 is used being not ver
tends to crystallise and choke up the
while $FeCl_2$ formed by the action of H
soluble, and never separates out. In
small wash-bottle between the apparat
liquid submitted to the action of the
JOHN GREY, F.C.S., Analytical Chem
castle-on-Tyne.

[64704.]—**Sulphuretted Hydrogen.**
imagine, the correspondent referred
Clegg, I fancy my method of obtaining
could be utilised for obtaining sul
hydrogen by placing in container ferrou
and partly filling outer glass with sulp
and water, the proportion being one of t
to six of the latter by measure. The holes
in bottom of container will have to be v
or else finely-divided particles of ferrou
will fall through into dilute acid; but
flat glass disc, fitting into bottom of cont
above the holes will, I think, tend to pre
the gas, however, will be mixed with free
Another method of obtaining a purer gas
stitute for the ferrous sulphide a m
granulated zinc and plumbic sulphide; t
of gas thus generated is said to be ver
Sulphuretted hydrogen is, however, ab
water, and the acid solution so formed
oxidised when exposed to the air. This
vent the above-named apparatus from fu
powers to the greatest advantage unle
ferrous sulphide is consumed within a sh
as there would be waste of the gas, ow
oxidation.—A. T.

[64707.]—**Lalande and Chaperon**
iron Cells.—The zinc is immersed in
of caustic soda, the iron in porous pot bei
round with oxide of copper, that known
scale." E.M.F., 1 volt.—W. PERREN-M

[64707.]—**Lalande and Chaperon's**
In contact with the zinc plate you requ
tion containing from 30 to 40 per cent.
potash; in contact with the iron you
oxide of copper. To prevent the caus
absorbing carbonic acid from the atmosp
well to pour a layer of heavy petroleu
the caustic-potash solution. About half
caustic potash solution and an ounce o
would be enough for one charge.—S. BO

[64709.]—**Bicycles.**—The bent handl
be set by using scroll wrench; the same
crank, care being taken that the spin
broken off. If the spindle is bent, it may
sary to take hub out of wheel and set sp
true between lathe centres. If the ba
only slightly twisted, it may be pulled
out much trouble. See that the hind whe
or is in a line with the front one; but if
bone is much out of truth, it will have t
hot and set. A buckled wheel should ha
spokes loosened two or three threads, the
wheel, lay it on the floor, bearing on
spindle of hub; two persons should ta
by the highest parts and press down; if
perly, the lower parts of the rim will ris
back to nearly their proper place, then
In loosening spokes, be careful to give e
the same number of turns of threa
tightening the same, but not all at onc

ı not dented or cracked. If you are f succeeding, take the job at once to a ıer, and don't go in for another cropper. I. A.

—**Engine.**—Make the lap barely $\frac{3}{16}$in. ıvel of valve $\frac{3}{8}$in., and throw of eccen- ıis. Above will cut off at about $\frac{3}{4}$ stroke, lvisable. Work at about 60lb. at least, 200 revs. to get ½ horse-power. Boiler say, 3ft. by 2ft., or a little smaller.— tol.

—**Filling Ends of Pinewood.**—Have ;lue or size, smoothing with glass-paper ?—SM.

—**Dynamo.**—A properly-made dynamo, armature, would light five or six 10c.p. .bout 20 ohms cold resistance; but the s of wire given are faulty in many First, No. 22 is too fine for the arma- le the quantity of No. 20 on the F.M. is or a series-wound machine, and too little t. Put 3lb. No. 20 on the armature, and llb. No. 22 on the field. Connect up as achine.—S. BOTTONE.

—**American Organ.**—Your query is ive to be answered in the "E. M."; but l forward me your address, I will give : help you require.—A. DICKSEE, Stan- tingall-lane, London, S.W.

—**American Organ.**—For the benefit " and other interested readers I send a ication for a 2-manual American organ.

'ER MANUAL (2½ rows of reeds).

s Stops.		Treble Stops.	
....	4ft.	Flute	4ft.
....	8ft.	Dulciana	8ft.
ıpler.		Celeste	8ft.
		Forte, 2.	

VER MANUAL (3 rows of reeds).

s Stops.		Treble Stops.	
....	16ft.	Clarionet	16ft.
....	8ft.	Melodia	8ft.
....	8ft.	Oboe	8ft.
er.		Treble coupler.	

RGAN (2 sets of 16ft. reeds, 30 notes each).

:don......	16ft.	Violoncello	8ft.

ıical stops, manual coupler, and pedal coupler.

.unroe's reeds and cavity boards, C scale. : treble registers be of 3 octaves, or 37 do not advocate the use of mechanical ı as dulcet, echo, piano, dolce, &c., unless .tify a liking for a display of stop knobs. have a vox humana to upper manual. e pleased to send a drawing of suitable nt of 2-manual action to "W. E.," free if he requires it. The different qualities pend chiefly on the voicing of the reeds, with other conditions of more or less e. Each note throughout a register ve its distinct character of tone, com- ı promptness of speech. This desidera- only be successfully accomplished by a ırkman—that is, by a man who knows ke a reed do something more than make [may add that if "W. E." has never American organ before, he had better ıaller instrument before he attempts so fair as he proposes. It requires no small practical experience to turn out a instrument worth listening to.—G.

—**Air Chest.**—As the pressure, what- y be, acts on the water as well as the simply has the effect of putting as much n the float upwards as it has downwards, effect of the pressure is neutralised.— stol.

—**Faulty Loco.**—Are the eccentric rods o the right ends of the slotted link? I ink not. If they are, the valve wants by the nuts at each end, unless valve is in which case I think the rod must be '. C., Bristol.

— **Podura.**—The animal found by probably *Machiles polypoda*, which has ısversely-marked scales, and is common boards. I have never found the Podura .t believe its habitat is in dry banks and lon't think it is very common.—DOCTOR

—**Podura.**—The *Podura plumbea*, or l, is a little wingless insect that is some- ıd among the sawdust of wine-cellars, in ıl-houses, or near decaying wood, leaping a flea by means of the peculiar power of ail, whence its name. The scales, under er of the microscope, look like watered .hey can be seen at their best under a :ted ⅛in. objective by transmitted light. nter ("The Microscope") says: "Its scales are of different degrees of strength of marking, and are, therefore, by no means of uniform value as tests." For further information "I. C." had better refer to Mr. Beck's article "On the Scales of Lepidocyrtus ———? hitherto called Podura Scales and their Value as Tests for the Microscope," in *Trans.* of Micro. Soc., N.S., Vol. X. (1862), p. 83, and to "The Microscope," by Dr. Carpenter, pp. 151, 178, 657, and 658.—S. S.

[64720.]—**Podura.**—The "fish-like insect" described by "I. C.," is a Lepisma—a creature which differs in every particular from the Podura. It is about fifty times bigger, and its scales are entirely different in shape, and in so-called "markings," from those of Podura. Poduræ are also vastly more common and numerous; they are abundant nearly everywhere in damp places—gardens, cellars, walls, &c.—but frequently escape observation, on account of their small size and neutral colour, and as easily escape capture by the activity of their movements, and the facility with which their muscular forked tails enable them to spring into the air, after the manner of toy jumping frogs. "I. C." will be most likely to find them by sprinkling a little oatmeal on a piece of white paper or a plate, and placing it in any damp place on the ground. He must not look for anything larger than the letter I in this sized type, and the best way to catch them unhurt is to put a small inverted test tube over them, into which they will speedily run or jump. They will live and multiply in a fern case, or in suitable cells, in which they may be watched with great interest under the microscope. A saucer of milk placed outside the garden door daily for my cat is frequently found covered with numerous dark specks, which, on inspection, are seen to be Poduræ, which have jumped in and got drowned. There are many species; but those most commonly found bear scales with markings similar to those usually figured as test objects. Though seemingly black by contrast when they run across white paper or fall into the milk, they are usually of a leaden colour, and when seen in a bright light shine with a pearly iridescence from diffraction of light by their scales.—F. R. M. S.

[64721.]—**Crystallisation.**—You will find it very difficult to prevent crystallisation. Even a slight change of temperature may cause a deposit of the salt. The only thing I can advise is to keep in a cool place where the temperature is constant; and also keep covered, in order to prevent evaporation.—CHEMIST.

[64721.]—**Crystallisation.**—Perhaps if the querist suspends a crystal of sulphate of soda by a string in his vat, he may divert the crystals from forming on the stuff. Perhaps, of all salts, Glauber's crystallises with the greatest ease, such, indeed, that this property has formed the basis of many curious experiments, and "chemical conjuring tricks."—L. SIDNEY.

[64721.]—**Crystallisation.**—This query is very vague. The solution with the cloth in it might be tightly corked up, or, if it did not require moving about, you could put a layer of oil on the surface of solution, which would prevent evaporation. Water would also do this, but in time will gradually mix with the denser liquid below, and so weaken it by diffusion. If you will say for what purpose you require this, perhaps somebody can say what kind of apparatus will suit best. Could you not use a more soluble salt (deliquescent), which would not crystallise at all?—PRINCIPIA.

[64724.]—**Bronzing Green.**—Spon gives strong sal-ammoniac and water bath for a few days, wash, and dry slowly; or suspend them in a vessel containing some chloride of lime till of the required depth of colour.—DADDY.

[64725.]—**Brothers- and Sisters-in-Law.**—This relationship, although unreal, and only the outcome of our civilisation, is not dissolved by death; witness the illegality in this country of marriage with deceased wife's sister.—B.SC., Plymouth.

[64725.]—**Brothers- and Sisters-in-Law.**—Oh, no! "Inquirer" cannot so easily shake off the mother-in-law incubus! He had better help to get the Deceased Wife's Sister Bill passed, and then he may have the chance of marrying twice with only one mother-in-law.—NEPHESH.

[64725.]—**Brothers- and Sisters-in-Law.**—This is a curious question. According to the "Table of Kindred and Affinity" at the end of the Book of Common Prayer—(17) A man may not marry his wife's sister (sister-in-law), (12) neither can he marry his wife's mother (mother-in-law). Firstly, with regard to the death of a man's wife, I should say that the relationship between him and his brother-in-law is maintained after her decease most certainly, because it is illegal for him to marry his sister-in-law (she being a relative in the second degree of affinity), and as his brother-in-law stands in the same position towards the man as the sister-in-law (by affinity); and as the decease of the man's wife does not alter his sister-in-law's position towards him, how can the brother-in-law's be changed? The illegality of marrying a "deceased wife's sister," however, seems very likely to be a thing of the past in a year or two. A man may not marry his mother-in-law, as it is forbidden by law; therefore the relationship is continued. Secondly, a woman may not marry her husband's brother (brother-in-law), and I should think that her relationship is continued with her sister-in-law and mother-in-law. Of course, a man is not legally bound to support his mother-in-law, sister-in-law, or brother-in-law any more than they are compelled to support him.—S. S.

[64727.]—**How to Make Caustic Potash.**—Boil 1 part of potassium carbonate with 12 of water, adding a small quantity of slaked lime. In this reaction chalk is formed, which falls to the bottom, caustic potash remaining in solution. The clear liquid should then be removed to another vessel, and evaporated to dryness.—COLONEL.

[64728.]—**L. & S. W. R. Single Expresses.**—I do not think that this type of engine is now in existence on our line. A considerable time ago, however, I believe there were two single expresses in use—viz., the "Canute" and the "Havelock," and they sometimes ran the Jersey Special to Waterloo. I fancy that the old Havelock is now used as a portable boiler only somewhere down the country. There were also two more singles, both called "Queen," one built by Messrs. Sharp and Co., and long since disused; the other designed by Mr. Beattie, and now turned into a four-wheel couple, and still in existence.—S. S.

[64728.]—**L. and S.W.R. Single Expresses.**—By a most peculiar coincidence I was talking to a friend on the line only a few days ago about these very engines. There is, to the best of my knowledge, only one left—the old "Queen"—and I have not seen her for a considerable time past. She sometimes used to run the Jersey special from Basingstoke to Waterloo, but was really kept more for show than anything else, being the only single engine on the line. She has doubtlessly been scrapped some time ago, as 33 years is a very long time for a locomotive to last.—S. S.

[64730.]—**Photometry.**—To find the more powerful of two lights, put them near together at the same distance from a screen or white wall; that which casts the darkest shadow (of the finger to wit) is the stronger light. The decrease of light is as to the square of the distance; therefore, if shadows are equal when one light is double the distance of the other, and the square of 2 being 4, one has four times the power of the other.—DADDY.

[64730.]—**Photometry.**—To estimate c.p. of any light, a standard sperm candle is placed at one side of a screen, and the burner to be tested at the other side. The screen is a sheet of white paper with a spot of grease (spermaceti) upon it, the burner is moved until the spot just disappears, the lights are then as the squares of the distances. It is usual to place the candle 1ft. from the screen, then the square of the distance in front of the burner is equal to the candle-power. The various photometers are adaptations of the same principle, but with provision for ascertaining the results accurately and conveniently. To compare two lamps, place them several feet apart in a room without other means of lighting, and, if possible, with a dark wall-paper without mirrors; between them place a sheet of white paper, and upon the paper set upright a piece of wood, or anything to cast a shadow upon the paper. Move the paper until the shadows are equal in intensity. Measure the distance each is from the wood which casts the shadow; the square of the two distances will give the relative values of the lights. For example, assuming one to be 2ft. and the other 3ft. from the wood, the lights will be as 4 to 9.—HALL.

[64730.]—**Photometry.**—To test the candle-power of artificial illuminants accurately requires an elaborate apparatus; but "Essex" may find the following description of some use:—A Bunsen disc of paper is held in an upright position, and the lights to be contrasted are placed one on each side of, but at some distance from, the disc, in such a manner that a straight line, if extended from light to light, would pass through the disc at right angles to its surfaces, and also through each flame midway between its apex and base. The weakest light to be then moved towards the disc until it becomes equally illuminated on both sides. The distance from the disc to the centre of each light is then measured and squared, and the quotient resulting from the division of one of the squares by the other gives the relative illuminating power of the flames. If, for example, one of the lights were 10in., and the other 50in. from the disc, the square of these numbers being 100 and 2,500, and the latter divided by the former would give the value of the greatest as 25 times that of the weakest light. All testings must be made in a room that is well ventilated, free from draughts and vibrations, and where no light can penetrate. Bunsen discs can be obtained from any wholesale chemist.—J. PICKERSGILL, Newcastle-on-Tyne.

[64731.]—**Brilliantine.**—The following two formulas for making brilliantine are given in "Beasley's Druggist's General Receipt Book":—1st. A solution of castor-oil in eau de Cologne, 1 part to 4. 2nd. Glycerine and eau de Cologne, of each 1 part; honey, 2 parts; rectified spirit, 4 parts.—ITALICUS.

[64732.]—**Telescope Object-Glass for Photography.**—A 1½in. good achro. telescope object-glass, 15in. focus, should make a landscape lens that will produce a picture, but not like those specially designed for the purpose; the 3in. will probably require a camera of unworkable length. The size of the picture depends greatly on the aperture of the stop used; the smaller the stop the greater area will be sharp.—B.SC., Plymouth.

[64734.]—**Racing of Engines.**—If the vessel pitches, or waves recede from propeller, of course the engines will race.—T. C., Bristol.

[64735.]—**Lightning.**—There are two ways of doing this, and I will give both, so that "Grot" may choose for himself. The first is by means of lycopodium (procurable at most chemists). Take a pair of bellows and join a piece of indiarubber tubing about 4in. long and ½in. diameter to the nozzle. Connect a piece of glass tubing slightly larger in bore and about the same length to the indiarubber. Open the bellows, fill the glass tube nearly full of lycopodium, and give a sharp blast over the flame of a small spirit-lamp, when a great vivid streak of flame very much resembling lightning will shoot out. The second one is by means of lightning paper. Mix five drachms of strong nitric acid with an equal amount of strong sulphuric in a glass vessel, and after the mixture has cooled immerse in it some thin dry unsized paper, pressing it down with a glass rod, covering the vessel with a glass plate, and leaving it for a quarter of an hour or so. Lift the paper out with the glass rod, put it into a bucket of water, and wash it thoroughly till it no longer reddens blue litmus paper. Dry very gently, and be very careful not to get any of the acid on your hands.—S. S.

[64736.]—**Differential Calculus.**—This has nothing to do with Taylor's theorem, nor with the equation to the tangent; but a simple geometrical construction will make matters clear. Draw two lines at right angles to represent the axes of x and y, that of x horizontal and y vertical. Then draw any curve—say a parabola—with vertex at origin and focus on axis of x. Measure off any distance x from the origin, and draw the corresponding ordinate y to the curve, and draw a tangent to the curve at that point; then measure off a further distance h along the horizontal axis, and draw a vertical ordinate produced till it meets the tangent—the length of this ordinate from axis to tangent call y_2. From point of contact of tangent with curve, draw a horizontal line at right angles to y_2; we thus have a right-angled triangle, the base of which is h, and the altitude is the difference between y_2 and y. The differential coefficient $\frac{dy}{dx}$ or $f^1 x$ is the trig-tangent of the angle made by the tangent with the axis of x—that is, $\frac{y_2 - y}{h}$. Hence $f^1 x = \frac{y_2 - fx}{h}$, putting fx for y, and therefore $y_2 = fx + hf^1 x$.—M.I.C.E., Bath.

[64736.]—**Differential Calculus.**—The question is not very clearly expressed, and I am by no means sure, therefore, that the following explanation of the mode of finding the equation to a tangent will help "G. C." out of his present difficulty. I presume that he takes $x\,y$ for the co-ordinates of the point P, where the tangent touches the curve $y = f(x)$, and y_2 for the ordinate of some other point, not on the curve, but on the tangent. His difficulty is apparently centred in this y_2. But, in finding the equation to the tangent at P, we have no need to trouble ourselves about the value of y_2. Suppose Q to be another point on the curve, having for its co-ordinates $x + h, y + k$. Then $\frac{k}{h}$ is evidently the tangent of the angle which the chord P Q makes with the axis of x. Now, by turning the chord round the point P we can bring Q as near to P as we like, and when the distance between these points vanishes — that is, when the chord becomes a tangent $\frac{k}{h}$ becomes $\frac{dy}{dx}$. Hence, if $x = a, y = b$ be the co-ordinates of P, and m the corresponding value of $\frac{dy}{dx}$, the equation to any line parallel to the tangent is of the form $y' = mx' + c$, where $x'\,y'$ must not be confounded with the co-ordinates $x\,y$ of the curve, and c is an arbitrary constant. When this line coincides with the tangent at P, the co-ordinates of P satisfy its equation; and, therefore, $c = b - ma$. Therefore, for the equation to the tangent, we have $y' = mx' + b - ma$; or, as it is often written, $y' - b = m(x' - a)$.—J. R. C., Charing.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

Since our last, W. Perren Maycock has replied to 64347.

64128. The Stack-fried, p. 446.
64130. Carnot's Law, 446.
64132. Lantern Slides, 446.
64135. Composition, 446.
64142. Magnetic, 446.
64145. Polishing Rock Crystal, 446.
64156. Bathroom, 446.
64157. Electric Tramway, 447.
64165. Brake Experiments, 447.

64373. Losing Lever, p. 541.
64377. Bearers for Cutler's Wheels, 541.
64379. Resistance, 541.
64388. Salt Graters, 541.
64390. Rackwork for Eyepieces, 541.
64394. Coil Boiler, 541.
64398. Canoeing, 541.
64400. Zinc Etchings, 541.
64404. Leclanché Bells for Lighting. To "Lyulph Lumley," 541.
64418. Wig Paste, 541.
64420. Automatic Gas Apparatus, 541.

QUERIES.

[64740.]—**Birds' Eggs.**—Will any kind reader tell me the best material to keep birds' eggs in? Is cotton wool the best?—L. E. O.

[64741.]—**Spongy Platinum.**—Would any of our chemical readers inform me the way the spongy platinum is made, as used in the self-igniting hydrogen lamps, and how is it used for igniting?—EXPERIMENTER.

[64742.]—**Nitrous Oxide.**—How can I destroy the fumes of this gas, or render it non-corrosive and free from smell? I wish to pass the gas over some chemical substance in a wide tube, then let it escape into the air. Would be much obliged to some of "ours" for information, or to any reference in "E. M." as far back as Sept. 1884.—EXPERIMENTER.

[64743.]—**Paint for Bicycles.**—Will some reader kindly inform me the ingredients and the proportions that are used in making black paint for bicycles?—CYCLIST.

[64744.]—**Pure Zinc.**—Will some fellow-reader kindly tell where I can buy, or how I can make, chemically pure zinc?—H. HEWLETT.

[64745.]—**Separation of Tin.**—I have a quantity of metal containing lead, copper, tin, zinc, and antimony. Could any reader give me a method for the separation of tin?—T. J. N.

[64746.]—**Spirit Varnish for Glue.**—Can any reader give me recipe for making a spirit varnish to fix wood together to be as strong as glue?—WOOD.

[64747.]—**Cement.**—I shall be glad if anyone can inform me which is the best cement for fastening a brass screw on a glass ink-bottle, one which will withstand both ink and water and bear a good pressure in screwing?—R. W. M.

[64748.]—**Small Boiler.**—Will "T. C., Bristol," kindly tell me what pressure I could work small iron horizontal boiler, 18in. by 9in., 3-16in. thick, no tubes through boiler, rivets 1in. apart, flat ends, ⅝in. rod through centre with nuts on each end? Also say largest size engine it would work properly.—E. T.

[64749.]—**Gold Lettering on Cloth-bound Books.**—Will some one be kind enough to tell me how the gold lettering on cloth bound books is done? I have bound a number of vols. in cloth, but don't know how to do the lettering. Full information will oblige—A NEW SUBSCRIBER.

[64750.]—**Diaphragm of Telephone**—Will some reader kindly tell me what metal to use for the diaphragm of a telephone consisting of a square bar magnet, the coil wound with No. 36 c.c. wire? Must the coil be insulated in boiling wax, and which pole of the magnet must be nearest the diaphragm?—H. T.

[64751.]—**Plan Colouring.**—Will anyone kindly state what to mix with water colours to make the part wetted contract, or dry perfectly smooth? I find the large flat tints pucker in drying—NO SIG.

[64752.]—**Storage Tanks for Coal Tar.**—Can any reader inform me whether underground tanks made of Portland-cement concrete will be the best and cheapest to hold crude coal tar, and whether rectangular shape will do? Also where one can learn some particulars as to the manufacture of roofing felt or of any publication on the subject.—M. J. SMITH.

[64753.]—**Bleached Paint.**—I give the woodwork of back of my premises a coat of green paint every year, but having a lot of sun I find in a few weeks the paint loses its freshness and turns bleached and a disagreeable white and streaky colour. Is there anything I can mix with the paint so as to preserve the freshness for a longer time?—J. L.

[64754.]—**Percentage of Oxygen.**—Will Mr. W. John Grey, F.C.S., kindly explain to me how to calculate the percentage of oxygen in BaO_2 over BaO by the permanganate process, on the supposition that BaO contains no excess oxygen, and that BaO_2, if completely oxidised, contains 100 per cent.?—A WORKMAN.

[64755.]—**Expansion on Freezing.**—It is frequently stated that water is the only substance which expands when solidification takes place. I understand, however, that bismuth does so in a marked degree, and that there are other substances possessing this property. Is it certain that there are any substances which do not do so? If there are only a few which do expand, I should be glad of a list giving the temperatures and the proportionate increase in bulk.—I. N. COGNITA.

[64756.]—**Cold Air.**—I wish to obtain some data relating to producing cold air (not necessarily below freezing point) by the liberation of compressed air. The object is to keep cool a compartment for holding fish on board a sailing vessel. The power to work air-compressor and circulating pump is a 2-cylinder steam-engine, 6in. diam. by 7in. stroke, 60lb. working pressure. What will be [illegible] of air-compresser, area of condensing or cooling surface to cool the compressed air?—W.

[64757.]—**Chrome Alum.**—Setting aside some exhausted bichromate solution, I found deposited after [illegible] time some beautiful ruby-coloured crystals mixed [illegible] others which were green, and I was informed that [illegible] former were chrome alum. I have tried in the same [illegible] to get similar ones again, but only the green ones [illegible] been formed. I should be glad to know how I may produce the chrome-alum crystal with certainty, [illegible] whether there is any way of preserving them, as [illegible] previously obtained became opaque from the formation of a kind of crust on the surface.—X.

[64758.]—**Engine.**—Having an old-fashioned [illegible] engine of 30H.P. nominal working a flour-mill, and [illegible] ing the coal consumption very heavy, I would feel [illegible] if any of your practical correspondents would advise [illegible] regarding the best style of engine to adopt, or state [illegible] ideas about the advisability of adopting the locomotive type of engine and boiler combined, for continuous [illegible] and day running. The old boiler is qualified to work [illegible] some years—dimensions being 26 by 7½, and 46lb. pressure, with double flues, but would be discarded in favour of [illegible] new outfit if considered more serviceable.—ENGINE.

[64759.]—**Iron Cistern.**—Would some reader say [illegible] to find the proper position and strain on wrought-[illegible] tie-rods across a cast-iron cistern, 10ft. long by 8ft. [illegible] by 4½ft. deep? I understand the proper place is at [illegible] centre of pressure, but I am unable to find this by [illegible] formula I have, and have the impression that it is [illegible] one-third of the depth from the top of water, but [illegible] like to know more accurately. Also is there any formula for the thickness of the plates, and the size and [illegible] of bolts according to the pressure?—J. R. G.

[64760.]—**Electric Bell.**—I want to connect [illegible] electric bell to all the doors and windows in my [illegible] How am I to set about it, for each door or window to [illegible] independently of the others? I have two batteries, [illegible] have connected one door: the result is the bell rings [illegible] well. I connected a window to the wires which led [illegible] the door to the bell; but I could only get it to ring [illegible] the door was open and the switch turned off. Why [illegible] this?—AMATEUR.

[64761.]—**Steam Launch.**—Am about to fit [illegible] and boiler to boat, 15ft. by 5ft., vertical boiler and [illegible] single-cylinder inverted launch engine. As I cannot [illegible] thicker than ⅛in. iron for boiler, I wish to make engine work at a very low pressure. Will any reader tell [illegible] what must be the size of boiler and furnace (no tubes) [illegible] diameter and stroke of cylinder, in order to insure a [illegible] of five miles per hour without danger? Also [illegible] and weight of fly-wheel, and size of propeller.—CHALO[illegible]

[64762.]—**Mounting Microscopic Objects [illegible] use with High Powers.**—In mounting [illegible] which it is intended to be examined with high [illegible] is it necessary to press the cover-glass down on the [illegible] so that there shall be as small a space as possible [illegible] the object and the lens of the microscope, or is it [illegible] to allow the cover-glass to fall gently on the object [illegible] rest in that position?—the thinnest glass [illegible] being used for covering. A few practical [illegible] would be very acceptable.—MICROSCOPIST.

[64763.]—**Heat.**—I apprehend that 1lb. of [illegible] burned as such, will yield more heat than if the [illegible] and hydrogen it contains were burned in a free [illegible] Thus I read that 1lb. of starch will yield 11,[illegible] [illegible] heat; but I feel convinced, and calculation seems to [illegible] port me, that the 44 9 per cent. of carbon, and the 6[illegible] of hydrogen it contains would not yield the same [illegible] of units of heat, the difference being the energy of [illegible] bination. Similarly I infer that fat would yield [illegible] heat when burned in that form than when chemically disunited into its elements of carbon, hydrogen, [illegible] oxygen, the latter being useless, I know, as a heat-[illegible] agent. Say, please, whether this reasoning is correct. [illegible] feel certain it is so; but I would like the opinion of [illegible] one else before I place full reliance upon it.—PHYSI[illegible]

[64764.]—**Mathematical.**—In a recent number [illegible] the *Electrician* a formula appeared for finding the [illegible] of speaking tubes joining a set of rooms. It was [illegible] = required number of tubes. Mathematically, if we [illegible] n points in space, the smallest set of lines joining [illegible] with every other point would be $\frac{n(n-1)}{2}$. Why is [illegible] Would some one kindly give the theoretical proof?—STUDENT.

[64765.]—**Arc Lamps.**—Is a Brockie-Pell arc [illegible] worked with alternating as well as continuous [illegible] without any change in the winding of shunt coil? [illegible] not the solid cores of series and shunt solenoids, and [illegible] number of turns in shunt magnet, prevent its [illegible] satisfactorily with alternate currents without a [illegible] in construction?—STUDENT.

[64766.]—**Water Supply and Power.**—Can [illegible] reader give information as to the method of boring [illegible] the diamond drill, which brings up a core of the rock [illegible] about the expense, and time required to bore, say, a bore, 300ft. deep, through old red sandstone strata, sandstone and conglomerate? Also how the tubes [illegible] inserted in the bore, and if the drill is worked by [illegible] or manual labour? Could such a well, where the [illegible] rises 20ft. above the ground in a 9in. pipe, be made to [illegible] a turbine, and what would be the power with a supply [illegible] 3,000gal. per minute? Could the turbine be attached direct to it, without first running the water into a cistern —J. R. G.

[64767.]—**Leclanche Cells.**—I put up some Leclanché cells the other day, and after being at work [illegible] about a week stopped working. On examining them I found the zincs quite black, and when I took them out of

t came off quite easily with the finger. I also
: same black deposit on the bottom of the
The porous pots had white crystals strewed
urface. The cells are new, everything was
nd sal-ammoniac good, about 3oz to each No.
l any brother-reader tell me what is wrong?
sing Leclanché cells for many years, and,
sent, never had the slightest trouble, the
ys keeping quite clear till exhausted, and
troubled with the salts creeping.—T. J.

**mateur Manufacture of Tobacco
r, &c.**—To "To Eos."—Tobacco I only in-
r my own amusement and consumption, the
here making profitable growing on a large
erate scale out of the question. I chiefly
s of perfume flowers suitable for this climate,
method of extracting employed in India. I
ne little fancy bottles that came from India
m a child) retained perfume years after all
d had disappeared. With regard to dyeing
e. Do not be offended; but if you refer to p.
you will see the instructions given by you
with "as large as a piece of chalk,' &c. Please
es approximately, as experimenting is not
e—material has to be grown. Will not tar-
acid do instead of lemon juice? It pays to
s from Italy, absurd to say. Citric acid is
verything else. I tried with some flowers I
de was very pale—colour did not seem to
etals freely. You distinctly say cold water.
oiling do? The spent petals seemed to have
t at all. While on this subject, can you give
ion as to cultivation of real saffron? Why
? I priced chiretta—it is 1s. per oz.—R. L.
enstown, South Australia, Jan. 31.

eflection of Beams.—Some time ago
ol" was kind enough to direct me to Cam-
"Iron Bridges, &c.," which I have got, to-
later one by the same author on "Materials
tion" (1881), and it is in the formula for de-
latter that I find a difficulty, as I do not
or M in this formula, $D = \frac{W l^3}{25 \cdot 6 M}$; but turn-
t chapter on the "Elasticity of Iron," I find
of elasticity to be 6,391 tons. Is this the
? Both the above seem good books, and I am
. C." for them.—J. R. G.

teel Castings.—To "T. C., Bristol."—
ature of the small steel castings now become
h as spanners, &c.? Are they similar to
t with a little more carbon, or are they
Would that kind of steel be suitable for
eccentric rods, &c., of a small power engine,
to have a forging made in the old way? I
f an engine with a 2in. to 3in. cylinder and
or 1in. diam.—F. A. M.

Heating Small Boiler.—Will Mr.
ly say whether this reckoning is about right?
about 100lb. of water:—Coal or coke, 10lb.,
d.; coal gas, 200c.ft. at 3s. 6d., worth 8d.;
l., worth 7d.; which makes evaporating by
ut seven times the cost of evaporating by
amount of coal would be required to run a
engine I hope we may arrive at, if our
ave such little engines will kindly test them
e results? May we, perhaps, take the duty
engines at 10lb. per H.P. per hour? If so,
b. per hour would give 2 man-power for one
for 10 hours at a cost of 3d. Thus gas heat-
imes that cost would come to 2s. for 10 hours.
burner for the kerosene would Mr. Fletcher
I.

teel Castings.—Being located in a
and consequently cut off from the advantages
ompany city life, I would like if any of your
would assist me in the way of moulding and
bove. To begin with, I have none of the
ances in use for the working of steel. The
m connected with is an ordinary cast-iron
g a very fair class of general engine castings;
small job to cast in steel, I would like to
npt at casting same. First I should make
ry-sand one, and after sleeking it would wash
o wash. Then as to the melting of the
l use about three or four times the amount
ssary for melting pig-iron. But as I am
casting being hard, and having no special
e annealing of it, information on this as in
connected with the casting of steel will be
lly received. Also please to state if you
work published on the subject.—Novice.

lineral Waters.—Is there a substance
ve a body on addition to water (like porter
without giving any taste, or flavour, or any
te its presence? If there is, how is it to be
rmentable? Also I would wish to know if
ing which would give a clear and sparkling
water, without taste, &c. I want these for
rs.—T. Bryne.

ylinder Friction Machine.—As I am
up an electrical machine of the above de-
all be much obliged if some one will kindly
llowing information:—1. How to make the
he silk rubber, and how to put it on. 2. How
glass cylinder should the silk flap come—
r 3in. or more from the prime conductor?
e rubber should be insulated by being fixed
od. 4. How to make a good varnish to coat
tool, &c., with, to insulate them?—King

efective Electro-Magnet.—A friend
lectro-magnet made as follows:—Cast-iron
by $2\frac{1}{2}$in. diam., ends 4in. diam., $\frac{1}{2}$in. thick,
square and 2in thick, base being separate
ld to reel by wrought-iron bolt passing
e, and held to cross bar by nut on top. The
ed with $8\frac{1}{2}$lb. No. 16 c.c. wire, each layer
paraffined paper. There are 8 layers of 105
aking 840 turns in all. It is intended to
t either block downwards or inverted. Used
of six cells the pull is less than 1lb. Would
responding electricians of "Ours" kindly say what is the defect in construction, or what may be the cause of such an insignificant result? Weight of cast-iron in magnet 25lb.—Bolt.

[64776.]—**Mechanical Organ.**—Will some one kindly give me a few hints and instructions for making the above? I wish it to play by pressure of the feet, not by turning a handle, the music to be produced by pins on a barrel or cylinder. I want a few small pipes. Also some reeds What could be done with an old harmonium, keeping the case as it is for the organ case? I want a powerful tone, and easy to work, with the mechanism as simple as possible. Any hints and rough sketch showing how to make a really good instrument will greatly oblige. —A Music Simpleton.

[64777.]—**Screw.**—I want a screw that, on slight pressure, will enter into cork or similar soft substances. The screw itself to be connected to a handle by means of a swivel joint, which will allow the screw to turn while the handle does not, and in turning enter the cork. Will any fellow-reader oblige with a sketch of the most effective kind of screw requiring the least pressure to effect this? I want as many threads to the inch as possible.—Alkali.

[64778.]—**To Mr. Thos. Fletcher.**—Some time back you gave particulars of a really workable cold-soldering process, and then referred to another and better, but more expensive one. Would you kindly describe this? Could you also favour us with a description of a new German kerosene lamp known as the Blitz Lamp?—Finem Respice.

[64779.]—**Condensing Exhaust Steam.**—I want to condense my exhaust steam from a boiler, and use it over again as feed water, to avoid buying water, and to improve the water, so as to avoid the incrustation in the boiler. I have a supply of cold water that can be pumped by steam from a well. Can any reader advise as to the best way to go about it to be effective and not too costly? Can they refer to where it is to be seen in practice?—Timothy.

[64780.]—**Written Chinese Characters.**—Can any reader inform me where I can obtain a knowledge of Chinese written characters? I am familiar with the printed and with the orthodox written characters; but Chinese documents abound with characters which are not in any of the dictionaries, and it is with regard to these that I seek information.—F. B. Allison.

[64781.]—**Cut-Off L.P. Cylinder.**—Will anyone help me in the following problem? In a compound engine, diameter of cylinder fixed, h.p. cut-off fixed, to find the cut-off in l.p. cylinder to avoid drop in the receiver? Particulars:—Diam. h.p. cylinder 8in., diam. l.p. 15in., stroke 20in, clearance in both 10 per cent. vol. receiver 1·5 times h.p. cylinder, cut-off h.p. cylinder $\frac{1}{2}$ stroke, initial pressure h.p. cylinder 105lb. absolute. Some time ago I came across an excellent method of working out the above graphically, but unfortunately have lost it. If it was in the "E. M." will any reader kindly refer me to it? I cannot find this question fully explained in any book either graphically or mathematically.—Bengal.

[64782.]—**Engine.**—The bearings carrying fly-wheel of engine have been allowed to run dry, and although now kept well oiled, I cannot stop them from cutting. I should be glad if some fellow-reader could tell me of any plan to obviate this, as the bearings are grinding away badly.—Perplexed.

[64783.]—**To Weld Steel.**—I have some tools to make steel faced (mild steel). Have tried silver sand, but cannot make sound weld that will stand continually being sharpened. I should be greatly obliged for any information on welding iron and steel.—Blacksmith.

[64784.]—**Electrical.**—Would Mr. Bottone or other correspondent kindly give me the length and diameter of bobbin? Also size and amount of wire for an intensity coil to give $\frac{1}{4}$in. spark. Will that spark work vacuum experiments? Could any one stand a shock from it with the regulator fully out? What form of regulator would be best? I did not want to use a condenser if I could do without one.—Gens.

[64785.]—**Wheatmeal Bread.**—As there is a discussion on wheatmeal bread at present, will some chemical reader give us the chemical action which takes place when yeast is added to wheatmeal? What temperature is necessary? What retards or accelerates the action of yeast? Can carbon dioxide be evolved in stiff dough? What makes meal go sour?—Terranova.

[64786.]—**Double Star near Eta Orionis.**—While looking a few nights since at the Trapezium, I turned my $4\frac{1}{2}$in. Cook upon Eta. Could make a good elongation, but failed to split it with powers up to 350. The nearest star south in finder I believe to be a very close double. Will some one possessing better means say if it is so? I cannot find anything about it in "Celestial Objects" or "Celestial Cycle."—F. Wykes.

[64787.]—**Dying by an Effort of Will.**—It is stated that Hindoos have the power of dying of their own free will, without poison, by simply lying on their back. They have also the power to remain in a coffin, screwed down, for a space of six months in a trance-like condition. At the end of that period the coffin is unscrewed, and after a little attention they are brought back to their normal condition. These facts have been proved. Can any reader account for this seeming physiological impossibility?—George Macbeth.

[64788.]—**Violins.**—Will "War" kindly give the title of Savart's work to which he refers on the trapezoidal violin, and the year of "Fiddler's" communication to the "E. M." regarding the invention he mentions?—Pan.

[64789.]—**Domestic.**—A reader who is about to build a house would like to know whether telephones or speaking tubes are the most practical for use from room to room. Also, in regard to warming, what are the best modes of introducing warmed air from a central hall stove to the rooms, by openings through the cornices or over the doors?—Sanitarian.

[64790.]—**Magnets.**—Can I procure a magnet that will attract a bit of steel at 3in. or 4in. distance at a trifling expense, or improve a common one? Will a powerful magnet attract (suppose a needle) through living flesh, as the hand, foot, &c.?—Invalid.

[64791.]—**Engine.**—To "T.C., Bristol" or Others.—I am about to make a compound engine. The h.p. cylinder is $1\frac{1}{2}$in. bore, 3in. stroke, and the l.p. 3in. bore, 3in. stroke. I am in a fix how, and in what part of the h.p. cylinder, the steam is exhausted into the l.p. A sketch would make it much plainer. What would be the nominal power of such an engine?—Compound.

[64792.]—**To Mr. Bottone or Others.**—I am desirous of constructing personally a small plating dynamo of 4 ampères, and also one of 100 amperes, and am anxious to know of the best and simplest system, quantity and size of wire, mode of winding, &c., with a sketch of the machine, if possible. Could a suitable set of castings, &c., be obtained?—Matrix.

[64793.]—**Price of Patterns.**—Will any reader kindly give me a rule for estimating the price of spur and bevel-wheel patterns? A method of arriving at the value of the labour separate will oblige. I have read "Templeton" on this subject, but his tables are too obscure for me to understand.—Moulder.

[64794.]—**Meteoric Astronomy.**—To "F.R.A.S."—Do our periodical star showers show any marked tendency to move around the sun in the same plane as the planets, or do they move promiscuously in every possible plane? I have a theory, which, if true, would show cause why they should in time move in the same plane as the planets, and which would cause the latter ultimately to move in one exact plane.—J. Fraser.

[64795.]—**Wimshurst Machine.**—On p. 34, in last week's "E. M.," letter 28491, Mr. F. T. Fowler states that his Wimshurst machine with $13\frac{1}{2}$in. by $\frac{1}{4}$in. plates $\frac{3}{8}$ apart, gives 7in. sparks. Would he kindly say what shape, size, number, also what materials he makes the sectors from? The machine is a marvel.—Steel.

[64796.]—**To Prevent Mice from Getting to Birds Hung on Walls.**—Will any reader kindly inform me if there is any kind of composition, cement, or whitewash that can be made so slippery as to prevent mice from climbing up, or any method that has been tried and found really serviceable?—F. A. B.

[64797.]—**Zinc Plate.**—I have a large zinc name-plate, and the black in the letters has partly chipped off. The remainder are in small nobbles. What is the composition for the letters, and how is it melted in? Should the plate be polished before or after the composition is put in?—J. T.

[64798.]—**Photography—Swing Back.**—Can the advantages of a swing back be attained by a swing lens? I can alter my camera to the latter but not to the former. R. G.

[64799.]—**To "F.R.A.S."**—Would you kindly give me particulars of the lenses used in, and power of the usual eyepieces for, microscope, called by the opticians A, B, C, and D?—Finem Respice.

[64800.]—**Suspension of Block System.**—To Mr. Clement E. Stretton.—Would you oblige with the instructions referred to in your letter, 28475, and say who is the "goods agent" referred to, and at what station?—Finem Respice.

[64801.]—**Boiler.**—I have a copper boiler, 2ft. long, 8in. diam., 1-16 thick, dished ends, double riveted, and well stayed. Would anyone be kind enough to say what pressure it would be safe to work it at?—Engine.

[64802.]—**Angle Plummer Blocks.**—Can any of your readers kindly inform me what advantages angle plummer blocks in crank shaft bearings have over the square or ordinary form?—B. Grant.

[64803].—**Diamond.**—Can any of "ours" tell me what is the colouring matter of the diamond? Is it ferric oxide?—Principia.

[64804.]—**Encke's Comet and Faye's Comet.**—Can any reader oblige me with particulars of when and where these two comets are likely to be seen this summer, and also what power will find them?—Mars.

[64805.]—**Electric Bell.**—I would like make a 3in. trembling bell with the working part under the dome. Would "F. C. A." give a drawing with a description of one that will ring well?—J. H. Y.

[64806.]—**Carbon.**—I want to mould carbon studs similar to those used in the Blake telephone transmitter. Will any correspondent kindly inform me what process and materials to use?—J. G.

[64807.]—**Photography—View Meter.**—Wanted sketch with dimension for 10 by 8 plates.—R. G.

[64808.]—**Coil.**—Will Mr. Bottone or some one reply to query 64255, Jan. 20th? I find I was not quite correct in the dimensions, and perhaps that is the reason of no reply. The coil is $5\frac{1}{2}$in. high, 2in. diam., and core is $\frac{5}{8}$in. diam., projecting 5-16in. Is wound with c.c. wire. The battery is two $\frac{1}{2}$-pint cells, Smee. Is it the best battery, or would a bichromate do better? If so, what size?—Signal.

[64809.]—**Stereotype Casting.**—Can any reader inform me where I can get the paper used for casting stereotype on? I believe there is a paper made which is put on a mould, by which means any article can be cast, no matter how thin, of course with the proper mixture of metals.—Garfield.

[64810.]—**Chemical Analysis of Steel.**—Will one of our chemical friends be good enough to briefly describe the methods of analysis for obtaining from mild steel the proportions of carbon, manganese, phosphorus, sulphur, and silicon? Also the time occupied in the several processes?—Not a Chemist.

[64811.]—**Kites.**—Some twelve months ago I saw in *Tit Bits* that kites had been used for a carriage, travelling a long distance at a rapid rate with several persons in. Can any reader give any particulars of how the kites were made and governed?—Neva.

[64812.]—**Blow Lamp.**—I want to construct a blow lamp for $\frac{1}{2}$in. to $1\frac{1}{2}$in. lead-pipe work. I have got a blow pipe and should like to make a lamp to burn paraffin or colza oil. I am in a difficulty about the burner. Will some mechanic please help?—Radcliffe.

[64813.]—**Drying Wood.**—I get my wood in months before I require to use it, to give it time to dry. I keep it in a cool dry place away from sun and heat, but somehow I usually find one side hollow and the other side round. How can this be prevented?—M. R. C. S.

[64814.]—**Blacking Zinc.**—I have some small zinc castings, which I wish to stain black. There were a lot of recipes given some years ago. I recollect trying some. They were useless.—GEORGE.

[64815.]—**Dynamo.**—I have the castings of a 5c.p. dynamo with wrought-iron H armature. Kindly give size and quantity of wire for fields and armature? Cost and speed to run at. Also will it light a 25-volt Edison Swan lamp?—E. M. F.

[64816.]—**Time Keeper.**—I want to use a two-day marine chronometer, or a Vienna regulator in a small observatory. Which would be the most useful and trustworthy.—J.

[64817.]—**Testing Oxygen.**—Will some chemist kindly enlighten me as to the best and cheapest method how to test the amount of nitrogen as an impurity in a given sample of oxygen?—MAGIC LANTERN.

[64818.]—**Steel.**—Can any of our chemical friends give me a tip how to test steel for quantity of carbon?—STEEL.

[64819.]—**Skates.**—What class of skates do our champion skaters use when racing?—NEVA.

[64820.]—**Thermometers.**—How are thermometer tubes filled with the mercury or other composition?—NEVA.

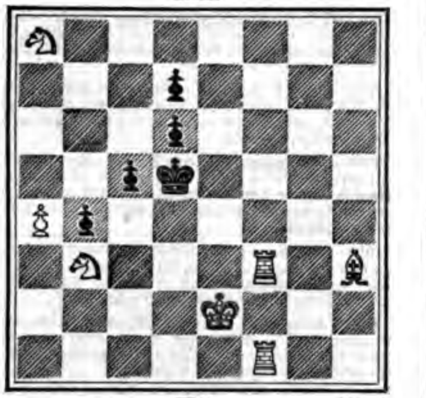
[64821.]—**Measuring Building.**—A large building is known to be of a square form, but no one of its sides could be measured on account of obstructions from other buildings. However from a point B three streets diverge directly to its three nearest angles A B C. Now P A = 60, P B = 40, and P C = 70yds. Required the side of the building.—PROBLEM.

CHESS.

ALL communications for this department must be addressed to J. PIERCE, Langley House, Dorking.

PROBLEM MLXXXVIII.—BY J. KEEBLE.

Black.



White. [7 + 5

White to play and mate in two moves.

SOLUTION TO 1,085.

White.	*Black.*
1. Kt (Kt 4) to K 5.	1. K moves.
2. P to B 3.	2 K moves.
3. Kt to Q-B 4 (ch).	2. K takes Kt.
4. P to Kt 4.	4. K takes Kt.
5. B to K 2 mate.	

SOLUTION TO 1,086.

White.	*Black.*
1. P-K 4.	1. Kt takes K-P (*a*).
2. Q to K 2.	2. Anything.
3. Q mates.	
	(*a*) 1. Kt-K 3 (*b*).
2. Kt-R 5, &c.	
	(*b*) 1. K-Q 5 (*c*).
2. Q takes P (ch), &c.	
	(*c*) 1. Kt-B 6 (*d*).
2. Q takes Kt &c.	
	(*d*) 1. P-B 5.
2. Q-Q R sq (ch), &c.	

NOTICES TO CORRESPONDENTS.

CORRECT solutions to 1 085 by J. Bryden, and A. Bolus; to 1,086 by E. J. Bevan, Hensing, G. T. Stringfellow, Link, and G. W. Middleton.

J. DAVIS.—Solution of the five-mover given above.

BLACK PAWN.—Tourney problems received.

C. READE.—Suppose 1. $\frac{\text{Q-K Kt 4}}{\text{B-K 2}}$, 2. $\frac{\text{Kt-R 5}}{\text{R-Q sq (ch)}}$.

UP to the present only three have entered for the Problem Tourney, while 15 are in for Solution Tourney. We must have at least nine more entries for the former before we can make a start.

MR. BLACKBURNE recently played 23 simultaneous games at the Shaftesbury Hall, Southampton, of which he won 17, drew 4, and lost 2, to Mr. Blake and Dr. Hemming.

"CHESS has become one of the institutions of the House of Commons. Since the introduction of the board to the smoking-room, many stiff games have been fought every night. Gladstonians challenge Unionists, and Parnellites also come within the chess circle. The other evening Mr. Bradlaugh and Mr Henniker Heaton were the centre of a group of interested observers, and still stranger conjunctions have been seen across the board. The players *are now* becoming fastidious. Two weeks ago they were *delighted to have a movable board*. On Tuesday night *they were agitating for a fully equipped table*. A petition in regular Parliamentary form has been prepared, and to it 100 signatures have already been attached. In this document the defects of the existing arrangement are gravely enumerated, and the Chief Commissioner of Works is requested to furnish forthwith all that the players desire."—*Scotsman.*

A SOLUTION Tourney has commenced in the *Dublin Mail*, to be continued three months. Seven book prizes from 21s. to 2s. 6d.

REV. A. B. SKIPWORTH has challenged Zukertort to a match for a nominal stake.

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to Hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, March 14, and unacknowledged elsewhere:—

JAS. BROGDEN.—Maj.-Gen. Cunningham.—W. P.—One in a Fix.—T. O. D.—E. G. M.—Elect Boring.—T. W. B.—C. T. G.—Mephisto.—Ursa Minor.—H. A. G.—A. J. Adams.—A. Marson.—Electro-Brassing.—E. P.—T.—E. H.—N. G. Beck.—W. B. Leigh.—Cabin.—W. A. S. B.—S. S.—Gwent.—W. Perren-Maycock.—S. Bottone.

DESMID. (If your query, "sent about a month ago," reached us, no doubt it was answered in this column. We have no space to spare at present for Volupuk. See what was said about it in Vol. XLIII. No doubt a bookseller could procure you the grammar you require; but the query is clearly against the rules. See Hint No. 4.)—ENQUIRY. (We cannot undertake to advise about patenting inventions unless we have some clear idea as to the inventions themselves. Most machines of the kind alluded to, if they are improvements and will save time, without being expensive, are worth patenting, especially as a patent now costs only £4; but we illustrated on p. 546, last volume, something similar to one, and there are certainly many forging hammers worked by the means hinted at.)—INCUBUS. (Possibly you have not seen the article on the home-made incubator, which appeared so recently as the number for Feb. 17? You will find other incubators in Nos. 935, 1007, 1009, 1075.)—C. D. S. (You could answer the question at once by drawing the figure on a piece of paper or by rolling a penny along a line. If a vehicle is rolling along a road, the top of any of its wheels must, at any given moment, be moving through a greater space than any other part of the wheel, consequently it must be going faster. See a treatise on the "Geometry of the Cycloid," or No. 237, p. 81, Vol. X.)—J. M. G. (You are quite right. The Bower-Barff process consists in producing a "scale" or rustless oxide on the surface. It can be recognised by the fact that the "scale" is really the surface, and cannot be scaled off.)—W. G. BIGBY. (Many recipes have been given. Borax is strongly recommended, or a mixture of dried flour, red-lead, and sugar.)—EXPERIMENTALIST. (See indices for various methods of deodorising paraffin oil. If you succeed in rendering it free from smell, take out a patent at once.)—ARTHUR SAUNDERS. (The quantity of mercury will depend on the diameter of the tube. Fill it quite full, place the thumb on the top, and then invert, immersing the end in a little cistern of mercury before removing the thumb. If the tube is one of those with bent ends, ending in a turned up reservoir, you must put the mercury in the reservoir and shake it over the bend until the whole length of tube is full and a little is still left in the reservoir.)—NEPHESH. (In paragraphs or articles relating to scientific matters, it is usually understood when the kind of thermometer is not mentioned that the temperature referred to is that indicated by the Centigrade instrument, the zero of which is the freezing point of water. It is not unusual to translate the reading into degrees Fahrenheit for English readers.)—OLD SUBSCRIBER. (See indices. The papier-mache (old style) was paper softened into pulp and moulded under hydraulic pressure of many tons. Are you prepared to buy and erect the requisite plant, as it is simply the "pressure" that is required?)—IVO. (We do not see how we can assist. Certainly, if your brigade helps to put out fires, the insurance companies ought to pay something; but your local authorities should move in the matter, and the company which came to the most reasonable terms would most likely get the bulk of the insurance business.)—COUNTRYMAN. (A well-tried recipe for self-raising flour is Jones's patent, which has stood the test of years. In the ordinary way add baking powder in required quantity; but to prepare the above-named, take of kiln-dried flour, 1cwt.; tartaric acid, 10½oz.; and mix thoroughly, the acid being in fine powder well dried. After two or three days add 12oz. of bicarbonate of soda, ½lb. of lump sugar, and 1½lb. of common salt, all thoroughly dry and in fine powder. Mix the lot and pass through the dressing machine. This self-raising
flour has been used for years, and keeps i
a long time. Mix with cold water and p
as quickly as possible.)—A READER. (C
say without examining the water; but n
The earth passes through a stream of n
month. See indices.)—BEN. (Try whit
crocus, and finally the hand; but see ind
not repeat such directions every month.
(You will find all about it in back volu
the methods of making blue prints.)—
DALL. (We published full directions
American organs in Vol. XXVI.)—A. M.
been frequently stated in our columns th
not be done cheaply at home, except in t
bons and small articles, and then only wi
dyes. A proper plant is required, whi
good deal of space.)—A CONSTANT READ
long? Mr. Eldridge, 54, Murray-street,
advertises a useful book on hot-water h
CIUM. (We do not know that it is so, bu
is, the paper contained china clay. 2.
superintendent. Why do you want to carr
—T. LEE. (See index issued with th
something about octave couplers 2. Try
it with paraffin oil, and apply a hot iron
little. 3. How can anyone say without se
haps it is not intended to come off?)—W
(No doubt you mean "507 Mechanical
Try Trübner and Co., Ludgate-hill, E.C. T
it in 1870.)—AMATURE. (Do not under
it was made by an optician, surely it
See indices.)—WIMBLEDON. (See Hints
—A. E. F. CLAYBON. (No room for that j
not work it out with the aid of the table
book, and that given in many almanacs?
TON. (Some recipes have been given in t
The best way is to let it settle.)—CONST
(For rotary engines, see indices and Vo
FARRAND. (Where do you find referen
instrument?)—A. B. (Please see adverti
and back volumes.)—LIMELIGHT. (Pro
—say, Chadwick's "Magic-Lantern Man
F. Warne and Co.—or look up the indices.
is almost exhausted, and we really cannot
at long intervals.)—DUNCE. (Ink for
p. 134, Vol. XXXIX., and many other
thick solution of aniline violet, containin
cerine.)—ELECTRICIAN. (See the in
CHANDLER. (Read previous answer. T
machine has been fully described in its
by the inventor himself, and we cannot
queries which apparently proceed from
not aware that their questions hav
answered many times in our columns.)—J
haps you have looked for it under the wro
is Dalton, not Dawlton.)—TOM. (Try t
recipes, or one of the advertised remedies
of dry flour, red lead, and sugar is general
—M. F. (Directions for making fountain
405, 459, 582, 801, 967, 973, 974, &c. 2. Que
it can be preserved without a "house"
What is it you do mean? You evidently
how it can be stored, and the answer is, In
house, both of which have been frequentl
the "house" so recently as p. 468, last vo
TURUS. (Is it not too elementary? Sup
it out on paper first, and then make a
difficulty.)—E. CLYDE. (What is it you
"gold" used by some jewellers freque
more than 50 per cent. of alloy; but we d
you would use such "gold.")—H. M.
state in definite language what it is you
may be able to help you.)—F. W. MUNC
of zinc is the solution obviously, as not
mentioned.)—ELECTRIC BELL. (Please
volumes, and current numbers, for infor
electric bells.)—F. C. (All legal querie
over to the Legal Editor of the *Weekly Ti*
who replies in that paper, which you h
in.)—J. H. (Dr. Allinson will probably
sulted personally, or in his capacity as Me
the *Weekly Times and Echo*, but not he
perienced people would simply do harm
opinions.)—DADDY. (Yes; but be brief
given many such in past volumes.)—D.
have written him. If he doesn't send
return the money in a week, let us know,
not advertise again.)—J. T. LAWRENCE,
type.)

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The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, MARCH 23, 1888.

PRACTICAL ELECTRIC BELL-FITTING.—VIII.

Connecting-Up.—(*Continued.*)

FIG. 55 shows an arrangement suitable for long distances, a relay being used to close the local bell circuit. The zinc of the tery and one of the wires from the relay put to earth. When the button of the h P is pressed in, the current flows from the positive pole C of the battery D, through the push to the wire A, and from there through the relay coils to earth. The armature of the relay is thus attracted, closing the local bell circuit; the current flowing from the pole C of the local battery D' through the bell to the insulated post P of the relay (see Fig. 25, page 473), and thence by the armature A and wire to the negative pole Z; the armature of the relay remaining down so long as the button of the push is kept in.

Fig. 56 shows the method of connecting up the continuous ringing bells shown in Figs. 20 and 21, page 425. On closing the circuit by pressing the push P, the current flows from the pole C of the battery D to the terminal C of the bell, through the bell coils to L, and thence by the wire and push to the zinc of the battery. The lever G being released on the first stroke of the bell, the local circuit through the bell is closed, the current flowing from C of the battery to terminal C of the bell, through the bell to terminal Z, and thence by the wire to zinc of the battery, the bell continuing to ring until stopped by pulling the cord W.

Fig. 57 shows the connections for a continuous ringing bell when the circuit is very long, the ringing of the bell being continued after the original circuit is broken, by a local battery. The current in the main circuit flows (when the push is pressed) from the

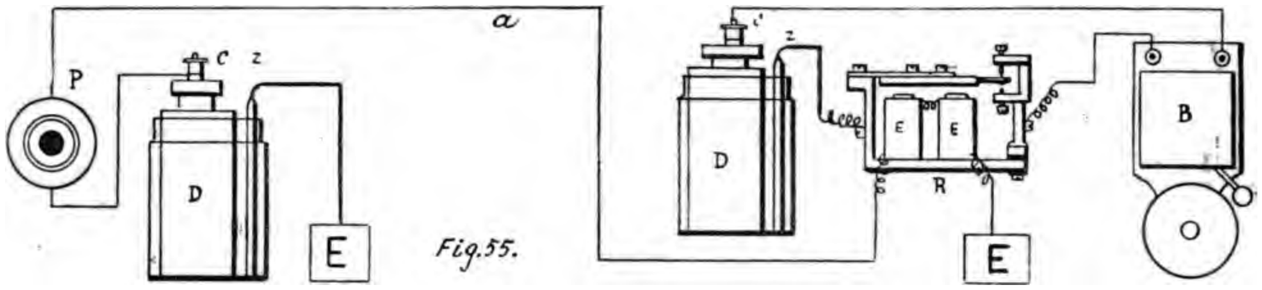

Fig. 55.

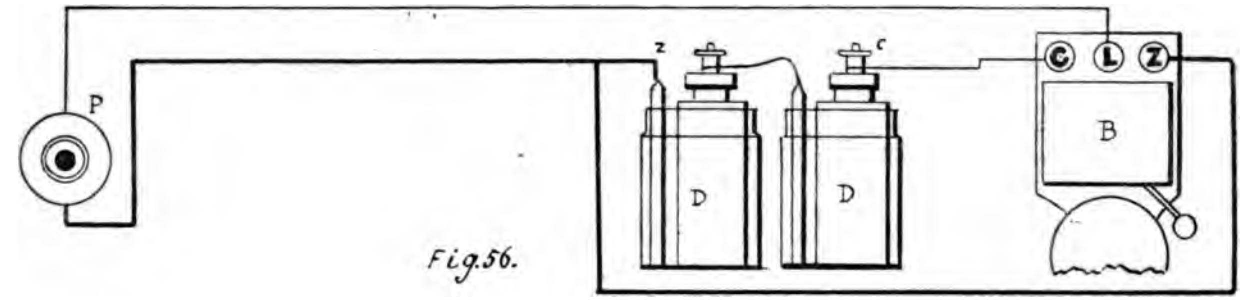

Fig. 56.

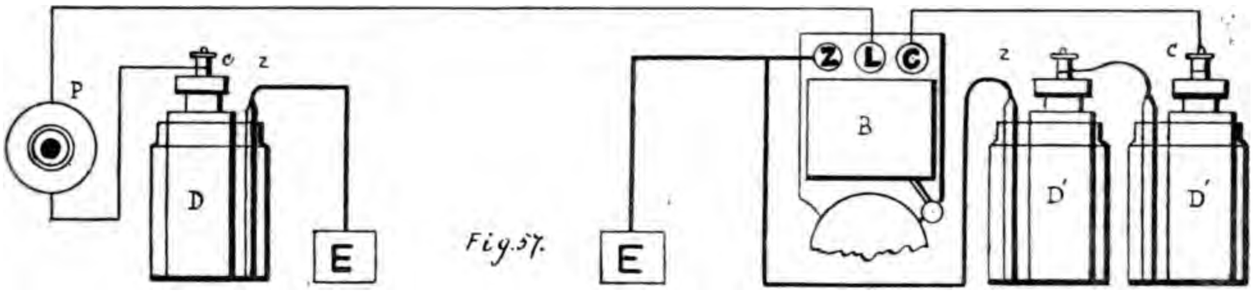

Fig. 57.

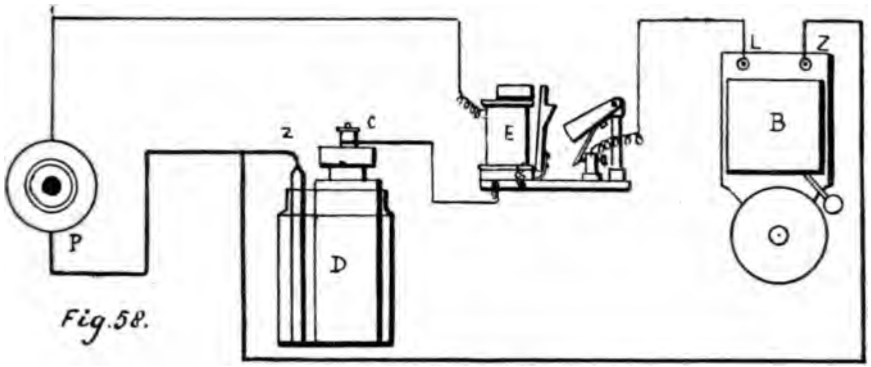

Fig. 58.

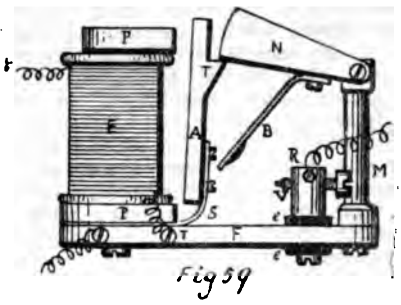

Fig. 59

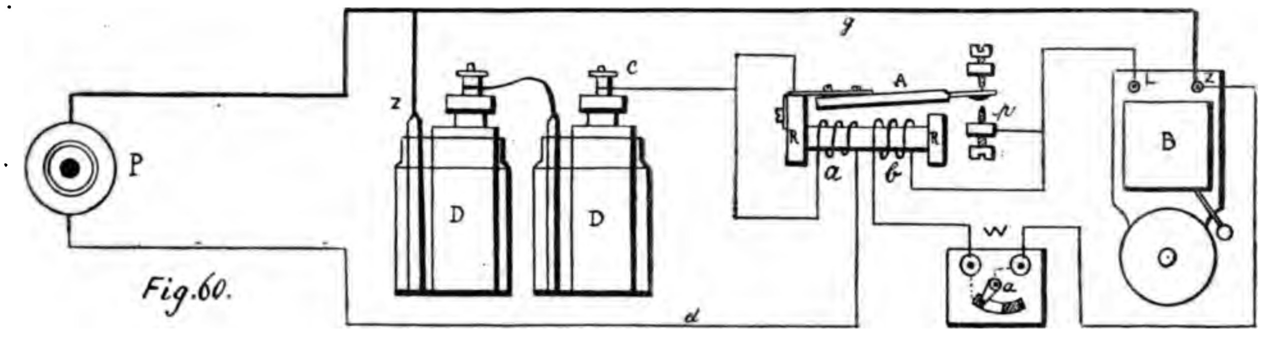

Fig. 60.

pole C of the battery D, by the push P and wire to terminal L of the bell, and then through the coils to terminal Z and earth, the other pole of the battery being also put to earth. The local circuit, after the bell is once started, runs from C of the local battery D' to the terminal C, through the bell to terminal Z, and then by the return wire to the zinc of the battery, the bell continuing to ring until stopped in the manner previously described.

Fig. 58 shows how an ordinary bell can be made to ring continuously by using an indicator constructed for such a purpose. Fig. 59 shows the indicator in detail: P P are the poles of the electro-magnet E, provided with an armature, A, which, when at rest, is kept off the poles by the spring S. To the frame F is fixed the pillar M, the upper end of which carries the arm N in its normal position supported by the catch T. A contact post, R, fitted with a platinum-pointed contact screw, V, is also fixed to the frame F, but insulated therefrom by the ebonite washers *ee*. When a current flows through the coils of the electro-magnet the armature is attracted, and the lever N slips off the catch T, causing the contact-spring B to make contact with the screw V; thus connecting the insulated post, R, to the frame. The arm N (the face of which is painted white so as to show through the perforation in the dial of the indicator), is reset by pulling a cord at the side, which throws up the arm, causing it to again engage with the catch.

When the push P (Fig. 58) is pressed, the current flows from C of the battery to the frame F of the indicator; thence, by screw J and wire, through the coils of the electro-magnet (attracting the armature and releasing the arm), and then by wire and push to the zinc of the battery. The current now flows from C of the battery to the frame of indicator, pillar M, arm N, contact post R, thence by wire to terminal L of the bell, through the bell to terminal Z, and then by the wire to the zinc of the battery, the bell continuing to ring until the indicator is reset.

In Callow's continuous ringing attachment for electric bells, which was referred to on page 426, an ordinary relay is used in place of the drop relay shown in Fig. 21, page [illegible]. This is connected to the bell in the usual way, but with this addition — the coil of the relay is so connected as to form a shunt circuit across the terminals of the bell. It will be seen from this that on the armature of the relay being attracted and a current flowing through the bell, part of the current is shunted through the relay, thus keeping the circuit closed. In adapting this attachment to bells already working with a relay, the relay is wound with two wires, the primary or first layer being connected direct to line, and the secondary or second layer in the shunt circuit. This arrangement is shown in Fig. 60. When the button of the push P is pressed the current in the main circuit flows from the positive pole C of the battery D through the relay coil A, and thence by the wire D and push P to the zinc of the battery. This attracts the armature A of the relay R, closing the local bell circuit, the current flowing from C of the battery to armature A of the relay R, contact post *p*, terminal L of the bell, through the bell to terminal Z, and thence by wire *g* to the zinc of the battery. Part of the current also flows along the wire from the bell terminal L, through the relay coil *b* and switch W to terminal Z of the bell, thus keeping the armature of the relay down after the main circuit has been broken, the bell continuing to ring until the shunt circuit is broken by moving the arm *a* of the switch W over to the opposite side. The bell can also be stopped by short-circuiting the relay, which can be effected by an *ordinary* push.

It will be seen that more than one bell can be rung from the same attachment, and the bell can, by moving the arm of the switch W, be made continuous ringing or not at will. If the arm *a* of the switch is moved over to the opposite side to which it is shown in the figure, the shunt circuit of the bell through the relay is broken, and the bell will ring only so long as the button of the push is kept in. This continuous ringing attachment is very convenient for front doors, &c., where trouble is experienced in securing immediate attention to the summons. Instead of being taken to the switch, as in Fig. 60, the two wires are taken to a contact (see Fig. 40), fixed on the side of the door-frame, and so arranged that, when the door is opened, it either short-circuits or breaks the shunt circuit; thus, when the push is pressed the bell rings until the door is opened, the continual ringing of the bell insuring prompt attention.

F. C. A.

(*To be continued.*)

GEARING.—XII.

Worm Gears.

THIS section of screw gears is in more common use than the preceding. In this the axes are usually, though not necessarily, at right angles to each other, the velocity ratios are many to one; and the worm is the driver—not the driven, the gears not being reciprocal. Owing to the large percentage of friction developed, the screw angles being less than the angle of repose for iron, there is no risk of running back; but the worm and wheel will remain stationary under the load at any instant. In angle wheels each of a pair usually contains, if not the same numbers of teeth, at least, numbers not very disproportionate. But in worm gears, the wheel A, Fig. 86, contains many teeth—that is, *portions* of many screw threads, and the worm B, one or more, seldom more than two or three, *complete* threads. If the worm has one thread, or tooth, the wheel will be moved a distance equal to one tooth at each revolution of the worm; if the worm has two threads, or teeth, the wheel will be moved a distance equal to two teeth during each revolution of the worm. So that in the first case the single-threaded worm would have to make 22 revolutions to move a 22-threaded wheel round once; in the second case the double-threaded worm would have to make 11 revolutions only. If it is intended that the worm alone shall drive, as is commonly the case, the angle which the teeth make with a perpendicular to the axis should not exceed 9°, 10° being the angle of repose for iron.

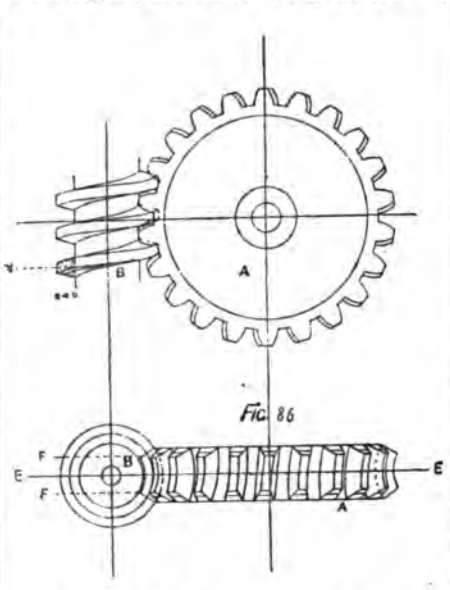

Fig 86

There are those, both workmen and amateurs, who experience an initial difficulty in connecting the twist wheels of our last, with the worm gears of the present article, because their appearances are so very unlike. I will endeavour, therefore, clearly to establish the family relation between the two, and we shall find their essential construction easier to comprehend by the adoption of this comparative method.

Fig. 87 represents the centres of the threads of a typical screw wheel, illustrating similarly

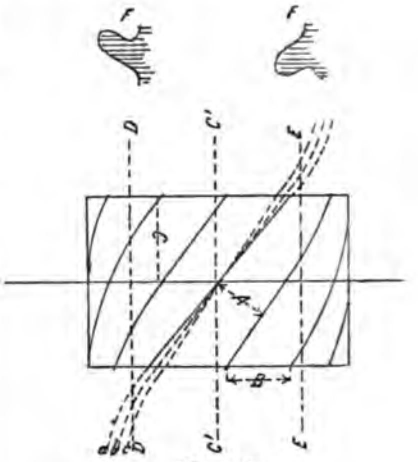

Fig. 87

to Fig. 67 in Article X., A the normal pitch, B the circumferential ditto, and C the divided axial pitch. Looking at the thread centres of the worm and wheel, Fig. 88, the same reference

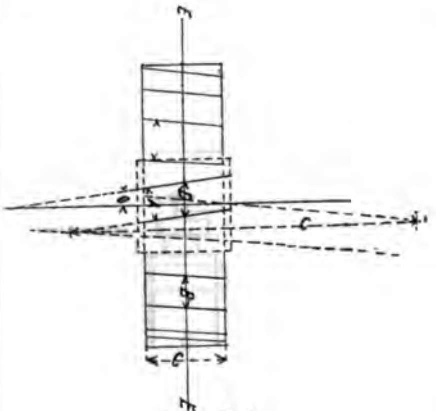

Fig. 88

letters indicate identical pitches. The worm is there a complete single-threaded screw of small total axial pitch, D, working into a wheel containing numerous very short sections of a many threaded screw of extremely long axial pitch, the total axial pitch D of the worm being equal to the circumferential pitch B of the wheel. We said in the last article that whatever differences may exist in the relations of these pitches, due to difference in angle, in any case the normal pitch A must be the same. In worm-gearing this again holds good, although the difference in the other relations is very much greater than in angle wheels. Giving to the pair of gears, Fig. 88, definite dimensions, we can trace out the relations between the pitches in a satisfactory manner. The worm has a single thread whose pitch D measured parallel with the axis is 2in.; this is, therefore, its *total axial pitch*, or distance from centre to centre of tooth thread, and there is no divided axial pitch. If the worm has two threads or three threads, as in Fig. 89, then the distance D would represent the pitch of any single thread, and the distance between contiguous threads C, would be a divided axial pitch Then for one revolution of the worm the teet of the wheel would be passed a distance equa to D. In other words, while in Fig. 88 th worm wheel passes one tooth only to ea revolution of the worm, in Fig. 89 it wou pass three teeth to each such revolution. order to correct gear, it is evident that the sc sections on the worm wheel must correspon centres with D in the same Fig. 88, or wit in Fig. 89. Hence we take no account of normal pitch A, though that, of course, m

ond in worm and wheel, but simply take
entres on the line E, E (see Figs. 86, 88),
g them the same on worm and wheel, and
re our first dimensions. In Fig. 88, the
e D is 2in., and say we have 22 teeth in
eel, 22 × 2 = 44in. circ., and $\frac{44}{3{\cdot}14159}$ =
iam., that is measured on the line E—E.
tooth angles of the wheels are affected
meter as well as by pitch. There is no

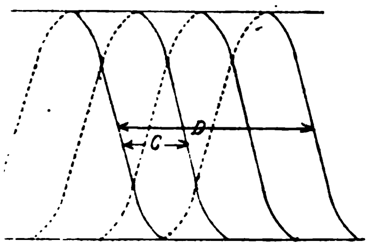

Fig. 89

xing the diameter of the worm within
imits, but it seldom exceeds three times
ch, and is often less. The smaller it is
eater the gain in power. About twice
ch may be considered a fair average pro-
1. Say we make it 5in. on the pitch
e in Fig. 88. Then let R = pitch radius
m = 2½in., P = D = the axial pitch 2in.,
the angle of the thread which we want
. Then the relation obtains:—tan. θ =
= $\frac{2\text{in.}}{2 \times 3{\cdot}14159 \times 2\frac{1}{2}\text{in.}}$ = ·127. The tan-
f 7° we find to be ·122, so that we say
gle θ is 7° about. This is merely the
ometrical rule $\frac{\text{perp.}}{\text{base}}$ = tangent of angle,
rcumference of 5in. = 15·7in. being the
nd the pitch 2in., the perpendicular of a
le whose angle is measured by θ. Without
ation, the angle θ can be obtained by
down a diagram.
orm and wheel alike, therefore, the angle
ead is 7°. In Fig. 88, the tooth centres
rtions of a series of 22 screw diagonals,
ices, making the angle θ = 7° with the
of the wheel axis. The total circum-
ial pitch of the wheel being 2in. × 22 =
this is the height of the perpendicular of

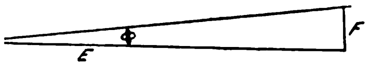

Fig. 90

angle measured by θ, of which in Fig. 90,
hypothenuse, is the tooth angle, and the
the base, or the total axial pitch. Then
= base, or Fig. 90, $\frac{F}{{\cdot}127}$ = E ; hence
360in. In other words, the total axial
f the worm-wheel threads is 30ft.
last determination is of no practical
; but we have at least made clear the
mental relation, spite of the vast differ-
etween the screw and the worm gears.
vided axial pitch is a very large dimen-
s seen in Fig. 88, C being very much greater
he entire breadth of the wheel itself, so
e may regard this also in a worm wheel
o practical value. On the other hand,
rmal and circumferential pitches A and
ectively in Fig. 88, though not identical,
very nearly alike, that as regards tooth
th they may be said to correspond. The
l pitch which is the basis of calculation
t wheels is scarcely made use of in worm
the circumferential pitch more con-
tly taking its place.
m a worm wheel is made with straight
et at the angle θ, the analogy between
ew and worm-gear pitches is complete.
hough there might be supposed to be a
f rounding and twist on the teeth, yet
ally, owing to the enormous length of
al pitch, they are on the length G,
t teeth simply, set diagonally at the
. Contact, then, as in screw gears, takes
t a point, and that on the line E—E.

In order to obtain better wearing surface, therefore, the teeth of the worm wheel are often *hollowed* to form *envelopes* of the worm, Fig. 86, which somewhat disguises the real construction of such gears. The reason why the tooth ends are bevelled off in the same figure, towards the centre of the worm, is to remove a useless and weak overhang.

The correct shaping of the teeth on these gears is of so much importance, and their construction often so faulty, that it will be desirable to enter into this with some detail, a matter which will not be so difficult now that we have a correct idea of what these wheels are in principle. The teeth are variously formed, but involute curves are much to be preferred to cycloidal for simplicity of working out, the worm teeth being those of a rack, and the wheel teeth those having single curves only, as in Fig. 86. In the straight tooth form of worm gear, Fig. 88, the tooth *sections* and *spaces* of the worm wheel are uniform throughout, like those of the ordinary spur gears, and there is not any difficulty in making these. But in the curved tooth Fig. 86, these vary at every position from the centre plane E, E, to the face, a fact which is apparent on inspection of the profile of the worm tooth, which twists or winds as an envelope round the thread. To obtain proper forms for the worm-wheel teeth, we may either take certain sections of the worm teeth at different positions, and develop corresponding profiles of the worm-wheel teeth in the position where the two come into contact; or cut out the teeth of the wheel by a tentative method, using the worm as a templet. With all due deference to those who decry rule of thumb, I, who have made a good many worm gears in my time, hold that this is by far the best and most accurate method. Before describing these, however, let us look at our figures once more, and learn what are the lines on which we must work.

A worm being a screw thread, single, or multiple, as the case may be, the centre plane *d* of the thread, Fig. 86, taken transversely to the axis will be always perpendicular to that axis, and the flanks will be symmetrical about it. But the thread angles will not be alike at any two sections, varying at *a*, *b*, *c*, the point, pitch, and root respectively. The greater the number of separate threads in the worm, the more will these angles lean towards the axis. To this leaning of the screw threads is due the difficulty of making correct contact of the envelopes. Also it is evident that if we cut the worm in any plane parallel with the axis, and radial from the centre, we also get a tooth section perfectly symmetrical.

Further, taking the angle wheel Fig. 87, it is seen that the lines *a*, *b*, *c* again represent point, pitch, and root centres respectively, and that the angles of these are different from one another. If we take a section here in the plane of the axis longitudinally C′—C′ as in Fig. 86, we also find that section is symmetrical. Also, if we do what we could not do in Fig. 86, take a tooth section transversely to the axis, we find that symmetrical. Or any tooth section, say, at D—D or E, E, if *radial*, would also be alike on each flank. But now sections at D—D, E—E, *parallel* with a central plane C′—C′, cutting through the axis will *not* be symmetrical, but will lean over to one side like F, F. This, which is due to the angle or leaning of the threads, causes the difficulty in striking out the teeth of worm gears. We know that if we obtain such forms in the extreme case, Fig. 87, the same peculiarity must exist in any screw gear, and, consequently, if we cut a single-threaded worm along the lines F, F, in Fig. 86, we shall have this same lack of symmetry, though not in so marked a degree, since the tooth angle of Fig. 87 may be 45°, and that in Fig. 87, 7° only. It will be more evident in a double-threaded worm, and in a worm of quick, than of flat pitch. This is, therefore, the vital point, which, if neglected, must lead to bad gears. It has often been the practice to mark the tooth sections on the pattern joint and on the outer faces of the worm wheel alike, and work through parallel. This is manifestly absurd, because no two sections should be alike throughout, and the profiles on the outside faces cannot be symmetrical, because the worm profiles on lines F, F, in Fig. 86, with which the wheel profiles have to gear, are not symmetrical.

J. H.

THE PINHOLE CAMERA.*

HAVING recently had occasion to take several photographs, using a pinhole as a substitute for a lens, I was much surprised at the distinctness of the images. The resulting negative is, of course, not as sharp, and a silver print from it would not look quite as well, as if taken with a lens; but for bromides, where the detail required is not so great as for silver prints, very satisfactory results may be obtained. I have recently taken a number of photographs with pinholes of various sizes, and the following facts have been deduced:—(1) The distance from the hole to the plate may be as short as desired, but should not exceed 12in. (2) The shorter the distance, the better the definition. (3) The size of the hole is regulated by the distance. For a distance of 12in., the best results are obtained with a hole measuring $\frac{1}{100}$in. in diameter. If smaller than this, the image is blurred by diffraction; if larger, the image is likewise blurred. But for most purposes where shorter foci are used, we may lay it down as a rule that the aperture should in no case exceed $\frac{1}{50}$in., nor be much less than $\frac{1}{100}$in. As regards exposure with $\frac{1}{100}$in. aperture, and a focus of 3in., on a sunny day with a rapid plate, one should give about ten seconds. So that, although the exposures are longer than with a lens, it will be seen that they are by no means excessive.

The pinhole may be made in a piece of black paper, or in a piece of thin sheet metal, which should afterward be thoroughly blackened. In either case the burr must be carefully removed. A simple method of avoiding the burr is to burn the hole in paper with a red-hot needle.

The advantages of the pinhole camera are: (1) That doing without the lens, one saves weight and expense. (2) That one can take as wide an angle as the camera will admit of—say 120° on the horizon against 80 to 85° with a wide-angle lens. (3) That all objects, near and far, will be in equally good focus. (4) That one may suit the size of the image to fit the plate without changing one's point of view. (5) That one may take a view, if necessary, directly toward the sun, as there is no trouble from fogging caused by the sun illuminating the surfaces of the lenses. Indeed, very satisfactory photographs may be secured showing the sun in the picture. In this case, however, the sun takes black instead of white, owing to the reversal caused by over-exposure. Finally, while not advising photographers to throw away their lenses and substitute pinholes, I wish to call their attention to the fact that the pinhole picture is not a thing to be wholly despised, and that there may occur circumstances under which the pinhole may prove a very useful auxiliary.

The pinhole principle may also be used for another purpose, more amusing, perhaps, than artistic, which was first suggested to me by Mr. J. R. Edmands. Let us substitute for the lens a narrow vertical slit, about 3in. long by $\frac{1}{50}$in. wide, made by pasting two strips of black paper side by side. About 2in. behind this arrange a horizontal slit of the same dimensions; 2in. behind this place the sensitive plate. The apparatus is analogous to two cylindrical lenses of different foci placed at right angles, but is more readily adjusted. If an exposure is now made, we shall find everything distorted to twice the size horizontally that it is vertically. By turning the camera on its side we get a vertical distortion. By inclining the slits at different angles, variously distorted pictures may be obtained.

APPARATUS FOR ILLUSTRATING NEWTON'S LAWS.†

THE elementary or fundamental laws of force, known generally as Newton's laws, and variously formulated in the different textbooks, may be illustrated by the use of the apparatus shown in the accompanying engraving. In general terms, it consists of an arrangement for projecting or throwing a marble in a horizontal direction. A piece of board, about 2½in. wide and 8in. or 10in. long, forms the base of the apparatus. On each side are fastened two thin strips that rise half an inch from its surface, so that a wide, shallow groove is formed. A block of wood, about 4in. long, is made of exactly the width of the groove, so as to slide freely in it with no lateral shake or "lost motion." Pins are driven into its rearward end, or a little bar is nailed across its upper surface, near the end, and projecting on each side. Corresponding pins are driven into the base of the apparatus, near its front. These are for the reception of springs.

For the latter, indiarubber bands, or, what is far better, spiral wire springs, may be employed. These are attached to the two sets of pins, as shown

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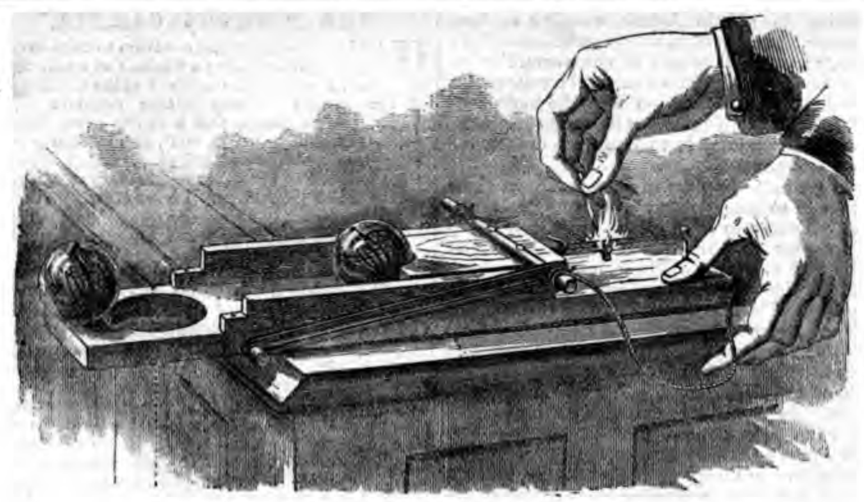
* By WM. A. PICKERING, Harvard Observatory, in *Anthony's Bulletin*.

† By T. O'CONOR SLOANE, Ph.D., in the *Scientific American*.



in the engraving, so that the sliding block is drawn forward and downward by them. The springs, in drawing the end of the block downward, carry out an arrangement adopted to keep the block in position. Were the pull of the springs horizontal, there would be a constant liability on the part of the springs to throw the block up and out of its seat.

To prevent the block from being drawn too far forward, strings limiting its motion in that direction are attached to the same pins that hold the springs, and thence are carried to the rear end of the base. When the springs are at the end of their strain and just ceasing to pull the block forward, the strings come into play and prevent the block from going any further forward. This leaves a space of three or four inches free in front of the sliding block.

As near the front of the baseboard as possible a large hole is made. This should be considerably larger than the marble it is proposed to employ. The dimensions followed in this description apply to an apparatus constructed for marbles of 1⅜in. diameter. The hole where these are used may be made about 2in. in diameter. It is well to have the front end squared out. Across the front a strip of wood is left about ½in. wide. Exactly in the centre of this strip a slight depression, which need not exceed $\frac{1}{16}$in. in depth, is made. With equal exactness a notch—a triangular one is best—is made in the centre of the front end of the sliding block. This notch should be about ¾in. across. If the block is drawn back, a marble placed on the base against the sliding block, and lying in the notch, when the block is released the marble will be projected across the depression in the front of the apparatus.

To illustrate the law that forces act upon a body independently of each other, and also to present an incidental illustration of the law of impact of elastic bodies, the block is drawn back and tied back, as shown. Hooks or nails are provided for this purpose—one on the block and one on the base. The apparatus is placed on the edge of a horizontal table and held firmly there. One marble is placed resting in the depression in front; the other is placed against the sliding block. The string is now burned through with a match.

As the string parts, the block is drawn forward, driving the marble also before it. As it goes forward it strikes the other one in front. The impact, in virtue of the law as affecting elastic bodies, stops its course. Nearly all its mechanical energy is imparted to the other ball, which at one flies forward 6ft. or 8ft. before it touches the floor. The first marble thus checked falls vertically through the large hole. Both marbles strike the floor with one report. The vertically falling and horizontally projected ball reach the ground simultaneously.

By using a single marble and placing the apparatus on rollers, on projecting the marble, the distance to which it will go will be much abridged, while the apparatus will fly back. This illustrates action and reaction. By endeavouring to repeat the first experiment with the apparatus on rollers, the front ball will tend to fall vertically, and the other ball will go over it and fall in advance, and probably will collide with it in passing over it.

The mode of release by burning a string is far the best, as it avoids all disturbance. Accuracy of construction is essential. Glass or stoneware marbles answer admirably. As fast as they break, new ones can be substituted. Wooden or ivory balls are not sufficiently elastic, although far more durable.

THE first railway in Brazil, the Mana line, from the shores of the Bay of Rio to the foot of the Orgues chain of mountains, was opened on April 30, 1851.

A FOUNDRY CUPOLA.*

I PRESENT a small cupola that we have kept in constant use for the past two years, notwithstanding we have one double and two single air furnaces and five other cupolas ranging in size from 30in. to 72in. diameter, from one or the other of which we can obtain fluid metal almost any time. I merely mention the above fact to show the advantage and usefulness of a furnace of this kind. The purpose of operating it is the production of castings of special mixtures, such as cams, heading dies, and small forms for spike and horseshoe mills, experimental mixtures, testing the various brands of iron, and we have used it for melting up quantities of light and heavy old scrap brass, so it can be handled to advantage in the crucibles.

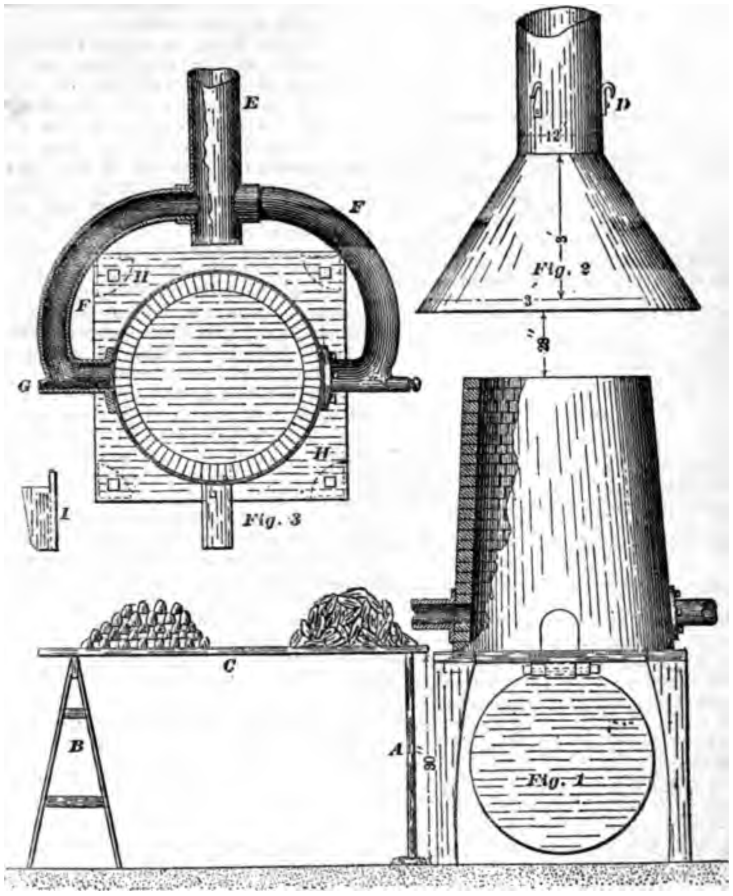


Fig. 1 represents the cupola broken away so that it will readily be understood; the shape of it allows the material to settle freely, and I think in a manner concentrates the heat. A is cast-iron and B wooden trestles to support the slab C, which answers for a charging floor. Fig. 2 is a sheet-iron hood and stack held by three guy rods from hooks D. Fig. 3 shows the arrangements of the blast pipes; a 75in. Sturtevant blower, with a 16in. main pipe extending around the wall, with branch pipes to twenty forges, is used in the blacksmith shop to supply them with blast. The pipe E goes through the wall and connects with one of these branch pipes. E and F are of cast iron, with a peep hole at G. The dotted lines H H are the tops of the angle-shaped legs bolted to the plate; the cupola shell is riveted to the plate with three small wrought angle-irons. I is the side view of the spout.

There is often so much power required from the wheel that runs the blacksmith shop fan that, while the blast is all that is needed for the forges, it is hardly enough for the cupola.

Dimensions of Cupola.

Outside diameter at bottom, 26½in.; at top, 24½in. Thickness of lining, 3in. Height from bottom plate to top of shell, 4ft. Style of tuyeres, plain round. Size of tuyeres, 2¾in. Number of tuyeres, 2. Height from bottom plate to bottom of tuyeres, 9in. Height of tuyeres above sand bottom, 6in. Size and length of pipe E, 6in. diameter; 8ft. long. Size and length of pipe F, 2¾in. diameter; 30in. long. Cupola 200ft. from fan.

MODE OF CHARGING CUPOLA.

Fuel used for bed		Coal, 100lb.
First charge of iron	pig, 250lb.	Scrap, 150 „
First charge of fuel		Coal, 50 „
Second charge of iron	pig, 180lb.	Scrap, 120 „
Second charge of fuel		Coal, 45 „
Third charge of iron	pig, 180lb.	Scrap, 120 „
Third charge of fuel		Coal, 40 „
Fourth charge of iron	pig, 120lb.	Scrap, 80 „

MODE OF WORKING CUPOLA.

Time of starting fire	2.00 P.M.
Time of charging first iron	2.40 „
Blast put on	3.30 „
First appearance fluid iron	3.37 „
First stopped in	3.40 „
Bottom dropped	5.35 „

Kind of fuel used, best Lehigh coal.

TOTALS.

Amount of iron melted	1,200lb.
Amount of fuel consumed	235 „
Ratio of fuel to iron used	1 to 5 1-10
Fluidity of melted iron	Hot.

I said in the commencement of this article we had melted quantities of scrap brass in this furnace, and run it into ingots; but excuse me from melting any more large quantities of old brass in a cupola or air furnace unless there is some arrangement to carry off the fumes of the zinc, or we do the work in the open air. This cupola is situated in a small brass foundry, 30ft. by 45ft., and the five men (myself included) who were in the foundry, had, I think, a clear case of zinc poisoning from breathing in the oxide of zinc vapour with which the shop was filled, coming from the zinc in the old brass. We were all afflicted alike; nauseating sickness, chill and high fever, followed by a difficulty in taking a long breath. As I have not seen a heat of this kind reported, I append the results.

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* By ROBERT E. MASTERS, in the *American Machinist*.

MODE OF CHARGING CUPOLA.

Fuel for bed	Coke,	100	lb.
First charge of brass		600	„
First charge of fuel	Coke,	65	„
Second charge of brass		500	„
Second charge of fuel	Coke,	60	„
Third charge of brass		500	„
Third charge of fuel	Coke,	60	„
Fourth charge of brass		510	„

MODE OF WORKING CUPOLA.

Time starting fire	11.00	A.M.
Time charging first brass	11.40	„
Blast put on	12.00	
First appearance of fluid brass	12.03	P.M.
First tap	12.13	„
Bottom dropped	3.40	„

TOTALS.

Amount of brass melted	2,110lb.
Amount of fuel consumed	285 „
Ratio of fuel to brass	1 to 7 4-10
Brass	Hot.

We have melted bronze pinions of 400lb. weight in this cupola, and can make bronze castings from it of 600lb. weight. The figures in a bronze heat are about the same as the above, and we have made bronze castings as high as 5,000lb. in a single casting from the air furnace, and we have never suffered any inconvenience when making new mixtures without zinc.

UMBROMANIA.*

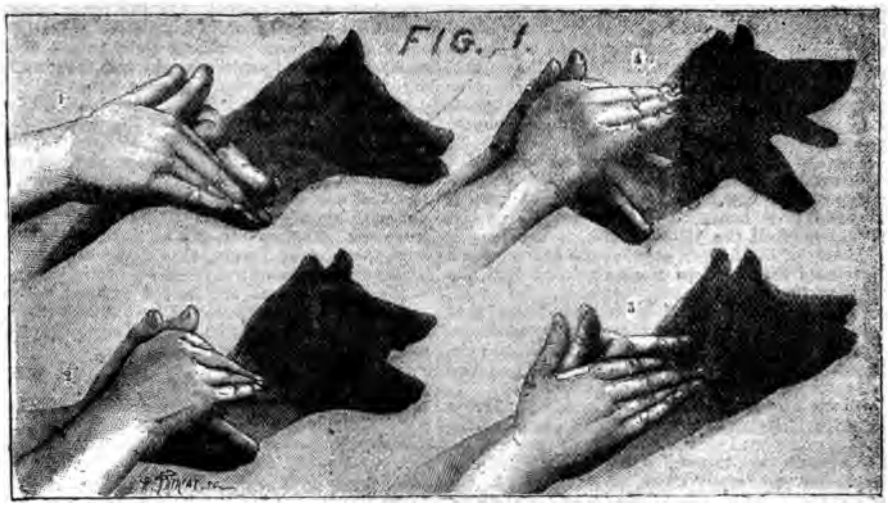
THE idea of projecting the shadows of different objects (among others, the hands) upon a plane surface is very ancient, and it would be useless to attempt to assign a date to the creation of these animals and classic figures, such as the rabbit, swan, negro, &c., that have served to amuse children in the evening since time immemorial. Within a few years these rude figures have been improved, and we are going to show how the play of shadows has now become a true art instead of a simple diversion. The Italian painter Campi was one of the first who thought of adding new types to the collection of figures capable of being made with the shadow of the hands. He devised amusing forms of animals that delighted the school children before whom he loved to exhibit them. His imitator, Frizze, imported the nascent art into Belgium, and it was in this latter country that our countryman, Trewey, got his knowledge of it.

Trewey was not long in discovering that umbromania was capable of improvement, and, after patient exercise of his fingers to render them supple, he succeeded in producing new silhouettes, which are, each in its kind, little masterpieces. Before giving a glimpse of these, we must point out what the various exercises of the hands and fingers are that it is indispensable to perform in order to reproduce such figures more or less perfectly.

The first exercise consists in bending the little finger as much as possible without moving the others, while the hand is spread out. It must be understood that all that is done with the right hand must be repeated with the left. The two hands being once broken-in to this motion, the little finger is raised and an effort is made to bend the middle and ring fingers, while the fore and little fingers remain extended. The third exercise consists in bending solely the two last joints of the fore and little fingers, while the ring and middle fingers are bent inwardly. In this position, if the thumb be bent inwardly, it will be found that the shadow made by this profile on the wall will form the head of a cat. The fourth exercise consists in leaving the two last joints of the first and little fingers bent, and in extending the middle and ring fingers. Afterward follow exercises in separating the fingers from each other by opening them in the direction of the width of the hand. First, it is the little finger that is isolated, the fore, ring, and middle fingers resting against each other; then it is the separation of the fingers into two groups, the little finger against the ring finger, and the middle against the fore finger, the latter and the ring finger making as wide an angle as possible. Then comes the assembling of the fingers, the extremities of each being hidden behind the middle finger, so that the hand has the profile of a spear head.

Finally, we have the exercises in which each finger is made independent of the others, one being bent to the first, the other to the third joint, the latter extended as when the hand is open, the former elongated and at right angles with the hand.

It is through such a series of exercises of the fingers that Trewey has made his hands so supple that he not only can form the most diverse figures upon a screen, but can also give them motion and life. The swan smoothing its plumage, the bird taking flight, the cat making its toilet, the tight-rope dancer, who, after saluting the public, rubs chalk on her feet before walking on to the rope, are true wonders, and it is hard to believe that these perfectly accurate profiles are obtained solely by means of the shadow of the hands. The artist has thus far devised more than 300 figures, and his inventive mind is leading him to get up new ones every day.



Instead of reproducing a large number of these, we have thought it would be better to devote ourselves to the study of one in particular, in order to initiate our readers the more perfectly into the art of umbromania. Let us, for example, take the dog's head represented in Fig. 1 (No. 1). The ears are erect, the snout is thrust forward, and we conjecture that the animal has just scented a choice bit. In fact, he is snapping at it, and No. 2 shows us the efforts that he is making to swallow his prey, which is represented by the angle of the bent forefinger that moves in the mouth. After strong efforts, the mouth is seen to close (No. 3), showing the act of swallowing. A progressive motion of the hand shows us the swelling of the throat caused by the descent of the food in the œsophagus. One would imagine that he had before him the shadow of a genuine dog, so wonderful, natural, and accurate are the motions. After this laborious repast, we finally see the animal yawning voluptuously, the middle finger representing the tongue, which cleaves to the palate, and the general profile of the head expressing the completest beatitude.

It is very evident that in order to reach such a degree of perfection, the artist must be naturally endowed with great manual dexterity, without which the preparatory exercises would give no result. There are signs by which such dexterity is recognised, and an attentive examination of Trewey's hand has enabled us to verify the laws laid down by Mr. H. Etienne upon the native perfection of the senses. Thirty-five years of research have permitted Mr. Etienne, who has been continuously in contact, in shops, with Swiss watchmakers' apprentices, experienced workmen, and artists even, to find a certain criterion by which to judge of aptitutes in different trades and several professions.

A young Frenchman who, after reverses of fortune, was desirous of giving up the study of the law in order to learn watchmaking, presented himself one day before Mr. Etienne at the shop of a skilful master of apprenticeship, who received the intelligent countenance with eagerness; but, while pressing the hand of the future apprentice, a cloud passed over the face of the placid master clockmaker. "What did you feel, then, in pressing the hand of that young man who has just gone out?" asked Mr. Etienne. "With hands like his we don't make a watchmaker," was the reply, and the prediction came true. It was as a consequence of this conversation that Mr. Etienne sought and discovered the following rules, that we think we can reproduce without straying from our subject.

The characteristic of dexterity is shown in the first place by the *curve of the thumb arched outwardly.* This is an indispensable condition for the handling of the hammer. The blacksmith, who wields with his arm the heavy striking mass that he lets fall perpendicularly, without deviation, repeatedly upon the same point; the file cutter, who strikes so regular blows upon the chisel that no flaw is visible in the cut, so equal everywhere is the imprint of the tool—these and all superb workmen, all artists who shape white-hot iron with the hammer, who chisel the precious metals who sculpture marble and stone, owe the exact precision in the force and accuracy of the blows that they give with the hammer to the suppleness of the first joint of their thumb. To this natural gift they owe their fortune, for, in shops, selection is made, to the profit of the most skilful, of those alone to whom the most difficult and most delicate work can be intrusted.

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* From *La Nature.*

A second characteristic of skilfulness is indicated by the faculty of reversing the metacarpal phalanges of the fingers, so that when the hand is extended it is convex. On the greater or less flexibility of all the joints, either at the base or extremity of the fingers, depends the dexterity and skilfulness displayed in work executed with the file, plane, or lathe.

This suppleness cannot be independent of that of the thumb, but it does not replace it; while the curved thumb will more easily dispense with the great flexibility of the other fingers. These two characteristics are in most cases united.

Trewey's hand, reproduced by moulding, figures in several English museums. It possesses the faculty of reversal of the phalanges to the highest degree, and the thumb, which is of wonderful suppleness, renders Trewey, as we shall see, the greatest services in the formation of his shadows. Let us add that his fingers, which are long and slender, differ very perceptibly in length, the middle finger, for example, exceeding the ring finger by nearly 1in.

In addition to the profiles of men and animals composed by the artist, the latter, by means of a few accessories, exhibits to us living persons playing amusing pantomimes. Here, for example (Fig. 2), we have a fisherman. A piece of cardboard, properly shaped and held between two fingers, forms the hat; the boat is a piece of wood held in one of the artist's hands; a metallic ring holds the fish pole against the thumb of the other hand, and it is opposite this latter, bent as shown in the figure, that we observe all the emotions of the fortunate fisherman, who, phlegmatic at first, and livening up when the fish bites, finally is triumphant when he has it at the end of his line. It is necessary to have witnessed all these little scenes in order to understand how, by means of his fingers alone, the artist can evoke the laughter and applause of hundreds of spectators. In Fig. 3 we have a scene with two persons. It is a fight between a landlady and one of her tenants. As may be seen, the accessories are here very simple again. We believe that with a little practice our readers might succeed in reproducing these little scenes, and even get up new ones.

To make the shadows sharp, the following things are indispensable: The source of light must be a single lamp inclosed in a projecting apparatus, throwing very divergent rays, The lens must consequently be of very short focus. The electric light or oxyhydrogen lamp necessary in a theatre may be replaced at the amateur's house by a lamp, or, better, by a wax candle, or, indeed, even by a common candle that gives very sharp shadows. The mirrors in the room where the exhibition is given must be veiled in order to prevent reflections, and all brilliant objects must be removed. When the oxyhydrogen lamp is used, the screen is placed 10ft. away from the light, and the artist's hands at 3ft. from the same, and consequently at 7ft. from the screen. But it will be understood that there can be no absolute rule about this, all depending upon the scale of the fingers. It suffices to recall the fact that the nearer the hand is brought to the light the more the shadow enlarges and loses its intensity, while on bringing the hand nearer the screen the shadow becomes sharper, but smaller and smaller. Fig. 4 shows Trewey exhibiting the scene of the preacher in the pulpit. The canopy is formed by the arm and the first phalanges of the fingers, bent at right angles, while a block of wood affixed to the arm near the wrist forms the pulpit. In order that the preacher may appear smaller than the pulpit, he must necessarily be nearer the screen, and this explains the distance apart of the artist's arms in our engraving, the screen being situated in front of the arm that forms the preacher. The necessary distances, however, are best determined by experiment.

DR. RICHARDSON ON IDEAL FOOD.*

AT the Memorial Hall, Farringdon-street, E.C., on Friday evening, the 9th inst., Dr. B. W. Richardson, F.R.S., delivered the second of the above series of six lectures, entitled "The Study of Foods: Physiological and Practical."

Dr. Richardson, after briefly summarising the five reforms comprising the heads of his previous discourse, as reported in our last issue, observed that what he wanted to do that night was to show as clearly as he could the subject before them by the facts of Nature in regard to the digestive organs of man and animals. It must be fairly admitted that if they understood the digestive systems of man and animals, then they knew a great deal of the whole food question. On the other hand, if they knew nothing of the digestive organs, they could not be considered as right judges of the matters in hand; anyone might trip them up and say, "You don't know anything about it. You don't even know the primary principles." He was going that evening to speak of the primary principles, and they would first of all consider what man and the higher class animals were made up of. Man was composed of a certain series of organs, a fact that was well known to the ancient world, but not with that fulness of detail which we now possessed. Taking man as a high-class animal, the type, the head of Nature, they found first of all in his constitution a system of organs entirely devoted to the reception and application of food, the preparation and appropriation of food to make a sound body. That was the first thing they would recognise in man, and, in fact, all the lower animals, for wherever they went there was always this primary system. The ancients called it the first way, the first entrance into the body—and it was a very good term, and to this day the doctors used it. The next system was called the circulatory system, and consisted of a series of vessels by which the food, when properly prepared, was conveyed as blood all over the body and to each part requiring it. Whether they took animal or vegetable food, it must first undergo the preliminary process of digestion before it could get into the circulatory system. If they took a portion of nutritious vegetable food, it must first be resolved into something resembling blood before it could be utilised. But suppose they took a portion of animal flesh that had already been through the process, had that to go through the same process again? Yes, it had. Nay, if they took the very blood itself, and turned it into food, as was done in some parts of the country in the form of "blood-puddings," there the very substance of blood had again to go through all the processes of digestion. Then, in common with plant-life, they had air-food, which they got from the atmosphere in breathing, and which was as much food to them as any other. This was called the respiratory or breathing system. Almost every living animal possessed these three primary orders.

The lecturer then briefly referred to certain other systems, as the five organs of sense in man—touch, smell, taste, hearing, and sight, and the nervous system. In order that all parts might be efficiently held together, there was another great system, called the skeleton, a hard, firm system of bone, with cavities in it for holding the viscera. Over this, again, was laid the muscular system, by means of which they were enabled to move their limbs and travel about. In order that the body, so constituted, should be supplied with humours or fluids, it was further provided with a secretory and excretory system. And, lastly, they had the whole of the organs of the body wrapped up in membranous matter. Just as the skin covered the whole of the body and clothed everything, so the lungs, heart, and other organs were covered with protecting membrane. Now, these nine systems were all intended for the construction of a high-class animal; but it was with the first, the primary, the digestive system, he was about to deal. On the welfare of that all the other systems depended. Without it there could be no preparation and distribution of food; nothing could act without it. They probably remembered the old fable, where the different members of the body found fault with the stomach because it did not work, and said it was a lazy organ. Ultimately the stomach resolved to show them what it had been about, and so absolutely refused to work or digest anything, the result of which, of course, was that the different members at once began to die. This was a good illustration of the prime importance of the digestive system.

In approaching the study of ideal food, they would ask themselves what that really was—what kind of food was indicated as best adapted for the digestive organs of man. In order to arrive at a true solution of this question, they must go to the lower animals, and compare their digestive systems with that of man in regard to the various parts; but that evening he would take especially those lessons to be learned from an examination and comparison of the teeth and stomachs of the different animals, because they might at once admit, whether they were vegetarians or not, that there were two chief classes of animals—viz., those which live solely on vegetable food, and those which live solely on animal food. But there was, nevertheless, a certain number belonging apparently to both these classes or either, and there were some that lived on fruit. So that really there were four classes of animals—vegetable feeders, animal feeders, intermediate feeders, and fruit feeders; or, scientifically, herbivora, carnivora, omnivora, and frugivora. When they considered the first food, they might be quite sure everything came from the plant world. There could not be a race of carnivora—animal feeders—by themselves by any possibility; such a supposition would be carrying the argument to an absurdity, because if animals had nothing but animals to live on they would become extinct. There must be a source of food supply and a sourc derived from the earth. The earth was the grea feeder, and was truly their mother—she gave ther water, a very important food, and which sh supplied abundantly to all the classes alike, t animals and to plants. The earth was their mother but she did not feed them with bread, but onl water, directly; and, in order that food might b arrived at, she gave them the intermediate world o plants. Plants took up from the earth that whic they transformed into food; and animals took fro the plants that which they had taken from th earth. They might take plant food indirectly a animal food, or plant food in the natural state, s that, primarily, all food was derived from the plan world.

He then proceeded to treat briefly of the teet of the different classes of animals, and compare them with the teeth of man. This of itself was most interesting study. There were, roughl speaking, three classes of teeth—the cutting, th tearing, and the grinding teeth; the sharp, chisel like teeth of the sheep and horse, for cropping th grass; the strong, tearing teeth of the lion, fo rending the flesh of its prey; and the firm grinder of the elephant, to crush and break down the plan foods on which it lived. In the molars, or grindin teeth, of some animals a rough, uneven surface wa always exposed to the food. In the molar teeth o man there were little tops or prominences whic wore away in time, so that the tooth became quit flat. In opening ancient mounds and graves, the sometimes came upon the skulls of the forme inhabitants of these islands, or they might se them arranged in collections at the variou museums. It would be observed that in many o these the molar teeth were worn down quite level showing that these people were nut, acorn, an grain eaters—that they broke down, and groun into a pulp, the hard grains composing their food by which means their molar teeth were worn dow as described. There was another series of teeth sometimes called the tearing teeth—the canin teeth, as in the dog. These were represented i the human subject. The tearing tooth in man wa a firm, deep, pointed tooth, sometimes called th dog-tooth, the canine tooth, or the eye tooth, from a false impression that it was in some way connected with the eye. This, however, was not th fact; except that it was situated under the eye The next series of teeth were called the incisors or cutting teeth. They were the four front teeth in each jaw of the man. Some persons ha supposed that these incisors were specially adapte for cutting or biting flesh-meats, but this wa hardly probable, as all the lower vegetable feedin animals possessed these biting teeth. In fact, i the incisors of some lower animals were placed beside those of man, it was quite possible to mak a mistake, so much were they alike. There wa also a class of animals called insectivorous, living on insects, but which could be induced, under certain circumstances, to live upon vegetable food. The bat was a good illustration of an insectivorous animal. A peculiarity in the teeth of this clas was that they fitted one into the other, like the teeth of a saw, by which means they could tear and crush their prey very thoroughly indeed. They would next examine the jaws of the ape. There they would see the teeth of an animal that lived upon fruit. Let them compare the jaw with the next specimen, the teeth of man. There they had the four front cutting teeth, incisors; two pointed canines; the bicuspids, or small grinders; and finally the three back grinding teeth, or molars. He thought the inference fairly to be drawn from these human teeth was that they more closely resembled those of the pure fruit eater than any other. A flesh-eater himself, he was quite free to admit that the teeth of man were admirable illustrations of the fruit-eating animal. They certainly did not represent the herbivorous teeth or the carnivorous teeth, in the strict sense of the word, but presented very clearly and very distinctly their adaptability for fruit eating. Those cutting incisors were pre-eminently fitted for such work; and as to the canines, or tearing teeth, they were admirable for holding the fruit in the mouth. A boy eating an apple would take it from the branch of the tree, bite through the stalk with the front teeth, and then, fixing his canine teeth into it, would tear pieces out. That was tearing—tearing in a modified sense, but not in the same way as the lion tore beef—it was not nearly so violent. Then, the fruit being in the boy's mouth, he broke it down with his grinders into pulp, and prepared it for passing into the stomach. For all kinds of fruit the human teeth were extremely perfect—more perfect than were those of the pure vegetable feeder on the one hand, or the tearer of flesh on the other. He therefore put it forward as the simple truth, that, so far as the human teeth were concerned, they were as good an illustration of instruments intended for eating fruit as they possibly could be, and did not tally with anything else so well. Of course, as fruit-eaters, they woul agree with him. (Laughter.) But these mola teeth were also good mill-stones, and did extremel for grinding corn or other grain; so that they t also say that the human teeth were good -eaters—eaters of bread and that class of ances derived from the vegetable world— and grain or bread-crushing instruments. lause.)

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* From the *Vegetarian*.

ey would next take the stomachs of these ent animals, and compare and see what they like. In regard to the digestive canal in the ent classes of animals, it was but fair to admit hat of the animal living entirely on flesh was impler structure than that of the fruit-eating al, and a much more simple structure also than of the animal living entirely on vegetable . And thus very many persons urged that, high class of animal, man for instance, to be top of the scale of life, to be all-powerful, ing and master of all other animals, it was rtant that he should have the simplest food, most easily digested, and most elaborately red for his work; and that, therefore, flesh were the best, because animals which lived imal food had the simplest digestive apparatus. her that argument were true or not as re- d man's position, they were bound to admit ct that animal feeders had the most simple tive organs, and performed the process most . In the stomach of a lynx, a cat-like animal, ived entirely on flesh foods, they found a very e digestive canal—and for all that a very rful digestive apparatus. So with other like ls. The stomach of the lion was of as simple racter as that of the lynx. The food was d into the tube, and there immediately ted, without any prolonged elaboration, and d into the system to make blood to feed the l. Therefore, as a general fact, they might hat in all classes of animals the simplest tive apparatus was found in the animal which on flesh food. And the same rule applied to arnivorous birds and insects, or any other l. If they examined the stomach of a veget- feeding animal, as, for example, the ox, they l find a very elaborate apparatus. This class imals were termed ruminants, or chewers of d. It was a very curious question to solve, here should be all this elaborate preparation. of their greatest naturalists had a very in- ing theory of these animals, that, to avoid rsuit of the savage carnivora, they took an ous quantity of food into their stomachs, and retired into the jungle and safe places to it; that, in course of time, this temporary idental practice became a confirmed habit, n this way the phenomenon of ruminating t up and perpetuated. Others thought—and ps this was the most commonplace and on sense idea—that, in feeding on grass, animals had to take in a considerable amount er, with but little other nourishment, thereby ing the necessity for a very large quantity of in the stomach during the after-process of ion, and that tallied exactly with what they e animals doing. The ox in the field was browsing—not just a short meal, as they with a talk, a laugh, and a joke—after which down to rest and chew the cud. The camel desert, as was well known, had to go fre- ly for a considerable period without water; o enable it to do this, it was gifted by nature very peculiar provision. In the interior of imal there was found a number of sacs or es, which opened into the stomach. The re took in a full supply of water, which was ved by the contracted mouths of these es, and then, when occasion required, they rged their contents into the stomach, to be ed and carried into the blood. Sometimes lers were so pressed by thirst that they were ained to kill the camels, to get at the supply ter in these sacs. In the stomach of the , a pure plant-eater, they had a very simple atus, wholly free from the complications ad seen in the stomach of the ox. In the h of man they would observe a comparatively apparatus. It was clearly not the stomach erbivorous, neither was it the stomach of a orous animal. It was more complicated than tter, more curved, with more surface for ion. The human stomach would seem to n intermediate position between the digestive atus of the carnivora and herbivora, with a inclination towards the fruit-eater. Again, took the length of the whole intestinal from the commencement to its end—a good —the human digestive organs approximated e of the fruit-eaters. They could not, how- est on that alone; but, on the study of the atus as a whole, they would come pretty near truth. By that means they would see that ovision made for digestion in man was much laborate than that made by nature for the ora; and that all these details placed man st the frugivora or fruit-eaters. Taking the nal canal, the stomach, the digestive process, e teeth, as the tests, man might be truly said frugivorous animal, and fruit with grain al food. (Applause.)

SCIENTIFIC SOCIETIES.

THE LIVERPOOL ASTRONOMICAL SOCIETY.

THE sixth meeting of the present session of the Liverpool Astronomical Society was held at the Royal Institution on March 12th, Mr. J. Gill, F.R.A.S., in the chair. Fifty-three candidates were elected and proposed, and Professors C. A. Young and E. S. Holden were elected Associates of the society.

The Secretary announced that he had received letters from the members of the council sympathising with Capt. W. Noble, whose residence had been entirely destroyed by fire. The chairman remarked that few persons had done so much to popularise astronomy as Capt. Noble, and he was sure that the intelligence of Capt. Noble's loss will be heard with regret by all amateurs.

Mr. F. Woulfe Brenan proposed that the society should institute periodical examinations in astronomy, and that the council should be empowered to grant certificates of competency. The possibility of gaining such a certificate would stimulate amateurs to follow up some systematic study of the science, and prevent them from lapsing into mere stargazing. Mr. W. H. Davies seconded the motion, but suggested that the certificate should not be granted for mere textbook knowledge so much as for practical experience. The Directors of Sections were likely to know who had done the most useful work, and they might include, in their annual reports, the names of those whom they thought deserving of certificates. Mr. W. F. Denning thought the idea was a good one. Many persons felt a shade of contempt for the assumed scientific dignities of men who strung a lot of letters after their names, but who had to pass no examination whatever for proficiency in the science they professed. If the Liverpool Astronomical Society would take the initiative in this matter, it would be a good thing in his opinion. The resolution, according to custom, was left for decision until the next meeting, a hope being expressed that in the mean time members would communicate their opinions by letter.

In continuation of his article on Plato, Mr. Elger described the remarkable details which have from time to time been detected on the floor—viz., light spots of a doubtful nature, crater cones, and delicate markings. He pointed out the physical connection which probably exists between these objects and the changes in visibility which they undergo. The author also referred to the interesting region north of Plato, and to the details of the great fault which traverses the formation from N.W. to S.E.

In concluding his paper on Jupiter, in the series of "Illustrated Notes on the Planets," Mr. Denning observed that drawings of that planet obtained under the highest powers that can be used with advantage, and with a cautious regard to faithful delineation, would probably throw much light on the phenomena occurring in the Jovian atmosphere. It was most desirable to pursue the various markings year after year with unflagging perseverance, for it was only by such means that we could hope to solve the extraordinary problem which their behaviour offered for solution. Too much stress could not possibly be laid on the necessity of observers being as precise as possible in their records.

In a paper on the double star Σ 175, Mr. Gore said that the changes in position angle and distance in the case of the components of this pair was due to uniform rectilinear motion. Assuming that the brighter star was the one in motion, the proper motion was 0·1198″ per annum in the direction of 196·8°.

Papers were read by Mr. W. H. S. Monck on "Eclipses of the Moon"; by Mr. Elger on "Saturn"; by Mr. Tarrant on "Micrometrical Measures of 200 Double Stars"; and by Mr. St. Quintin Gage on "Star Colours."

An Educational Branch was formed at Douglas, Isle of Man, which already numbered 17 members, and promised a rapid extension through the island.

The meeting terminated with an address to the students on the positions of the planets by Mr. J. Gill.

Dead Finish for Walnut.—For a simple but not very solid dead finish for walnut, proceed as follows:—Take equal parts of burnt umber and finely-ground pumicestone; mix them together. Apply with a woollen rag or hair cloth dipped in raw or boiled linseed oil. Clean with soft old cotton rags. The longer and harder the rubbing, the better the results. You need not fill or oil the walnut.

A Valuable Coal Discovery.—A fine virgin tract under the Bedwas estate has been recently explored. The result is highly satisfactory, it being estimated that a sufficient area and thickness of coal has been met with to insure a supply of 1,000 tons per day for 50 years.

SCIENTIFIC NEWS.

THE death of Dr. R. G. Latham, the famous ethnologist, appears to have been passed over almost without notice, owing to the fact that he had so long been retired that most people thought he had been dead for years. The fact is, that Dr. Latham was some time ago attacked by aphasia, loss of power of speaking and writing; but he lingered in life, and died the other day, almost on the completion of his 76th year.

The *New York Tribune* says that "much satisfaction is to be felt at the announcement that Prof. William R. Brooks, of the Red House Observatory at Phelps, N.Y., has been elected a Fellow of the Royal Astronomical Society of Great Britain, in recognition of his numerous astronomical discoveries. Prof. Brooks has discovered no less than eleven comets, and added many facts of the highest importance to the world's stock of knowledge of other worlds. It is observed, too, that he has accomplished these results with telescopes of his own construction, he having even ground and polished the lenses with his own hands." The Americans use the title "professor" freely; but that does not detract from the merits of Mr. Brooks, whose observations must be well known to our readers.

At a recent meeting of the Physical Society, Mr. G. L. Addenbrooke exhibited and described a compact form of reflecting galvanometer, lamp, and scale which he has designed as a portable commercial instrument, and also a modified Post Office Wheatstone's bridge. In the galvanometer the coils are easily removed or replaced by others, and loose wires for connecting the coils together are avoided, the required connections being made through the screws which secure the coils in position. The suspension is arranged so that the needle can be quickly taken out without breaking the fibre, and replaced by another for ballistic purposes if necessary. A simple liquid damping arrangement is provided. The lamp (a paraffin one) is inclosed in a copper cylinder, which also supports the scale. The height of the lamp and scale can be varied, and the beam of light can be directed at different altitudes by having the lens tubes mounted on pivots, the line joining them passing through the centre of the flame. The whole is very compact and portable.

The German Association of Gas and Water Engineers has repeated its offer of a prize of £50 for the best essay upon the ventilation of gas-lighted rooms. The offer was first made in 1885, but has so far been without fruit.

Those who are in the habit of visiting Kew Gardens may like to know that a plant of the common *Coffea Arabica* is now to be seen in the Palm House loaded with ripe fruit. Those who do not know what is done at Kew may probably pay a visit to the gardens to see it, and the other botanical treasures and objects of interest which are there provided for their information and instruction—or, rather, for the advancement of botanical science.

It seems, from the statistics supplied by Dr. Hellmann, of Berlin, a well-known meteorologist, that the Riviera is not quite so warm and comfortable in winter as many people imagine it to be. The temperature often falls ten degrees below freezing-point in the winter during the early morning hours (in the night, say), and sometimes remains below the zero of Centigrade thermometer during the greater part of the day. Mere temperature seems, however, to have nothing to do with the attractiveness of a locality. It is the relative freedom from biting, drying east winds that makes or mars a place as a winter resort.

Scientific papers are not much interested in the progress of what is called the woman's rights movement; but it is rather amusing to find in a well-known paper, which is supposed to be "written by ladies for ladies," that the late Asa Gray was an American "lady botanist," and was elected to the Paris Academy of Sciences in 1878 as "its corresponding member." The distinguished professor would have laughed heartily at this mistake, for he cared nothing for the *vox populi*, and was a scientist *pur et simple*. There is, however, a moral to this, and it rests between "What is Fame?" and "What are the Society papers?"

A Bill has been introduced to the House of Commons providing for the examination of persons having charge of steam-engines and boilers on land throughout the United Kingdom. It is sure to meet with a good deal of opposition, for it provides: "(1) The Board of Trade shall from time to time appoint and remove examiners for the purposes of this Act, and fix districts for which any examiners are to be appointed, and determine the mode and amount of remuneration of examiners, and make and alter regulations in relation to examinations, the qualifications to be required from applicants for certificates, and to the issue and registration of certificates, and generally for the purposes of this Act. (2) The Board of Trade from time to time may affix and alter the fees to be paid by applicants for examination, and the time, manner, and place of payment of such fees. (3) The Board of Trade may at any time, whenever it appears expedient so to do, suspend for any period, or cancel altogether, any certificate of qualification; and may at any time re-issue any certificate which has been suspended or cancelled; and shall keep a register showing the names of persons whose certificates have been suspended or cancelled, with the official number of each certificate and the grounds for suspension or cancellation, and of the reasons for re-issuing any certificate which may have been suspended or cancelled." Makers of gas and hot-air engines are sure to support such a Bill.

We have received from Mr. C. Rous-Marten a copy of his "Notes on the Railways of Great Britain," presented to the Minister for Public Works, New Zealand. As a special envoy from the colony, Mr. Marten was afforded many facilities for examining every detail of the working of our chief lines of railway (that is, all he cared to examine), and his "Notes," which we presume form a sort of preliminary report, contain a mass of valuable information concerning our railways which cannot be found elsewhere.

According to Mr. Findlay (manager L.N.W.) trains twice as heavy as those 20 years ago are now driven at 14 per cent. higher average speed by an expenditure of hardly more than half the quantity of coal. Speaking presumably of the North-Western Railway, he said passengers on their course travelled with a safety to which our fathers were strangers, under the protection of 1,400 signal cabins, erected and maintained at an expense of £2,000,000, to control the action of 30,000 levers and 14,000 signals, worked by rods that would stretch from Land's End to John o'Groats, and wires that would reach from Liverpool to New York.

The Orient liner *Orizaba* arrived recently at Plymouth from Australia, having accomplished the fastest passage between Australia and England. The actual time of the passage is 32 days 3 hours 45 minutes, including all stoppages. The *Orizaba* is 6,148 tons, and 7,000H.P.

At the People's Palace, Mile End-road, an exhibition of life-saving apparatus will be held next month. It will consist of unsinkable war ships, steam vessels, lifeboats, and rafts for use at sea and on shore, also life-saving apparatus of every description, and clothing. Conferences will be held from day to day and discussions on the merits of exhibits. Applications for space or to read papers must be made in writing only, to the chairman, Life-Saving Apparatus Committee, the People's Palace, Mile End-road, London.

We have the eighth annual report of the Hemel Hempstead Natural History Society for 1887, and though naturally the society is not a very large "field club," it is doing good work, and we have no doubt will prosper. Mr. J. H. Harley is the hon. secretary. The more of these societies there are the better, provided they do not hamper one another.

News has arrived in Brussels that Captain Van Gele, who explored the River Oubangi up to the 22nd degree of longitude, has discovered that the Ouelle and the Oubangi form one and the same river flowing between the 4th and 5th degree of northern latitude, and are, therefore, the same tributary of the Congo.

At a recent meeting of the Paris Academy of Medicine the report of a commission appointed to inquire into the phenomena reported by M. Luys, and commonly called hypnotism, was presented. The conclusion is that M. Luys has been the dupe of an hysterical patient, and that there is absolutely no truth in the phenomena described by him last autumn. (See pp. 186, 229, last volume.)

The "cancer bacillus" is not yet a discovery. Researches in this country have been made without success, and lately Dr. Senger read a paper before the Berlin Clinical Society in which he stated that although he repeated Scheurlen's experiments, he could not obtain a micro-organism which could be recognised as specific. On one occasion he did find a bacillus answering to Scheurlen's description, but that bacillus was due to the potato on which the culture was made. Cancer is apparently a disease peculiar to humanity, for it has never been successfully inoculated in the lower animals.

In the course of a lecture before the Sheffield Literary and Philosophical Society, Mr. A. H. Allen, the borough analyst, said that in consequence of the wide occurrence of lead-poisoning during the last few months, it had been necessary to remove the lead from water drawn from the taps. It had been found that that could be done very efficiently by certain forms of filter; and on further experiment it turned out that those filters which were efficacious, and which retained their efficacy for a considerable period, were those in which animal charcoal was employed in some form. Animal charcoal was largely composed of phosphate of lime, and there was no doubt that its power of removing lead was dependent on that fact, and on the consequent formation of highly insoluble phosphate of lead. In fact, animal charcoal which had been used for a considerable period in purifying lead-contaminated water became white from the formation of phosphate of lead. That it really was the phosphate which was the active constituent of animal charcoal was proved by the fact that phosphate of lime was itself just as efficient for removing lead as was animal charcoal. He exhibited a novel filter, devised by himself, in which the water was caused to pass through a block of compressed phosphate of lime, and showed by experiment that lead was wholly removed by such treatment.

We would call the attention of our readers to the advertisement, on another page, of the Hammersmith Industrial Exhibition Society. We understand that the Society held its first exhibition most successfully last year, when the City Corporation showed its appreciation of the Society's efforts by granting £21 to its funds. The Worshipful Society of Girdlers also contributed a donation of £10. We have not heard of these bodies renewing their interest by donations this year. We have no doubt, however, that the Girdlers will again show their interest in Hammersmith. We learnt not long since that the Worshipful Company of Mercers had sent a donation of £10. Some beautiful lace will be lent to the Loan Section by Cardinal Manning, and it is believed that the collection of old needlework will be one of the features of the exhibition.

Novel Marine Clock.—A curious marine clock, patented by W. I. Hadlock, in the United States, has attracted considerable attention from steam-vessel captains and owners. It looks like an ordinary marine clock, but by the aid of electricity is made to assist pilots and others in navigating vessels of all classes where courses are run, and where it is necessary to be particular as to time and distances. The clock is valuable, also, because when in operation it is a guarantee that the officers in the pilot-house will not be able to take more than forty winks. The device consists of, first, a clock with white transparent dial, running eight days, having compensation balance and fine movements; second, electric contact piece or spring fixed to minute hand, by which the contact is made and continued six seconds, during which time a bell rings, the circuit is then opened, and the spring passes by. Any number of seconds or minutes up to sixty can be run, and when the desired time is up the bell notifies the pilot, and the clock is again set for the next run. On the side of the clock is a log slate bearing the names of lighthouses or points from which departures are to be taken.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions o our correspondents. The editor respectfully requests that al communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR o *the* ENGLISH MECHANIC, *332, Strand, W.C.*

All Cheques and Post-office Orders to be made payable t J. PASSMORE EDWARDS.

*** *In order to facilitate reference, Correspondents, whe speaking of any letter previously inserted, will oblige b mentioning the number of the Letter, as well as the page o which it appears.*

"I would have everyone write what he knows, and a much as he knows, but no more; and that not in this only but in all other subjects: For such a person may hav some particular knowledge and experience of the natur of such a person or such a fountain, that as to other thing knows no more than what everybody does, and yet, to kee a clutter with this little pittance of his, will undertak to write the whole body of physicks, a vice from whenc great inconveniences derive their original."—*Montaigne' Essays.*

◆◆◆

THE COST OF THE "CHALLENGER" EXPEDITION—CAPELLA IN DAYLIGHT AT LISSON GROVE—TELESCOPE—SPECTROSCOPE—FASTENING IVORY ON EBONY—PHOTOMETRY—TELESCOPE OBJECT-GLASS FOR PHOTOGRAPHY—"NEMO"-NICAL LESSONS IN PHYSICS—THE PLANETOIDS—SUNDIALS—BIRDS' EGGS—DYING(?) BY AN EFFORT OF THE WILL—METEORIC ASTRONOMY—MICRO-EYEPIECES: AN APOLOGY.

[28527.]—Now that something like a public awakening in connection with our National Expenditure appears to be really taking place, I should like to suggest to any member of Parliament who may chance to read these lines, that he should move for a detailed statement of all sums of £10 and upwards paid on account of the *Challenger* expedition, with the names and addresses of the persons to whom, and the services for which, such sums have been paid. Also a list of the persons and bodies to whom the publications have been presented, and the numbers of the copies *sold*. I have an abiding conviction that a truthful reply to such a motion would literally appal the British tax-payer. Heaven knows that long-suffering idiot has been infamously plundered enough by the Ring at South Kensington, but the cost of the specimen of the endowment of scientific research to which I now invite attention literally out-Herod's Herod.

With reference to the paragraph with which Mr. Godden commences letter 28472 (p. 32), if we assume the latitude of Lisson Grove to be 51° 30', as we may do for our present purpose, without sensible error; then as the North declination of Capella is 45° 53', it must be 5° 37' from the zenith at the instant of its meridian transit. Hence the opening of any vertical tube or chimney would have to subtend an angle of 11° 14' at the very least, at the place of the observer's eye for that observer to see the star even at night time, which is absurd. Capella then, would not be a fair or even practical test, unless, indeed, your correspondent could erect a tube 40ft. or 50ft. long, and from 6in. to 9in. in diameter, pointing due south, and inclined at an angle of 84° 23' to the horizon.

In connection with replies 64424 (pp. 36 and 37) I may say that it never occurred to me that "Fitter's" object-glass was a *compound* one. I took it for a single lens with another one between it and the eyepiece. Will "Fitter" say of how many lenses his objective is made up?

In reply to query 64700 (p. 42), the ordinary pocket spectroscope consists of three crown-glass prisms, alternating with two of flint-glass, in such a way that as viewed sideways, the apices of the flint-glass prisms and the bases of the crown-glass ones are upwards, and vice-versâ. By an accurate proportioning of the angles of these prisms, the rays of mean refrangibility pass through without deviation; but the *dispersion* of the two flint-glass prisms so considerably exceeds that of the crown-glass ones that a spectrum is obtained.

Why does not "Hamilton" (query 64710, p. 42) try Foulke's cement? If the ivory be well cramped up, and the box left for three or four days, I question if anything but boiling water will fetch the ivory off. I united the edges of a narrow strip o glass in this way years ago, and it is still intact i my observatory, which, goodness knows, is dam enough to have dissolved any ordinary adhesiv material in three months time.

"Essex" (query 64730, p. 43) should get a shee of white foolscap paper and drop a spot of stearin on it from a candle. He must scrape off the soli stearine, put two or three layers of blotting pape over the spot, and iron it until it is neither t strong nor too faint, the proper strength being matter of experiment. Then he must fasten hi paper into a slate frame furnished with some co

for placing it vertically on a table at the
of his lamp flames. Now let him select
gest table he has, and, stretching a
r drawing a line upon it, place his Argand
one end of this line and his duplex one at
r, and move the screen between them until
disappears, which it will obviously do when
nination of it is precisely equal on each
t only remains to measure the distance of
en from each light, and to square such dis-
find the relative illuminating power of
ps. Thus, suppose that the Argand lamp-
as 3ft. from the screen, and the duplex
when the spot ceased to be visible, then
9, and 4·25 × 4·25 = 18·1625. So that in
ginary case the duplex would give a little
an double the light of the Argand.

ne thing which would militate against the
1½in. achromatic telescope object-glass for
graphic landscape lens (as suggested in
1732, p. 43, by "Neva") is that the chemical
al foci would not coincide, so that a pic-
rply focussed on the ground-glass screen
e blurred and indistinct in the negative.

xceedingly difficult to argue with anyone
emo" (letter 28498, pp. 54 and 55), whose
of physics is his own, and nobody else's
world. "Would," asks that gentleman,
A.S.' assert that minute particles of such
s do not exist in space?" To which my
, that assuredly "F.R.A.S." would make
ertion, for the simple but sufficient reason
water, or any other ponderable matter,
in space, its immediate effect must be to
he movements of the planets, which would
describe spirals, and finish by falling into
What your correspondent means by heat
g the elements of water for its propaga-
ave not the most distant idea. There is
teric philosophy at the back of this which
ight over my head. Inasmuch, too, as the
s of "Nemo's" peroration are not as the
es of Thomson, Routh, Steele, Tait, and
knowledged authorities, I really do not
there is to discuss.

not propose to interpose in the discussion
Dr. Caine and "E. L. G.," and will, there-
tent myself with the remark (in connec-
h letter 28499, p. 55) that it is absolutely
hat the asteroids are *not* "the remains of
planet." Dr. C. should study the elements
orbits in some recent work on astronomy.

invite the consideration of Mr. Hampden
8525, p. 62) to the elementary fact that at
distance of the sun from the earth the
al radius of our world (3,963·3 miles)
an angle of 8·848″ only, and ask him
nceivable difference there can be, under
cumstances, between the appearance pre-
y a sundial at the earth's centre, and by one
to it on any part of her surface?

tell "L. E. O." (query 64740, p. 68) that
collection of birds' eggs is kept in a
some 4ft. high, containing eight drawers,
by partitions, in which the eggs repose on
f cotton wool; the upper division contains
of the smaller British birds, the lower
larger eggs of sea-birds, &c.

Ir. Macbeth (query 64787, p. 69) enlighten
how the "facts" (?) of which he speaks
een proved"?—because there was one case
of a Fakir who was buried alive, but in
ertain precautions to preclude the possi-
the ordinary trickery were taken, with the
at when dug up the poor creature was as
door-nail.

ly to Mr. Fraser's query (64794) on p. 69,
es of the orbits of the periodical star
exhibit no tendency whatever to coincide
t of the Ecliptic. Taking at random the
that occur to me, the Perseids—of which
display occurs on August 10—travel in a
le direction in an orbit inclined 64° 3′ to
ptic; while that of the November Leonids
nclination to the earth's of only 17° 44′.
hs of these mysterious bodies lie in all
s and at all angles.

st inform "Finem Respice" (query
69) that circumstances which, could they
led here, would, I feel sure, excite his
y, have temporarily deprived me of access
n microscope and, to a large extent, to my
nd must beg him to accept this as the
ion of my inability to reply to his ques-
ome little time to come.

w of the Royal Astronomical Society.

SATURN.

.]—PERMETTEZ moi de vous signaler
inexactitudes dans l'impression de ma
Saturne que vous avez bien voulu repro-
ns "l'E.M.," No. 1,199, p. 61. Il faut,
isibilité de la bande de Struve surtout dans
entale; à l'occident, au contraire . . . ."
e du globe est concave sur A et sur B
te sur la division Cassinienne.
tie supérieure du globe, dans les dessins, doit être ombrée, à partir de la double bande, et cette ombre doit être le plus marquée près du pole. L'anneau A doit être plus clair, et le plus clair dans le dessin du 8 février, entre la bande d'Encke et la division Cassinienne. Le bord interne de l'anneau obscur doit être plus confus à l'occident. La bande d'Encke doit être plus près du bord extérieur de A le 8 février à l'ouest, et être moins marquée. La bande de Struve est trop marquée dans la moitié nord de l'anse occidentale.

Le Journal of L.A.S., Mars, 1888, p. 180, dit que M. Keeler, à Lick Observatory, "a vu l'anneau obscur séparé de B par une ligne distincte," ce serait exactement ma division de Struve, *telle que je la vois*. Il est dit aussi que M. Keeler ne voit pas de taches sur l'anneau obscur; ne pourrait-on voir son dessin et vérifièr s'il a vue des dentelures au bord de C et de la division Cassinienne et autres détails semblables ou qui s'y rattachent?

Louvain, 16 Mars. **Dr. Terby.**

LUNAR ECLIPSES.

[28529.]—I FEAR that the ingenious theory that the light shown by the eclipsed moon is due to the corona, will not bear careful consideration. Estimates differ as to the ratio which sunlight bears to moonlight; but the mean is about 500,000 to 1. Now, the total brightness of the corona does not on the average very greatly exceed that of the full moon, so that we may certainly say that not one part in 100,000 of the ordinary illumination of the full moon is due to coronal light. But in a total eclipse all the brightest part of the corona will be hidden from the moon by the earth, very nearly as thoroughly and for very nearly as long as the disc of the sun itself. If in mid-eclipse the moon shone only by direct coronal illumination, it probably would only give us about $\frac{1}{1000000}$ of the light it does when unobscured by the earth's shadow. Nor will the refraction of coronal light through our atmosphere help matters much, for the corona is especially rich in violet light, which would be absorbed in the passage. So far, then, from the eclipsed moon shining mainly by coronal light, it is possible that it never owes so small a proportion of its illumination to the corona as at such times.

On the other hand, not only do we know theoretically that our atmosphere has the power to refact the light of the sun itself sufficiently to cause it still to light up the moon; but the spectroscope gives us clear evidence that it actually does so; the telluric bands in the spectrum of the eclipsed moon being of the most phenomenal breadth and blackness.

E. W. Maunder.

Royal Observatory, Greenwich, London, S.E.,
March 16.

[28530.]—I THANK "F.R.A.S." and "W. T. N." for their notes on the corona theory. The test suggested by the latter correspondent, that spectroscopic examination would do much to reveal its truth, seems to have been applied at the time of the last eclipse; for I note that in your report of the R.A.S. meeting, on the 9th inst., Dr. Huggins is said to have seen a brightening of the spectral lines in places which strongly suggest the influence of coronal light.

Personally, it seems to me that both light refracted by our atmosphere and light reflected from the corona are concerned in rendering our eclipsed moon visible. The coronal theory alone does not account for the colour of the obscured disc, while the refraction theory does not explain its varying brightness (unless we invoke the aid of volcanic eruptions at Krakatoa or elsewhere).

Mr. W. F. Denning's paper, referred to on p. 52, accounts very satisfactorily for the red colour observed, and if on the moon's disc, so illuminated, we imagine the pearly coronal light to fall, the hue would be lighter and the luminosity increased. The pinkish tint observed by Mr. Chambers, and noted in your above-mentioned report, would seem to confirm this view.

The objection raised by "W. T. N." (letter 28500) as to the apparent relative sizes of the corona and the earth's disc is not necessarily fatal; the corona certainly extends over a much larger space than that visible through our atmosphere, and although there would be a great falling-off of illumination at a distance from the sun, this may be compensated by the large extent of the corona and its appendages, all of which must reflect some light, however little. At all events, the covering up of a circular patch, 2in. in diameter, of the corona, would still leave enough light to render our eclipsed moon visible, projected as she would be in a black sky.

Might I ask "F.R.A.S." to make the comparison he suggests in letter 28469 in a few cases (assuming him to have the data conveniently at hand), and let us know the result? This would, so far as I am concerned, set the matter at rest.

Jno. Harvey Jones.

SELENOGRAPHICAL — CLEOMEDES — THE LEIBNITZ MOUNTAINS—TO MR. ELGER.

[28531.]—I HAVE to thank the gentlemen who so kindly replied to my queries concerning the fine walled-plain Cleomedes.

Mr. Gemmill's letter on Dec. 9, 1887, is very interesting; but I am sorry the diagram mentioned by him was omitted from the text. His conclusions are, doubtless, correct; and after finding so many authorities arrayed against the existence of the small crater N.E. of Cleomedes C, I can but fancy I have seen a ghost—a mere shadow. Probably, M. Gaudibert's explanation, Dec. 30, 1887, is the right one—viz., that it is a shadow in the "gap." At the same time, I hope to get another peep at the spectre before long. Certainly the formation in my drawing, March 25, 1887, seems slightly larger than that in rough sketch of same. It is interesting to note that Mr. Mee, Jan. 27, 1888, has drawn this formation as a crater.

Can Mr. Elger, whose fine lunar sketches we are always pleased to see, oblige us with a drawing of the Leibnitz Mountains? I vividly remember one view I had of these ranges, when the necessary drawing materials were not to be had; but the sketch, afterwards made from memory, I do not wish to put forward. What struck me was the visible vastness of the ranges, and the unusual appearance (in lunar views) caused by a number of bright points scattered over the scene, as if they were highly reflective cones. I hope some interesting information will be forthcoming.

Jason.

THE FIFTH STAR IN TRAPEZIUM, &c. —TO MR. W. L. LANCASTER, &c.

[28532.]—I THINK that the visibility to Mr. Lancaster of the 5th star in the Trapezium is accounted for by the higher altitude of Orion in his latitude than in mine. I have examined the objects mentioned by him, as far as possible, with the following results:—

1. I find *comes* of Polaris is quite easy with power of 87 (my lowest) in bright moonlight.

2. By a strange coincidence, I find an entry in my notes, dated Sept. 28, 1887, that *comes* of Vega was steady at 6.25 p.m., with 165. As the sun set at 5.45 on that day, the observation was made exactly 40*m. after sunset*, but I think the small star would have been visible quite 15m. earlier (ε Boötis easy at same time, though involved in sunset).

3. *Comes* to Aldebaran was seen on March 18th, when the moon was but a few degrees from it.

4 and 5. I do not remember ever failing to see all five of the brightest satellites of Saturn.

6. On the 18th, I had a splendid view of Saturn, and repeatedly *glimpsed* Encke's division in both ansæ, power 250. I do not profess to hold it steadily, but find the best time to observe it is when the planet reappears from behind a cloud, when every detail shows up most clearly.

7. *Comes* to ι Ursæ Majoris *easy* with 165, but only seen by *averted vision* with 320. (I see Mr. Wassell found same difficulty.)

May I, in return, ask Mr. Lancaster how his 3⅞in. performs on P VII. 170, following Procyon, which I divide with 165; also ε Equulei, which was also easy with same power.

I think if Mr. Wykes (64786) looks at p. 363 in Webb, he will find η Orionis described, and also a notice of Burnham's 10th mag. pair, *s.f.*

Ipswich. **A. Southgate.**

MATTERS: WET, DRY, AND HOT.

[28533.]—I HAVE taken the following from the *Echo* of March 6th:—"The mail just arrived brings an extraordinary story of an enormous aërolite over 100ft. in length and nearly 30ft. in diameter, and estimated to weigh 3,000 tons, having struck the ground in Cochin China on Oct. 29th, and ricochetted, after ploughing up a trench 100ft. long, 20ft. wide, and about 6ft. at its greatest depth. It struck a place called Shan-duc, but was seen by French officers who were three miles from each other and 18 miles from where the aërolite struck, so that they were able to calculate its trajectory and speed. It rebounded at a depth of about 1½ miles a second, and it is calculated that it must have ultimately fallen about 440 miles from where it touched the ground, or in the middle of the China Sea."

Now, for those whose scientific digestion is not equal to 3,000 tons, let us assume that this fresh arrival weighed 3,000lb.; or, if this is too much of a bolus, let us suggest 3,000 grains. The weight is immaterial; if the aërolite fell, it is not the first that has fallen by a great many, and, doubtless, it will not be the last. What is confirmed by it is the fact that extraneous matter reaches the earth from time to time in the shape of aërolites, which, Lockyer informs us, have been found to contain at various times as many as 21 different elements in combination. The consideration is whether the forms of combination in which matter may reach, or may have reached, the earth at any time are restricted. Many years have elapsed since fortune threw in my way for the first time a number of the "E. M.," which so took my fancy that I have since been a very attentive reader of the same paper as it issued weekly; and I can honestly say I have read the communications of none of your able contributors with greater pleasure or profit than those of "F.R.A.S.," next to whom I have to acknowledge my indebtedness to your very able correspondent, "E. L. G." I single out these two as being more immediately connected with the above-mentioned consideration. Our friend, "E. L. G.," is a stout advocate of the possibility of the existence of matter in space, in the shape, as I take it, of a chemical combination of oxygen and hydrogen; in other words, a "watery comet"; and, it appears, "F.R.A.S." is none the less stoutly opposed to such an idea. With your permission, I would respectfully, as a student, ask him, What are the physical facts as known to-day which militate against such a conception? Why should not matter exist in space as oxide of hydrogen just as easily as it does as an alloy of nickel with iron? Some time ago he complained of the lack of a *proof* that such a thing as a watery comet had ever existed; is there any proof that such a thing never did exist? I do not wish to appear too pertinent with these questions, but I am extremely desirous to learn. I therefore humbly ask not to be referred to what was written, say, 50 years ago on this subject (50 years ago is scientifically dead, buried, and decomposed); I wish to know what are the tenable views of *to-day*. I may as well confess "E. L. G.'s" theory of the cause of the Noachian deluge has already seemed to me very interesting, and I cannot understand how it is to be refuted by a mere pooh-pooh. If hydrogen monoxide exists, or ever has existed, independently in space, why should it not be liable to come into collision with the earth just as much as an aërolite is? This granted, I should leave to wiser heads the determination of the amount and the effect of the heat developed by such collision. I wonder how much arose from the impact of the aërolite with the earth. Assuredly "F.R.A.S." does not assume his antagonistic attitude to this theory of a watery comet out of idle indifference: he must have a very good reason for it, and I should very much like to know what it is. It is a long time now since I saw the geological model of the London basin, in Jermyn-street; but I well remember that it represents as overlying the London clay in irregular patches on either side of the present channel of the Thames an alluvium or red-coloured river gravel. I believe it is represented as forming the entire surface of Hyde Park and Kensington Gardens, and extending thence northwards towards St. John's Wood. A few years ago the West Middlesex Water Company were laying a large water main down Grove-road and Lisson Grove, and the trench excavated for this purpose down the Grove was, as the geological model said it should be, cut out of the London clay until the workmen reached the corner of Earl-street, where they promptly came upon the gravel, even as the model indicated. How was that gravel deposited? Did the waters of the Thames ever reach so far northwards as that, and a corresponding distance south, on the Surrey side of the river? I suppose nobody will deny that this is river gravel. Whence, then, would the Thames, or whatever river existed in the neighbourhood at the time, derive such a mighty volume of water?

Is the North Sea at the present time encroaching on the coast of Lincolnshire or not? I am aware of the submerged forest off Cromer. While staying at Skegness, last August, I one morning walked along the beach towards Ingoldmells Point; the tide was on the ebb; and, as all who have been that way know, the beach is very flat and wide at low water, and composed mainly of fine sand. When I had got entirely out of sight of Skegness Pier, the receding water exposed to view a large quantity of what I at first took to be nodules of black clay, but which on a closer inspection proved to be nothing else than the decaying trunks and roots of trees, in which the woody fibre was distinctly perceptible both with and without the aid of a lens. Even at its lowest point the water concealed an unknown portion of this collection, and it required more than half an hour's sharp walking on the return journey to pass the confines from north to south. I judged we have here the site of another submerged forest; but I do not remember ever having read anything about it. This would seem to be a comparatively recent encroachment of the sea. Mentioning the matter in Skegness, I was told that out that way there might be seen at very low water the old church tower of Ingoldmells; this, again, sounds like very recent work. But, I ask the question, because between Skegness and Ingoldmells Point there is a fine earthwork thrown up with a carriage-way along the top known as the Roman Bank. Between this and the beach there is another earthwork which marks the present limits of the sea's encroachment, so that it seems if the Roman Bank at any time served this purpose, *land has been actually* reclaimed from the sea reach there. I was also told that in quite recent times the sea reach extended over the present site of Skegness Railway Station. I therefore modify the question by asking, "Has the sea at the present time a *tendency* to encroach on the Lincolnshire coast?"

William Godden.

THE GLACIAL PERIOD AND THE MOON'S WATER.

[28534.]—If Dr. Caine were to read Mr. Howorth's book, "The Mammoth and the Flood," or refer to some of Sir J. Herschel's on celestial physics, he would find, I think, that there can be little doubt of the state wherein a mass of water no greater than our oceans would have to exist if alone in planetary space. It could only exist as a comet, either purely gaseous, or more probably cloudy, a mixture of extremely rare transparent low-pressure vapour, and the finest snow particles, such as are believed to constitute "mare's tail" clouds. No particles would be liquid while distant from a planet, but on approaching within a few thousand miles of our globe, her attraction would quickly reduce the whole to a liquid state, and none could fall as even cool water, but at least scalding hot, as the Persian and Talmudic legends relate the diluvial waters to have fallen. Much more ice than now exists would be soon melted by such a fall, and my chief difficulty is to account for so many of the mammoths as have been found near the Arctic Siberian coast, buried in frozen mud, being so frozen before they had time to decay. Howorth collects the accounts of their flesh in some cases affording a meal to wolves and foxes, but I have never before read of men, or even their dogs, partaking of such very stale meat.

Supposing such a comet, before collapsing, large enough to envelop both earth and moon (a supposition far from necessary, seeing that hardly any measured comet besides that of 1811 has had such a diameter), the quantity condensed on the moon would sink into her pores, and certainly could not leave any above her surface, even were it as much greater in quantity than our Deluge waters as it really must have been smaller.

E. L. G.

[28535.]—It appears by some writers to be taken as an established fact that the moon has been subject to volcanic eruptions, which have left what appear to be extinct volcanoes on its surface. Is this proved beyond a doubt? May not these apparent craters be nothing more nor less than hills and peaks of ice.

It is stated that the intensity of cold at the moon's surface is far greater than could be possible on our earth. Suppose, for instance, the surface of the moon to be covered with ice, or the moon to be simply a body of ice, the volcanic appearance could be easily accounted for; and, further, it is quite possible to supply what seems to me to be a missing link.

The enormous pull of the moon on the earth, or the earth on the moon, or, I, think, more sensibly, the one pulling against the other, has the effect of heaping up our seas between the moon and the earth. Is it not quite possible that a portion of the earth's water is being pulled off by the moon.

Taking it for granted that the earth receives tons of meteorites every year, is the earth growing and becoming heavier? If it is, it cannot keep its present position in space. Is it not more reasonable to suppose that the weight of matter received is balanced by means of something being given off; and may not this something be water? There is plenty of evidence that more water has existed on the earth. Where has it gone to? Even if the moon has been part of, and gone off from, the earth, the most likely and most easy part to be pulled away would be water.

A glacial moon would likewise strengthen the supposition that the moon has no atmosphere, because the necessary elements to form air similar to our atmosphere would be wanting. On the other hand, if volcanoes have existed on the moon, there can be but little doubt but that the moon has an atmosphere.

W. Potter.

THEORY OF BATTERIES.

[28536.]—Does it never occur to our electrical friends that the "acted upon zinc and the acting liquid" are the positive and negative elements respectively, and not the zinc and carbon as accepted, the carbon merely being the collecting conductor?

Daddy.

BREAKING STRAINS OF CABLE.

[28537.]—I do not presume to question "Sailor's" statements (letter 28479) about the Mersey; but, according to his own showing, the occasion when the Atlantic liner dragged her anchor and 105 fathoms of 2½in. (?) chain was an extraordinary one. The tide could not have been an ordinary tide, and probably the wind was very strong too. Anyway, there must have been more than seven knots tide running if the water was smooth.

In a seaway, as I stated before, the cable strai
are greatly increased. I may now add a few wor
on that point, which I wished to have said befor
but was prevented by want of space and tim
Everyone knows that the speed of a wave is muc
greater than the mean forward horizontal velocit
of the water moving in the wave. But at th
breaking point the water and the wave have th
same horizontal velocity. Waves that roll in fro
the ocean to break upon the lee shore maintai
nearly the same steady speed when passing ov
shallow as over deep soundings; but the movemen
of water in the wave is much more rapid an
violent horizontally when passing over shallow
than when passing deeps. If, when the bi
breakers are tumbling in from the North Sea o
our Sunderland beach, I throw my walking-stic
as far off as I can beyond the zone where the se
actually break, that stick advances shorewards
first at an extremely slow rate, but gradually accel
rating, till finally it is borne to the beach on th
rushing crest of the breaking wave. Now, when tha
stick was out in comparatively deep water, a cotto
thread, so to speak, would have moored it stationar
in spite of the inrolling billows. But when th
stick was in shallower water nearer to the breakin
velocity, a good many cotton threads would no
have sufficed to moor it. Similarly, it is true tha
ships moored in shallow water are subjected to
much more violent horizontal force from billow
than are ships moored in deep water from billow
of the same size or volume. Hence, all othe
things being equal, the shipmaster needs to allow
in shallow waters a greater horizontal drift o
cable than in deep waters. There is also a furthe
reason for allowing extra scope in shallow waters—
a reason not due to the additional horizontal forc
of the shallow-water wave itself, but due to th
mathematical nature of the chain curve. In dee
water the dip, or versed sine, of the catenary i
correspondingly deep; the horizontal extra tensio
of a passing wave is only a transitory phase o
force, alternating with an opposite and almos
equal force, which tends to urge the ship anchor
wards the moment she has fairly surmounted th
billow and is riding down its rear slope. Durin
this brief transition from stern-ward to bow-war
motion, the ship is not borne horizontally eithe
way a distance sufficient to very materially increase or decrease the strain of the cable; for whe
a catenary has a deep dip, or versed sine, a ver
considerable difference in its span, or chord, i
necessary to induce a very considerable differenc
of dip and of stress. But when a catenary has
shallow dip, the slightest alteration of span make
a very great alteration of dip and stress. Fo
example, take a chain, say, 100ft. long. Suppos
it hung across a span of 100ft. Then (but for it
elasticity permitting its length to stretch) the di
would be nil, and the stress would be infinite.
Now let that same chain be hung across a span o
99ft.; then the dip will be increased from nil to
more than 6ft., and the stress will be decreased
from infinite to about 2¼ times the dead weight of
the chain. Thus the horizontal wave movements
of a ship moored in deep water do not alter the
strain on the deep-dip cable nearly so much
as the same measure of horizontal wave movements of the ship moored in shallow water
would alter the cable strain. But, as we have
above seen, the horizontal movements due
to shallow-water waves are much greater and
more violent than those of the same waves in
deep soundings. There are thus two distinct
causes combining to create the necessity, which undoubtedly exists (all other things being equal) for
greater horizontal scope of cable in shallow than in
deep waters—viz., the function governing the
catenary, and the function governing the horizontal
velocity of water in the wave.

But, besides the effects of billows, there is the
effect of wind to consider, as a means of increasin
cable strain. A hurricane would so powerfull
bear on the hull and rigging of an Atlantic liner a
to drive her along at a definite speed, and that spee
(whatever it may be) may, in calculating cabl
strain, be regarded as virtually added to the spee
of the current in which the ship is moored.

I can quite understand, in view of all these con
comitants, that in a current running normall
seven or eight knots, and in water only seve
fathoms deep, 90 fathoms may be needful fo
scope; or even more than 90 fathoms under ver
extraordinary conditions, especially in view of th
fact that the dynamic character of the alternatin
pulling and slacking of cable effected by a vess
riding in a seaway introduces the very tremendou
element of the momentum of the ship's displac
ment weight; and though the application of th
momentum is intermittent, it is terrible while
lasts; and can only be avoided by giving plenty o
slack. The yield of the catenary does wonderfull
evade the force of momentum. Even for ordinar
scopes, a ship's cable never jerks taut right o
from the anchor. It would be a bad job if it di
I understand that small vessels, as a rule, need
much scope as large vessels, as their ground tack
is only proportional to their size. But "Sailor

will, of course, understand that though I have spent many years in specially studying wave and chains, &c., I am a landsman, and have no special practical knowledge on these subjects such as a sailor or sea-going engineer alone can have.

Sunderland. **Frank Caws.**

YELLOW STAINS IN FINISHED COTTON CLOTH.

[28538.]—I WAS exceedingly pleased to see a letter (28487) on this subject in your issue of the 9th; and Mr. De Casimer's recommendation as to packing I read with particular interest. I wish he would oblige us with the name of the patent packing paper his firm uses with such success, as I shall certainly advise my firm to give it a trial.

The subject of stained and damaged cotton goods is of great interest to your numerous Manchester readers; and as it is almost "unexplored," I feel sure that those of your readers actually engaged in the bleaching, finishing, and packing trade, as well as the shippers, will appreciate your editorial kindness in throwing your columns open for contributions on the matter.

The experience of Mr. De Casimer is not peculiar to the Argentine markets; my firm has had claims from *every* agent and buyer in the South American market with whom we have had business. We have had damaged goods almost times without end; and claims have been lodged against us—as shippers—amounting to exceedingly large sums. Indeed, it has been a common occurrence to have heavy deductions made by our S. American agents for "stained and otherwise damaged goods."

The great evil to my mind is not so much the "yellowish-brown" stain as the "dark red," "the pink," the "black spot," and the "dirty yellow" stains.

The yellowish-brown is easily removed, and hence the claim is not excessive; but nearly all the other stains enumerated arise from mildew growths, which cannot be removed by any ordinary means, and hence represent permanent damage. Besides, these stains are obviously not due to the packing-house; they can only come by careless, ignorant bleaching and finishing, and Mr. De Casimer's system of packing would not, I am afraid, affect the production of these stains in any degree.

The ordinary trade processes of bleaching and finishing, in many of the best known bleaching works in Lancashire, are notoriously crude, and many of their proprietors, who have made fortunes in their business, and who are personally known to me, are ignorant of the most elementary "texts" of the theory or practice of *modern* bleaching; indeed, rule of thumb does reign among them!

That works of this description do *the* damage to the trade I feel convinced. They have their special finishes (!), and "a connection," it is true, but these won't last long with the present feeling in trade circles.

The tendency is in the direction of manufacturers and weaving concerns bleaching and *finishing* their own goods, independent of the bleachers as they now exist; and I think Mr. De Casimer will bear me out in saying that when this is done the "stained and otherwise damaged goods" column will disappear out of most shippers' ledgers.

The whole fault, in my opinion, is with the bleacher; he sizes and finishes the goods with materials of the chemical composition of which he has not the slightest idea. He feeds the fungi, and the fungi ruin both cloth, manufacturer, agent, and shipper!

A Manchester Shipper, J.M.

WARBLES IN CATTLE.

[28539.]—I would respectfully beg to remind those readers who are owners of, or have the care of, cattle that now is the time for them to attend to the warbles in their own cattle. I think most, if not all, owners of cattle would be glad if the warble pest was exterminated, and I believe it might very soon be done if each owner would kill all the warble maggots, and prevent the attacks of the warble fly on his own cattle. I expect that in two or three years there would be very few or none left if cattle owners would be unanimous in their attack on the enemy. Though individually a person may think his loss by the warble pest is but small, and not worth troubling about, yet, in the aggregate, it amounts to a large sum, the damage done in this country having been estimated at from £2,000,000 to £7,000,000, so you will see that it behoves every owner of cattle to do what he can to prevent this great national loss; if not for his own sake only, he perhaps would not object to spend a little time and trouble, and a shilling or two, for the benefit of his country. It does not appear that the wild galloping or "gadding" of cattle we often see in summer is altogether the result of the attack of the warble fly, as the gadfly is also responsible; the bloodthirsty attentions of the latter feeling something like the prick of a needle, I have no doubt some of your readers have felt. So if the warble fly was exterminated it would not altogether prevent "gadding," unless something is done to keep off the gadfly—even the hum of the fly, in certain states of the weather especially, is enough to start them off; even calves, which have probably never heard or felt a gadfly, will gallop off with tails erect on making a buzzing noise with the lips, which seems to show that there is an instinctive dread of the fly born with the calf. For several years back during the "gadding" season I have once or twice a week dusted the backs of our cattle with sulphur flour by means of a pepper box, with, I think, an appreciable diminution of "gadding," though I don't think anything but keeping the cattle under cover will entirely prevent it, as I said before, in certain states of the weather approaching rain or thunderstorm it takes very little to start them "gadding." The dressing with sulphur also causes a considerable diminution in the number of warbles. Cattle "gad" mostly when the sun is shining, and as that also makes the sulphur smell pretty strongly, it probably keeps the fly at a distance. We keep from twelve to twenty cattle of different ages, and about 1lb. of sulphur will do for us one season. The following is quoted from Miss Ormerod, the Consulting Entomologist of the Royal Agricultural Society:—"To prevent fly attack in summer, train oil rubbed along the spine, and a little on the loins and ribs, has been found useful; so has the following mixture:—4oz. flowers of sulphur, 1 gill spirits of tar, 1 quart of train oil; to be mixed well together, and applied once a week along each side of the spine of the animal. With both the above applications it has been found that the cattle so dressed were allowed to graze in peace, without being started off at the tearing gallop so ruinous to flesh, milk, and, in the case of cows in calf, to produce. A mixture of spirits of tar, linseed oil, sulphur, and carbolic acid has also been found useful, and anything of a tarry nature appears serviceable as sheep salve (or bad butter and tar mixed with sulphur), or Stockholm tar or green tar rubbed on the top of the cows' backs between the top of the shoulder-blade and loins. Washes of a strong pickling brine, applied two or three times during the season are very useful. Paraffin and kerosine are useful for a time, but the smell goes off before very long."

I think the use of the two last-named detrimental to the cow, and don't think tar very good. I prefer sulphur alone, both for cleanliness and ease of application, and the expense is very small. Last year I destroyed all the warble maggots I could find, and this spring I find that, of the older cows, some have none, and others only one or two warbles; the youngest are the worst, one of last year's calves having a dozen or more. It seems that almost any greasy or tarry substance rubbed on the warble will kill the maggot, and there is a mixture called "McDougall's Cattle Smear" specially recommended for the purpose. The way I did, and am doing again this season, is with a chip of wood sharpened to a flat point about $\frac{1}{8}$in. wide, to press a bit of mercurial ointment about the size of a grain of linseed or dari into the breathing hole of the warble; if properly done, one dressing is sufficient. If mercurial ointment is used, care should be exercised, or the cure may be much worse than the disease, as one farmer found to his cost, losing several cows—I believe nearly all he had; but if used in the above manner, no fear of bad consequences need be entertained. When there are many warbles this is a tedious operation, and the cattle smear would be applied more expeditiously. One of my friends rubbed the backs of his cattle with train oil, and found it kill the warble maggots; but that makes a dirty mess of the cow's back. I may as well say here, to prevent any misapprehension that I have no interest whatever in the smear above mentioned, knowing nothing of it but what I have heard or seen in the newspapers. I do not recommend mercurial ointment as being the best, as I have tried nothing else. I have it, and as it is effectual and cleanly, and if used with care, safe, I use it. The belief that among your readers there are many cattle owners, as I know there are several in this district, is my excuse for troubling you with this communication, which perhaps more properly belongs to the province of an agricultural newspaper. I hope that its length will not preclude its insertion, but that it may induce some to do their share in exterminating the warble pest.

I notice one gill is the measure of one of the ingredients in Miss Ormerod's recipe. As the gill is a different measure in different parts of the country, I presume the imperial gill of one quarter of a pint is intended.

March 19. **Samothes.**

MAGIC SQUARE.

[28540.]—YOUR correspondent, John Hampden, has found a mare's nest. The construction of "magic squares" is only the application of a well-known principle in arithmetic progression—viz., that the sums of pairs of terms equidistant from any fixed term are all equal—*e.g.*, the quarter of 1888 is 472. Take 16 terms of an A.P., of which the common difference is 2, and 472 shall be the mean, then the sum of two pairs equidistant from the mean will be 1888. On this principle I will engage, "for a consideration," to send magic squares to readers of the "E. M." consisting of 5, 6, 8, or 10 squares per side, and, meanwhile, inclose a small specimen, similar to that of last week, in which the columns, &c., add up to 400.

85	113	111	91
107	95	97	101
99	103	105	93
109	89	87	115

John T. Lawrence, M.A.

MAGIC SQUARE FOR 1888.

[28541.]—THERE is nothing extraordinary in Mr. Hampden's square (28488) to anyone acquainted with the properties of magic squares. The type which produces his result is this:—

a.

1	15	14	4
12	6	7	9
8	10	11	5
13	3	2	16

Now, each term of this may be multiplied by, or added to, any, the same, number without altering its magic quality. Let us multiply each term by 2, and we have—

β.

2	30	28	8
24	12	14	18
16	20	22	10
26	6	4	32

Let x = the sum to be added to each term to make the column-sum 1888, then—

$$68 + 4x = 1888$$
$$x = 455$$

which will produce the square given in his letter. It is evident that the number of the year must be divisible by 4; consequently, by a similar process we should obtain results for the years 1880, 1884, &c.

Suppose we wished to treat the year 1882, we take the square a, then—

$$34 + 4x = 1882$$
$$x = 462$$

and so on for the years 1886, 1890, &c. With these squares we must have an even number of years; but if we take the 3 square—

2	9	4
7	5	3
6	1	8

we get some squares for years divisible by 3. Thus for 1881 we have—

$$15 + 3x = 1881$$
$$x = 622$$

and so on for 1887, 1893, &c.

If we wished to work in a similar manner for the year 1885, we must take a 5 square, when we have—

$$65 + 5x = 1885$$
$$x = 364$$

Similarly for the year 1895.

The only years which could not be worked out on this principle would be those whose numbers are primes. **Pi.**

FRICTION.

[28542.]—ON reading "A. D.'s" letter in the last number, I naturally proceeded to look up the question of friction, and referred to an article on the subject in "Amateur Work" (Feb. 1887), by our old friend "F. A. M." The pith of his remarks is as follows:—Friction is of three kinds.

1. "Solid friction," between unlubricated solids.
2. "Liquid friction," between a solid and a liquid.
3. "Journal friction," between two smooth, well-fitted surfaces, separated by a film of oil or other lubricant.

It is with this last alone that we have now to do, and its laws seem to differ from those of either "solid" or "liquid" friction, but occupy an intermediate position between the two. It seems that "journal friction," unlike "solid friction," is (1) *independent* of the pressure. This is borne out by the tightness of the lathe-band making very little difference in the ease of running *in highly-finished lathes.* (2) It is *proportional to the extent of rubbing surface.* This is borne out by the undoubted fact that mandrels with a front-bearing and back-centre run much lighter than those with two collars. In these respects "journal" friction resembles its "liquid" brother; but, unlike the latter, it (3) is not greatly affected by speed, and does not (like "liquid" friction) increase as the *square* of the velocity, but more nearly as the *square root* of the velocity.

These laws are the outcome of some experiments carried out about three years ago, by the Institute of Mechanical Engineers. It must be borne in mind that they only hold good in their entirety in the case of smooth, well-fitted, and truly circular journals. In those which are rougher, and less carefully fitted, a certain amount of "solid" friction makes its appearance, and alters the results proportionally.

Thus far, "F. A. M." Another factor must also be taken into account in explaining the easier running of any lathe after the alteration. Friction of any kind—implying, as it does, *motion*—must depend for its total amount on the distance travelled by the rubbing surfaces. Now the rubbing surfaces, in the case of my lathe, were, before the alteration, about ⅜in. in diameter; now they are only, at the outside, about $^{1}/_{64}$in. Therefore the moving surface, at its periphery, had before to travel a distance of about 1⅛in. over the fixed surface in each revolution; but now it only travels about $^{3}/_{64}$in. This alone would be almost enough to account for the greater ease of running.

To go further in my crusade against friction, I am about to fit my flywheel with a crank-shaft running in ball-bearings (it runs at present on a turned stud), and expect a great gain in ease of running. When finished, I will report the result.

Ursa Minor.

PARAFFIN-OIL LAMPS.

[28543.]—I wish to give Samuel Ray my support on the above. I have been amongst 25 for 30 years, and never saw any explosion, and our workmen always put their hands at the back side of the chimney and puff them out while in full flame, notwithstanding the weekly hearing of explosions. I think if they are properly cleaned—the cinder that falls from the wick being carefully cleared away—there is not the least danger. The ordinary lamps we have known so long are all that is required for household use, and if a larger lamp is required, the "Silber" is, to my mind, a much superior lamp to the "Defries," and I use both.

T. W. B.

THE BOEHM FLUTE—TO "VULCANITE."

[28544.]—Seeing that there are again inquiries relating to the Boehm flute, may I ask our friend "Vulcanite" to give instructions for making one, the same as he gave about the clarionet some time ago? I am sure the subject would be very interesting to general readers, and most instructing to old flautists. Long ago I desired this information, with the intention of making one, and no doubt others would do the same. I know what I am asking will entail much time and trouble on our friend; but if he can realise the pleasure he will give, I think he will feel repaid. If I might make a choice, I should prefer Carte's 1867 model; but if he thinks the 1884 one the better, I would leave it to his judgment.

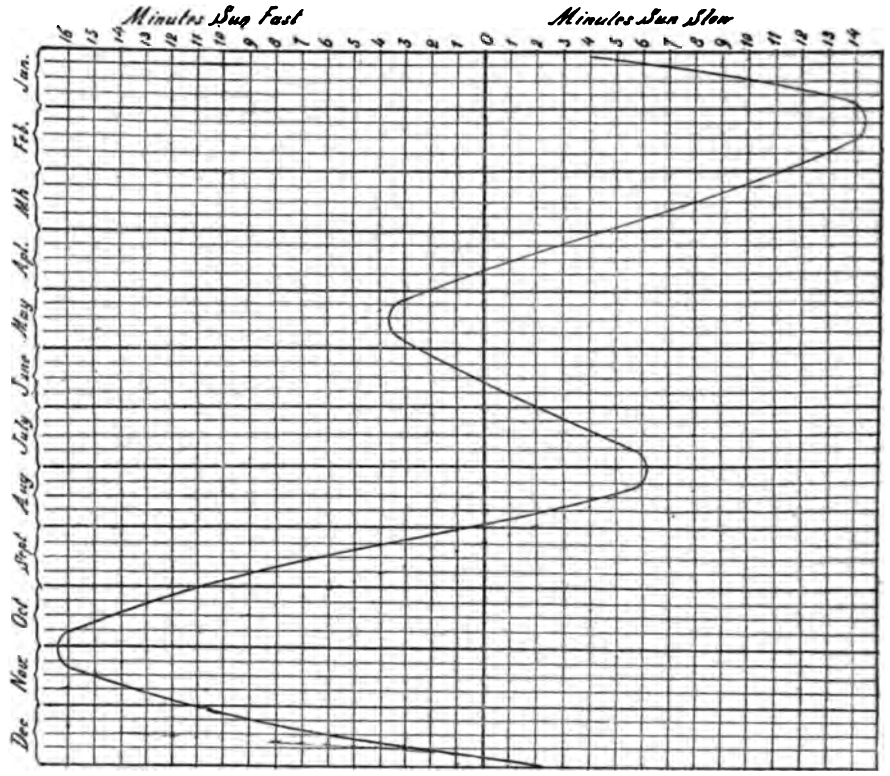
E. P.

DIAGRAM SHOWING THE EQUATION OF TIME.

[28545.]—Considering how little many sundials are used because there is not handy either equation-of-time table or diagram, I inclose copy of diagram which I have found not only convenient to use, or have drawn on a near dial, but even in its absence, having been once seen and examined, greatly assists memory of the equation of time for a given date. This is drawn for the year 1886, and the small variable error will not detract from its usefulness with a sundial.

It will be seen that the sun commences the year 3min. 50sec. slow, getting further behind mean time till Feb. 11, 14½min. slow; is correct April 15; then it souths before mean time until June 15, is slow till Aug. 31, then gains on mean time till it reaches 16min. 18sec. fast on Nov. 2; is correct again Christmas Day, and ends the year about where it began.

W. H. B.



INDIAN AND CHINA TEAS.

[28546.]—As one of the two planters referred to by "Nun. Dor." in letter 28270, I beg to say that the reason why sales of China tea are as steadily and rapidly declining as Indian is increasing, is that the public get better value in the latter. Indian tea is much stronger, weight for weight, and it is also pure. We dare not adulterate for two obvious reasons—first, we have more "leaf" on our bushes in the season than we can manage as it is, and it would be more than a manager's billet was worth to leave that to go and hunt the jungles for leaf to adulterate with. Secondly, trying to cheat in any way would be at once spotted by the trade, and his "name cut," which would mean simple ruin.

In re boxes, it is notorious we are yet behind China and Japan in this; there are technical difficulties that will, no doubt, be gradually removed. We cannot tare them yet, as they are made of various woods, light and heavy, and have to be made strong to stand the rough handling. Fancy nicely-planed and papered boxes of 100lb. tea, plus box and lead 30, equal 130, being shot down a shoot into the ship's hold—they often crack and burst in the process as it is.

The net weight marked outside, "Nun. Dor." can rely on (and the gross is unnecessary); we have to put in 1lb. always more than is marked outside, because of sampling. The man would be an ass who tried to cheat in weight. Oversights occur, of course. I refunded price of 80lb. tea last year, my native clerk having stencilled 10lb. too much on eight chests, by sheer carelessness.

The reason why the "best" China tea never goes to England is just because there is no market for it. It is a fancy tea, "fine to curious." As a rule China tea has flavour, and Indian strength; the latter hides the former very often.

What we planters and proprietors complain of is that the middle men get such profit and we so little, and the English mechanic may complain of it also. As I before said, teas that we can only get 9d. and 1s. for at the sales are retailed at 2s. and 2s. 6d. (the 6d. duty, of course, included). If we get 1d. or 2d. above actual expenses we are delighted; but the big dealers clap on at once 4d. to 6d., and the grocer another 6d.

The trade is omnipotent—a huge ring; let any outsider only try to buy our teas, and see how he will burn his fingers. The big dealers are pure speculators, and buy only to sell to small dealers, and these to others, and so on—highly respectable gambling.

I'm Tory generally, but hand and glove with the rankest Socialist as to the need of suppressing these "rings" in all food stuffs. Gambling in the necessaries of life should be made penal; it's as bad or worse than gambling in stocks. I hope every elector who reads this will tell his member that the speculator is the curse of our day, and should be suppressed. The poor suffer most by these leeches of society, and rings should be broken up mercilessly by law.

Sibsagar, Asam. **S. E. Peal.**

THE ATTRACTIVE POWER OF SNAKES.

[28547.]—I was very long sceptical of the "fascination" anecdotes I heard on this subject; however, "live and learn" is the common result of far travel and long life. I now write with the pen of an observant naturalist. I first noticed that frogs and lizards appeared to be enticed into the dread presence of their crawling enemy, and the former, seemingly bereft of power to escape, set up a squeaking note, which gave me warning to get a stick, with which I executed the stronger party; then the frog hopped off as naturally as ever. In the case of house lizards, they commenced a combined clicking chatter as they approached the intruder, leaving the lofty ceiling or perpendicular walls (which nothing but a bird could have reached) to meet their fate. They are much valued in Indian dwelling-houses for this peculiar tendency, besides as killers of insects, and even scorpions. I have seen one of the latter worried and then carried o for food by these useful "Geckos." It was shake and knocked on the ground (as a terrier serves rat) until motionless. But I was to see mor interesting instances of "fascination" in due tim When I lived in Lower Bengal, my children in th nursery room came to tell me of "such a prett mouse—so nice and tame," and how they had near caught it several times, as it lived behind a larg rotten clothes-basket in a corner. Breakfast wa announced, and when nearly over we heard th unpleasant cry of "Snake! Snake!" from th servants, who were cleaning the room, and ha moved the basket. My stick soon despatched a fi juvenile cobra, or hooded snake, of the gre species, about 2ft. long. The mouse I did not see probably he had been swallowed. The room bein full of furniture, why did not the mouse run aw to some safe retreat out of the snake's reach?

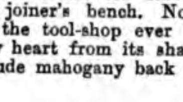
Again another instance, "as the moth to th candle." I was standing in my little garden, aw in South Africa, when I heard a curious sound o combined buzzing and chirping under a high ban overhanging a dry torrent. The mid-day sun wa blazing hot against that rocky ground, althoug there were some wild trees growing on its slop I approached the spot very slowly and noiselessly and, peeping over the rise, I saw a flock of man small birds wheeling and circling with gre rapidity and much chirping, till they revolved int a dense body, which might have been covered b an umbrella. They in their revolution near touched a large and thick black snake coiled up i a regular succession of folds (like a ship's rope) but his head and neck were erect, eyes sparklin tongue darting briskly to and fro in his mout I signalled to my Kaffir man, then digging th ground within view. He soon joined me wi some heavy stones, and made many good shots (a those hawk-eyed men usually do). The ug reptile was only "scotched, not killed," for h slowly ascended a tree, receiving more batterin till we lost sight of him in the dense foliage. H was called a "bad sort," and the Kaffir declin all further pursuit. What made these birds swar like bees into danger? More anon on a simil subject.

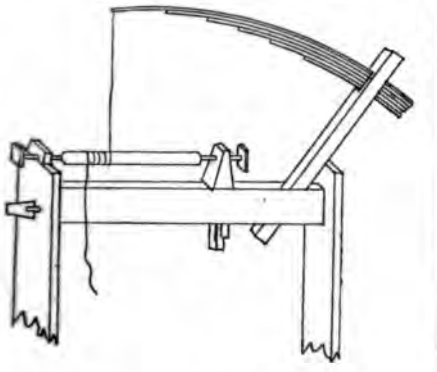
Eos.

POLE LATHE AND OTHER MATTERS—WHITEWASH.

[28548.]—It may please "O. J. L." to learn th within 48 hours of seeing his letter I had a po lathe at work, which has served to turn what enlightened courtesy may describe as cylinder a surface, and as it was rigged with scrap materia and differs from the classical pattern, even thoug the variations be concessions to temporary ex gencies rather than attempted improvements, pittance of experience may be of some intere short though it be. Experiment has redoubled confidence in "O. J. L.'s" opinion that this to deserves more extended recognition or reme brance, for, in addition to its cheapness, it has the beginner this advantage—that while the acti of the cutting tool is the same as in the mode lathe, the motion is slow enough for the causes of failure to be seen, and controllable enough to correct them, while in the speedier tool the first warning of error is just an almighty smash!

The only special purchase required was a pair of 4½in. by ⅜in. coach bolts; these form the centres, and, for more convenience in work, I fitted them with handles by drilling a hole through a bit of hard wood to fit the shank, and then sinking the square head flush into a mortise. The uprights are but floor-boards, through which the bearers are mortised and pinned outside, and at present the whole contraption relies for stability on being cramped to a joiner's bench. No long-coveted treasure from the tool-shop ever radiated such pleasure to my heart from its shapely, polished form as the rude mahogany back poppet caused when I first felt it tighten down on to the bed when the wedge was driven beneath. But my chief claim to novelty hangs on to the pole. I had no suitable material except a bundle of tiling laths, some half-dozen of which, cut to appropriate lengths and tied with a few bits of string, form a laminated spring. The butt end is secured by a wedge in a mortise, driven through a raking piece clamped to the tail end of the lathe-bed. The pole thus works in the plane of the centres instead of across them. It is too soon to say if working defects balance the structural convenience of the arrangement. As yet the tool-rest beats me, for a bit of plank secured by hand-screws to the back poppet is not an elegant or entirely adequate device, though, in fact, it would be easy to rig a pole lathe entirely with hand-screws and such ordinary contents of a joiner's shop.





Are not the curtain blinds described a few numbers back likewise a survival rather than a novelty? It is reasonable to think them more ancient than roller blinds; certainly they have been familiar to me these many years, whether rigged on rods of wood, iron, or brass, or on wires, and of all manner of materials, from silk to butter muslin. There is much to say for them; most important, perhaps, that they allow of dispensing with the professional blind-man.

There have been recipes for whitewash lately in the "Reply" column. Why do they unanimously prescribe the addition of blue or black to the wash? Surely, this is bad science, and worse art. The best decorators have abandoned the practice long since, while the science of the thing is just this: that one whitewashes the ceiling or the back-yard to get a good reflecting surface. The whiting serves our purpose well; but the size soils it slightly with yellow dirt. Trying to hide this by adding blue dirt only makes matters worse: sundry blue rays are stopped by the yellow size, sundry yellow rays by the blue-black. The net result is that less light is reflected, more absorbed. A remedy might be found in using starch for size; but why seek it? For, by a curious optical influence, explained by Helmholtz in his lecture on "Optics and Painting," the slight yellow tinge (besides harmonising with ther colours) produces a sunshiny effect, which s no small gain in this land, while, with the lueish, skim-milk colour, the reverse is the case.

Kensington, March 12. **W. A. S. B.**

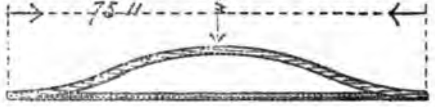
ON VIOLINS.

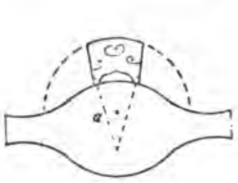
[28549.]—THE violin is, according to my under-anding, the most perfect of stringed musical struments. In its construction the law of oustics has been strictly observed, as far as the ractical handling of it permits. It is, therefore, ot surprising to find that almost all so-called improvements have been brought out in ignorance of that law, or are otherwise unpractical, and the inventor usually, and perhaps reluctantly, comes back to the original form.

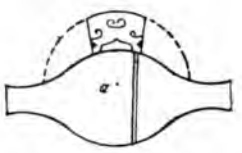
"Oasis's" bridge (letter 28416), however, seems to me really an improvement, although there seems to be some misprint in his description of the ordinary bridge; but I think I understand his principle, and shall try one of that form myself to see its value. I have tried to improve the bridge, but failed.

The idea which led me will be seen in the following. We cannot set a string in vibration without the bridge and the other three strings following suit; but we know that the weight of the bridge, or anything on it, mutes the tone. To avoid this, I constructed a bridge consisting of four parts, and connected them loosely in the middle. By that means each string rested on a part disconnected with the others. But as the feet of the bridges stood all close together, the breast could not vibrate without also setting the three bridges and strings in vibration—hence the result as above.

"Orderic Vital" (letter 28417) mentions a form for the breast which he thinks would give uniform resistance. Uniform resistance of the breast is most essential; but that is the difficulty which the violin-maker finds he can never make sure of. If the material were homogeneous, an architect or mathematician could give us that form. But if we look at Fig. 1 we see that the fibres of the wood are long and stiff in some parts, and short and weak in others, and as the breast cannot well be made unequal in thickness, the difficulty to get such a form is apparent. The breast must be arched, for two reasons. First, a wave can run with more freedom on a surface which is round, than on a straight line, where it has more work to do; and secondly, we gain a larger surface within the same outline. I found the tension of the four strings required 75lb., but that is not all. From the base or level of the breast to the nut or strings there is a ½in. lever which increases the pressure against the end of the breast at least to 85lb. The deflecting pressure of the strings on the bridge required 21½lb. Any form of the breast which does not equally resist that pressure all over its surface must fail, whether that be the "natural" or any other form. An abrupt line or a weak part in the breast takes up the greater force of the vibration, while the stiff or stronger parts remain comparaparatively quiet. "Orderic Vital" thinks the sound-waves may be focussed from the inner part of the breast to that of the back, and by that means get reinforced. This cannot be the case, as is shown in Fig. 2 and 3. In Figs. 2 dotted lines are shown in the direction the waves must meet, if there be no bass-bar or sound-post in the case. But that direction of the waves is prevented by the bass-bar and sound-post and directed to meet the back, at right angles with the short axis, as seen in Fig. 3. Each foot of the bridge stands on a node of the breast, and when the bow is drawn across the string it will turn a small portion round its centre, which is at the point A, and by that means it strikes the breast at right angles, although the bow is drawn parallel with the breast. If the periphery of the bridge were extended, it would strike exactly on the first node on either side of the breast, as shown by the dotted lines. Why the back should make a few vibrations less in a given time than the breast before they are glued to the case is simple enough. We know sound or noise can only be produced when the motion of a body is interrupted. If two bodies slightly connected were oscillating in unison they could not produce any sound or vibration internally. **J. H. Schucht.**







ANONYMOUS WRITING.

[28550.]—I SEE that my remarks on p. 559, with reference to anonymous writings, are characterised as "bosh" on p. 59, and I learn also that some argument I am supposed to have used is "worthless." I have not used any arguments over the matter: I stated a simple fact, which may be "bosh" according to some people's ideas. The fact remains, though, that of the really useful letters published in the ENGLISH MECHANIC 90 per cent. have been over a *nom de plume* or "an arrangement of initials." I can see a great deal further than Mr. Robinson thinks, and having already pointed out one hopeless blunder, I may call his attention to the fact (not argument) that if "Adept" "came as a teacher and no one molested him," it is remarkably singular that on p. 262, No. 323, he should have written:—"I much regret to see the letter signed 'J. D.' . . . as it is, unfortunately, conceived in the captious unfriendly spirit formerly prevailing." I can see far enough to see that the "J. D." referred to was the very individual Mr. R. (p. 59) selected for special commendation. The ethics of anonymous writing have been settled long ago; but certainly no paper in the world can show so much useful (not to say valuable) information, given without any idea of reward, as the ENGLISH MECHANIC, and, as a rule, it has been given over a *nom de plume* or an arrangement of initials. Suppose I sign this "John Smith," will anyone be a bit the wiser, or will it be impertinent for anyone to criticise it then? Why should anyone be termed an "ink-slinger" because he points out the difference between an argument and a fact, or ventures to differ from Mr. Robinson, or Mr. Brown, about the details of organ-building? **Video.**

TWISTED TREES—TO "H. A. G."

[28551.]—I MUST remind "H. A. G." that I quoted Bergeron's statement, and did not speak from personal observation. The fact is, however, curious and interesting; and I will now make a note of the direction of the twist when I find specimens. When weather is a little more pleasant, I will wander about the orchards, of which there is at least one large one in this parish. I shall be curious to hear "H. A. G.'s" theory of the cause of direction. Do our climbers—e.g., kidney beans and convolvulus, twine the same way?

O. J. L.

[28552.]—THE letter from "H. A. G." (28522) raises an interesting question, which I have often asked of skilled timber men in Canada, but have never got answered. I have for three years now spent my autumn holiday in Canada, and from one side of the continent to the other I found various trees twisted like a huge cable—cedars and fir-trees struck me most often as thus twisted in the Rocky Mountains and in British Columbia.

Perhaps some of the timber men who are among the readers of the "E. M." will tell us what are the facts—i.e., what trees and in what locality these twisted trunks are seen most frequently; what proportion of trees are thus twisted; whether right-handed or left-handed in their twist—i.e., like an ordinary screw-bolt, or the reverse, in their twist; whether the timber of such trees is worse or better for the ordinary uses of timber; and what they think to be the cause of the twist?

James Edmunds.

8, Grafton-street, Bond-street.

ORGAN MATTERS.

[28553.]—I HAVE been greatly interested in the controversy that has been going on in the columns of the "E. M." on the subject of the swell-box as an accessory of expression in the church and chamber organ.

I quite agree with Mr. Audsley in the desirability of more expression than has hitherto been usual; but I think some of the opponents of Mr. Audsley's views have shown clearly that the ordinary swell-box must to some extent detract from the genuine and natural speech or tone of the pipes shut up therein. If there is no means of simultaneous exit for the wind that passes into it through the pipes that are played upon while the swell-box is *closed*, the inevitable result must be congestion, for as you cannot put more water into a bottle than it will hold, so you cannot put more wind into a swell-box than it will hold, and the certain result of trying to do so is flatness of pitch and feebleness of speech, because the wind cannot have the full and free course through pipes, which is necessary truly and effectively to assert their quality and character. Some of your correspondents have made very light of the pipes being suffocated in this way, saying the wind, when the swell-box is closed, will escape through "chinks and crevices"

But it is preposterous to suppose that the wind, which enters in *more or less volume*, can find ready vent through "chinks and crevices."

Whilst I maintain that nothing should be suffered to impair the tone and speech of the pipes, I, nevertheless, consider the means of effecting true and legitimate expression of prime importance, and have studied this subject, and devised a plan by which the difficulty may be successfully surmounted. The plan I have conceived, most singular to say, is identical in every respect with that of Mr. Walter G. Clark, as described by him in the "E.M." of the 9th inst. (letter 28494, page 35). It is gratifying to me to find my own idea thus endorsed by one who, I presume, has practical, and it may be extensive, knowledge of the art of organ-building, and I congratulate Mr. Clark on the happy idea he, like myself, has formed of counteracting the proverbial defect of the average swell-box, and hope he may have the pleasure of extensively carrying out the improvement.

It is not with any idea of claiming priority of discovery that I announce my invention in this way, and I may here say I am not a professional organ-builder; but as I have for several years studied organ construction, and am at present devising a specification on which I am going to reconstruct a church organ of small scale as a chamber organ for my own house, and in which my new invention will be availed of, I may perhaps have some warrant to consider myself an amateur when I have completed the task I have taken upon myself to perform.

Isaac Stammers.

8, St. Domingo Grove, Liverpool, March 15.

BURNS.

[28554.]—WITH reference to letter 28526, no one can have a greater abhorrence of all kinds of cruelty than I have. But as I am thoroughly familiar with every sort of treatment to which horses are usually subjected, I can positively declare there is no more pain in what is called "firing" a horse's legs than in the application of ice-cold water to his master's face. I have seen a horse stand during the operation with no kind of restraint on him but his stable halter, and munching away the whole time out of a sieve of chopped carrots, as complacently as if his legs were being bathed with rose-water. A dog may lick his wounds if he has no friendly hand to apply more effective remedies; but in the case of strains in the horse's legs, water-lotions would be attended with very trifling and tedious results. The "firing" leaves a slight disfigurement, and for this reason is seldom resorted to till all other remedies have failed. But it affords a great support to the joints, and the horse, if consulted, would rather prefer it than otherwise. As soon as the animal betrays any uneasiness it is a sure sign it is being improperly done. And in the case of fidgetty horses, the mere holding up of one of their feet, so as to make them stand on three legs, is amply sufficient. As practised on human subjects, it is now never resorted to, except in cases of bites from mad dogs, where it is surely better than risking the consequences.

If "Lydney Dispenser" and every humane reader of the "E. M." would aid me in denouncing the real brutality which is practised upon every racecourse in England, and in every race that takes place, they would find it a thousand times more worthy of indignant remonstrance than all the "firing" that was ever performed. The skin of a well-bred racehorse is almost as thin as that of a woman, but the jockeys are compelled by their money-loving owners and unfeeling trainers to lash and spur these poor animals, who are doing their living best, as if their skins were made of horn. Both whip and spur ought to be banished from the racecourse. What would be fair for one would be fair for all. If anyone has seen a horse's sides after a race he would not say I was exaggerating the cruelty that was inflicted. And yet the high-born women of England call this amusement!

John Hampden.

CURIOUS ALLOYS—(*Continued*).

[28555.]—I SEND the following recipes for the use of amateurs who find amusement in casting small articles:—

Prince Rupert's Metal.—Melt in a crucible 4oz. of copper; when fused add 2oz. of zinc. This is a beautiful and useful alloy.

Pinchbeck.—Melt in a crucible 5oz. of pure copper; when fused add 1oz. of zinc. Pour into moulds. This being like jeweller's gold, is often used for cheap jewellery.

Best Bronze.—Melt 7oz. of pure copper; when fused, add 3oz. of zinc and 2oz. of tin. This alloy gives a fine impression—very exact—from the mould.

Gun-Metal.—Melt nine parts of copper and one part of tin.

Bell-Metal.—Melt six parts of copper and two of *tin. This is the* composition of those sonorous *bells and gongs for which* China has always been famous; but to my taste the Burmese castings have the sweetest tones. I have now one of their small solid triangular gongs, with the charming property, when struck with a kind of muffled drum stick, of giving out clear musical sounds, slowly repeated, till they die away into silence. The fellow gong having been struck by some hard substance, was cracked, and became dumb. I gave it to an Indian artificer, who recast it in the same shape, but it lost its resonant power for ever.

At the ceremonious casting of any new temple bell, the Burmese, old and young, rich and poor, contribute their donations of metal jewellery to the melting pot; gold and silver and the baser metals are all thrown into the priestly collection. Possibly this is the reason of the bells and gongs of that Budhistic nation being so superior in sound. My specimen was very expensive for its small size, and was obtained for me by an Englishman who had lived fifteen years in the country. Though bells of all sizes are used by the Indian Brahmins, their tone is loud and coarse. **Eos.**

[28556.]—WE must all feel grateful to our well-read friend "Eos" for placing before us knowledge which, although made patent to the scientific world some 70 years ago, has been allowed to moulder until almost forgotten. With great pleasure did I come across his quotations from Colin M'Kenzie's "One Thousand Processes in Manufactures," which first appeared in 1821. It is, indeed, surprising that greater use has not been made of the silver steel, and aluminium steel, as this latter more especially could now be made so much more exactly since the facilitation in the production of aluminium. The peculiar violet alloy resulting from combination of antimony with copper should, I think, find favour with such metal workers as seek to produce an effect by the variety in the colour of different portions of their work. The French are adepts in giving a pleasing variety to the fixed and movable portions of the microscope stand in this or a similar manner. May I ask "Eos" whether he has any practical acquaintance with the alloy of platinum with gold, described at p. 7, § XXII. of Mackenzie's work, and which is said to be "soluble in nitric acid," which does not act on either of the metals in a separate state? **S. Bottone.**

Liquid Fuel Competition in Russia.—The decision of the Russian Minister of Marine this week to fit a flotilla of topedo boats with liquid fuel furnaces gives interest to a competition now in progress at the Petroleum Exhibition at St. Petersburg to ascertain the best type of pulveriser displayed. Unfortunately, the liquid fuel section is very incomplete, both from an international and national point of view. No American or English inventors have taken the trouble to send models of their apparatus, while many Russian railways and firms are altogether unrepresented. For instance, the Griazi-Tzaritzin Railway, of which Mr. Urquhart is locomotive superintendent, and on which, as our readers are aware, liquid fuel has been applied to every engine, has sent no models at all, Mr. Urquhart's own pulveriser being displayed by another line, the Trans-Caucasian Railway, which has sent half a dozen excellent models of the different systems adopted for its locomotives. There is some talk of giving a gold medal for the best invention exhibited, but although the trials may be fair enough—the name of M. Gulishambaroff, as president of the jury, is a sufficient guarantee for that—still, it is quite clear from what we have said that the result cannot be very satisfactory. In Russia, the United States, and Great Britain, to speak of no other country, there must be at the present moment at least 150 different systems for burning liquid fuel before the public, if not more. A competition that deals with only 20 or 30 may be very interesting, and very just, as far as it goes; but the result will by no means have the value that would have been the case if the majority, instead of only a few, of the liquid fuel appliances had been tested.—*Engineering.*

Wild Silks.—According to Dr. Otto Witt, in *Dingler's Pol. Journal*, another link is added to the chain of progress in wild silks, as an excellent fibre has recently been successfully obtained from the cocoons of *Gricula trifenestrata* by carding and combing. This silk spinner (*Gricula trifenestrata*) lives in countless numbers in some parts of India, and especially in the most tropical parts. Its caterpillar, found there in such large numbers, is considered one of the greatest annoyances in the Mango plantations, while the cocoons also, numerously spun in frames of the shape and size of a cucumber, hang on the trees, and can easily be collected. As the living being is able to survive two generations in one year, it must be considered as extraordinarily productive, and the now successful preparation of its fibre is an important factor, and it therefore forms a new and remarkable source of raw material for the silk industry.

REPLIES TO QUERIES.

◆

*** *In their answers, Correspondents are respec fully requested to mention, in each instance, the tit and number of the query asked.*

[64071.]—**Limestone.**—In answer to "Pri cipia's" further query, I would state that t figures showing the composition of the limesto in question, not being the result of my ow analysis, I cannot state positively as to the ac used, but doubtless HCl. I would also state th having looked for indications of the limestone a geological map, I see it is to be found near Bea minster (Dorset), as well as Taunton and Bath. T organic matter to which it owes its colour is d stroyed when heated.—W. H. S. S.

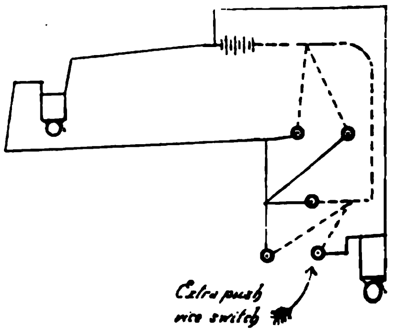
[64259.]—**Printing on Wood (U.Q.)**—F printing on wood, a machine more substantial build than an ordinary press is used, the boar are passed through, and receive a bold, clear i pression of any design wished for. They can obtained in London.—W. H. PALMER.

[64359.] — **Wheatmeal Bread.** — I ask "Hygienist" on what scientific facts he based h "astounding assertion" on p. 561. He replies in effect repeating his assertion in other words probably thinking that one assertion supports t other. Allow me to ask him, now, how he kno that white bread is a "delusive food, and not a re staff of life"? If he is not the possessor of yo back volumes, he can surely manage to see an el mentary textbook of chemistry.—AN ELEMEN ARY CHEMIST.

[64424.]—**Telescope.**—Referring to sketch page 36, will "Solar Radiance" be good enough explain the law under which a perpendicular r of light falling upon a perfectly plane surface glass is refracted in one direction, while anoth perpendicular ray falling upon the same pla surface is refracted in the opposite direction?—i each case, be it observed, before contact with t curved surface of the lens. I somehow fanc "F.R.A.S." will fail to be convinced of his error (—H. H.

[64440.]—**Coppering Iron.**—The querist shou refer to back numbers, or one of the manual Gore gives Kopp's process of simple immersion a bath composed of 10 parts of nitric acid, 10 chloride of copper, and 80 of hydrochloric acid The articles are immersed several times, an rubbed with a woollen cloth after each immersio A thin film can be put on by placing the thorough cleaned articles in a dilute solution of the sulphat made acid by the addition of sulphuric acid. I would be useless to give plating solutions unle one knew the plant at the querist's disposal.—NUN. DOR.

[64461.]—**Altering Bell Circuit.**—If aft turning the switch you press any one of the pushe H. B. will ring. There is no need for a switch, you will see by inclosed sketch. As regards the



use of uninsulated wires (or earth wires as w technically call them), you have left the very wir uncovered which most need insulation; E co nections should only be used between either (both) poles of the battery up to the first points the circuit, be they bells, or push, &c. See dott lines in sketch.—W. PERREN-MAYCOCK.

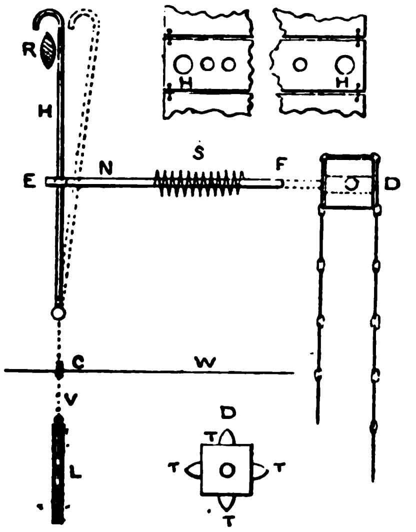
[64463.]—**Frets.**—The proportions of stri lengths are given in the textbooks, or can be fou in 1022, p. 185; while, in No. 1023, Mr. Dav said the simplest way to get the position for t frets is to place pieces of stout wire until the finger correctly. The places can then be mark saw-kerfed, and pieces of ivory let in.—E. G.

[64469.]—**Blowing Hollow Glass Spheres.**—Are these really blown true without a stem. T stem can be broken out, leaving a hole, or might melted down. However, let the querist get Sh stone's little manual of "Glass-Blowing," Rivi tons, and he will have a practical treatise. J. M. T.

64485.]—**Antifriction Metal for Bearings.** These are usually white brasses, Babbitt metal, d bronzes, according to the purpose. There are nty given in the books and in back volumes. A d alloy for heavy bearings running at high ed is made of copper 56, zinc 28, tin 16. That l give an idea. A white metal is made of pper 9, tin 78, antimony 18; and if wanted to t into journal boxes, of lead 32, zinc 18, anti- ny 60. The best of all "antifriction" arrange- nts is to have the journal and box so arranged t there is always a film of oil between the sur- es.—NUN. DOR.

64487.]—**Jacquard Machines.**—I don't know ere "Weaver" can find diagrams of the original ucanson and Jacquard machines, but probably Barlow's "History and Principles of Weaving," vork he is almost sure to find in any public rary in the weaving districts.—NUN. DOR.

64487.]—**Jacquard Machines.**—I was expect- ; some professional reader to reply to this query; t this not being, so far, forthcoming, I will com- micate what I know of the subject. It so ppens that, not finding any description of this trivance, some time since I took some pains to d out how this machine worked, and the little I s able to glean from various sources may be ficient for "Weaver." I am not acquainted h loom construction, and my object in looking o the matter was in connection with Wheat- ne's automatic system of telegraphy, in which erforated band of paper is used to govern the ctrical contacts for the transmission of messages, it is upon the beautiful contrivances of Jacquard t the mechanical portion of this system is nded. As all the warp threads are similarly ed upon, an explanation of the action of a single will be sufficient. The diagram, which is nply a skeleton and explanatory one, represents de view of the controlling portion of the quard loom. The warp thread, W, passes rough a collet C in the vertical thread V, the lower d of which has a weight L attached, the upper end ing hung to the hook H, situated at the top of loom. This hook passes loosely through the e E of the needle N, capable of sliding in the rection of its axis. This needle is provided with spiral spring, S, surrounding it, which in its rmal position holds the hook back, as shown by e dotted line. A rod or rail R, capable of oving vertically up and down, extends trans- rsely across the loom, close to and in a position catch any hook when the latter is pushed wards it. The cards, which are strung together osely, forming an endless chain, are hung upon e drum D, having four or more sides. This drum placed transversely opposite to the free ends F the needles N, and besides being able to revolve its pivots is capable of a horizontal motion m or towards the ends of the needles. At the ds of each of the sides of the drum D are teeth projections T, which engage in special holes H in each card to maintain the cards in position, d assist in carrying them forward as the drum ates. When the loom is at work the operation governing the raising of the warp thread is follows:—The rail R is first raised, l before it reaches the hooks, the drum is advanced horizontally towards the ends of the needles, pressing the card which pposite to these ends against them. Where no foration is opposite the needle, the latter is hed forward, and with it the hook H, which, ching the rail R, is raised, and with it the warp ad W. The shuttle is now thrown by the hine, the rail R descends, and the hook is pulled back again into the position of the dotted lines. Where there is a perforation opposite the needle end, the latter passes through it without being moved, for there is a hole in the drum opposite each needle, and the warp thread corresponding to it is not raised. During the descending or return stroke the drum D moves away from the needles, and at the same time, by means of a ratchet-like contrivance, turns through a quarter of a revolution on its axis so as to bring a fresh card opposite the needles for the next operation. While the drum is advancing towards the needles, and pressing the card against them, it is held in position and prevented from rotating by a special contrivance equivalent to the jumper in clockwork. Only one rail and one row of holes are shown in the diagram for the sake of simplicity; but there are usually more, and in looms where the pattern is complicated the needles are packed as closely as possible in nests, which, with the rows of hooks, the vertical threads, and warp, present, to the eye of anyone uninitiated, a hopeless mass of complication. It should be mentioned that there is a pretty little working model of the old Jacquard loom belonging to the Society of Arts exhibited in the Science Department of the South Kensington Museum; but, as is the case with most models which are not in motion, it would not be easy to see as much of the governing operation as has been here explained. All the various motions of the machine are automatic, the primary movement being rotary and continuous. More particulars would occupy by far too much space. I am unacquainted with the machine of Vaucanson.—A. MARSON.



[64533.]—**Two-Tint Writing.**—I saw this mentioned in some previous number of the MECHANIC, and wrote to J. W. Stoakes, Melan, O., America, inclosing, I think it was, 4s. 2d., and never heard anything from him. I am now writing again to the same address, omitting the amount for the pens. Does J. Drowley know of any other pens suitable for shading and marking.—J. A. LOCKWOOD.

[64541.]—**Long-Focus Rapid Lens.**—In the fourth line of my reply the word *not* appears instead of *on*. The sentence should read: "The depth of focus of a lens depends on the focus of the lens and on its rapidity or aperture; not in any other way on the maker of it."—T.

[64547.]—**Problem.**—As this query has received no reply as yet, I will give a few suggestions, for correction if erroneous. Let a, b, c, d, e, f, g, &c., represent soldiers standing in a line, and let their number $= n$, $n = 12$ in the question. The condition, as I understand it, is that in no rearrangement is a to be followed by b, b by c, c by d, d by e. I therefore propose to get the number of these forbidden arrangements, and subtract them from the total number of permutations of n things taken n at a time. All the permutations containing a followed by $b = n - 1$ things taken $n - 1$ at a time $= 1 . 2 . 3 . 4 \ldots\ldots (n-1) =$ factorial $n - 1 = \underline{|n-1}$ according to Todhunter's notation. All the permutations containing b followed by $c = \underline{|n-1}$; from this we must subtract the permutations containing a followed by $b = \underline{|n-2}$; hence we get $\underline{|n-1} - \underline{|n-2}$ new permutations. Now take all the permutations in which c is followed by $d = \underline{|n-1}$, subtract those in which a is followed by b and b is followed by c, together $= 2\,\underline{|n-2}$, and add the common arrangements in which a, b, c, d all follow in regular order $= \underline{|n-3}$. Proceeding like this, and tabulating results, we get—

$$\underline{|n-1}$$

$$\underline{|n-1} - \underline{|n-2}$$

$$\underline{|n-1} - 2\,\underline{|n-2} + \underline{|n-3}$$

$$\underline{|n-1} - 3\,\underline{|n-2} + 3\,\underline{|n-3} - \underline{|n-4}, \text{ \&c.}$$

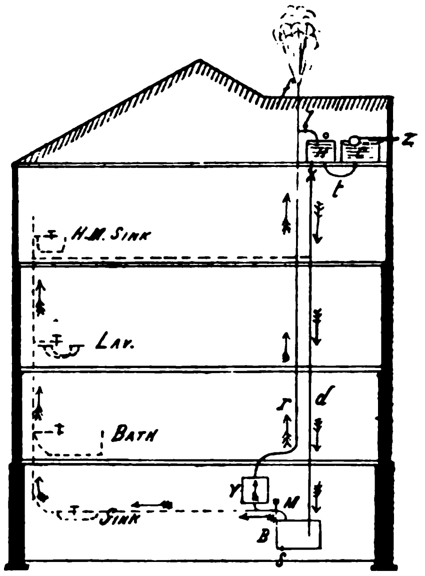
The sum of the coefficients in the 1st vertical column $= 1 + 1 + 1 + 1 +$ &c.; in 2nd $= 1 + 2 + 3 +$ &c.; in 3rd $= 1 + 3 + 6 +$ &c.; in 4th $= 1 + 4 + 10 +$ &c. But these are the series of figurate numbers, and 1st column contains $n - 1$ terms, the 2nd $n - 2$ terms, the 3rd $n - 3$ terms, the 4th $n - 4$ terms. Sum of $n - 1$ terms of series $1 + 1 + 1 +$ &c. $= n - 1$. Sum of $n - 2$ terms of series $1 + 2 + 3 +$ &c. $= \frac{(n-1)(n-2)}{2}$ Sum of $n - 3$ terms of $1 + 3 + 6 +$ &c. $= \frac{1}{6}(n-1)(n-2)$ (n [illegible] 3). Sum of $n - 4$ terms of $1 + 4 + 10 +$ &c. $= \frac{1}{24}(n-1)(n-2)(n-3)(n-4)$. Therefore, subtracting all from $\underline{|n}$, we get $\underline{|n} - (n-1) . \underline{|n-1} + \frac{1}{2}(n-1)(n-2) . \underline{|n-2} - \frac{1}{6}(n-1)(n-2)(n-3) . \underline{|n-3} + \frac{1}{24}(n-1)(n-2)(n-3)(n-4) . \underline{|n-4} -$ &c. $n = 12$ $\underline{|n} = 479{,}001{,}600$, and the whole series, if calculated correctly, $= 190{,}902{,}411 =$ ans. required. —J. C.

[64626.]—**Model Loco. Boiler.**—I have lately made a boiler which closely adheres to the ordinary form of loco. boiler. It is made of thin sheet copper; barrel, with outer firebox, is 8⅝in. long 2 3/16in. wide, 3⅝in. deep, stayed to outer shell, with water space all round; outer firebox is prolonged downwards for 1in. below water space by means of a piece of metal attached to it. One firetube, 1¾in. diam., passes to smoke-box; fire-door, ½in. by 1in; funnel, ¾in. diam.; boiler is well brazed, and carries a dome; 14 spirit wicks burn inside the firebox, about ¾in. up from the bottom. In order to get a thorough draught, I found it necessary to leave internal firebox open at the bottom, and a clear space of ⅜in. on both sides of spirit tank between it and sides of internal firebox for admission of air, and also to carry the blast pipes in smoke-box only up so far that their orifices open ½in. above lowest part of firetube. By these means a splendid draught is obtained and steam kept up in abundance, making the engine travel fast, even with a load. A boiler built on this principle will give entire satisfaction. I may add, the engine is a four-coupled bogie loco. with tender; length, 2ft.; driving-wheels, 2¾in., coupled; cylinders, ⅜in. by 1in. outside, slide-valve, and fitted with link-motion; gauge of line, 2⅞in.—AMATEUR.

[64627.]—**How to Make Caustic Potash.**—Caustic potash may be prepared by boiling a dilute solution of potassium carbonate with slaked lime—one part of the carbonate dissolved in twelve of water is heated, and two parts of lime slaked in nine of water being added. The liquid should be boiled after each addition of lime. The solution is then boiled for a short time, allowed to stand; the clear liquid then drawn off is caustic potash, which may be solidified by allowing it to boil for a short time till the hydrate begins to evaporate, and then allowing to cool.—T. O. D.

[64637.]—**Test for Mystery Gold.**—In answer to "Gimel," I send the following test for mystery gold. It consists of perchloride of mercury, one drachm, dissolved in pure hydrochloric acid, 8oz. Scratch the suspected coin, and apply a drop to the surface; if spurious, metallic mercury will be deposited on the coin.—N. G. BECK, Burgess Hill.

[64642.]—**Hot-Water Fittings.**—"A New Subscriber" will be very unwise if he does not employ a competent plumber, and hold him responsible. It is best to place the circulative cistern H alongside the cold cistern C, and connect the two cisterns with a trapped pipe, *t*, as per sketch. The rising pipe *r* discharges into H by the short branch *l*, and terminates on reaching the top of the boiler B. The return pipe *d*, connected at its top end to H, passes through the top of the boiler and continues down inside the boiler, and terminates within an inch or so of the bottom of boiler. The joints of the pipes, where they pass through the boiler top, should be fitted with proper union screws. Sometimes the return pipe is connected to the boiler not at the top but at the side near the bottom of the boiler. But the former plan is preferable, as giving better access to the joints, and for other practical reasons. The boiler should be a welded-iron boiler—i.e., all in one piece, without any riveted joint. The angles of the boiler round which the flame plays should be well *rounded*, or they will soon burn through The boiler should be so set as to present the largest possible surface to the flame; and it is particularly necessary that the bottom of the boiler should be well fired, because the bottom surface heats the water much more effectively than the vertical surfaces do. The plumber, as a rule, does not himself know much about the brickwork setting of boilers; but he



will be able to recommend to "New Subscriber" some bricklayer specially proficient in this important branch of the work. See that this bricklayer uses fireclay instead of mortar, and firebrick instead of common brick, then your boiler flues will not want rebuilding six months after completion. A "Peet's safety valve," M, weighted to the column of water, should be attached to the rising-pipe at some convenient warm corner, as near the boiler as possible. When the circulative pipes get choked from frost or from any obstruction whatever, the lighting of the boiler fire necessitates expansion of water, and thus, when there is no safety-valve, the boiler itself and the pipes near it are liable to burst. As a special further precaution against frost, the lead circulating pipes should be flattened to an oval section. This is a sure guarantee against the pipes themselves bursting with frost; but it does not prevent their freezing, nor does it dispense with the need of a safety-valve to save the boiler from collapsing. The plumber will object to flatten the pipes because it is unusual to do so. It is only recently that the wisdom of this expedient has been fully discussed and demonstrated. It is a new wrinkle, and a good one. The arrows on the sketch show the direction of the circulating current. If the boiler is powerful enough, there will be but little difference between the temperatures of the rising and return pipes; but the rising pipe is the warmer, and on that account it is usual to take the branches to the sinks, baths, and taps direct from the rising pipe. If the baths, sinks, and taps are near to the rising pipe, hot water will be got as soon as the taps are turned on. But if the baths, sinks, and taps are a considerable distance from the rising pipe, the long branch-pipes are liable to contain tepid water, which has to issue, on turning on the tap, before the hot water comes. To avoid this defect, the branch pipes can be made to communicate with each other, so as to carry on a secondary circulation of their own. In this case, the lower end of the branch pipe system should connect with the rising pipe, and the upper end with the return pipe. I have represented this arrangement of circulating branches by dotted lines on sketch, merely to give a general idea of what I mean by a secondary circulation. Hot-water cylinders generally in the proximity of the kitchen, are usefully employed, especially in cases where the circulation is not rapid. These cylinders may be regarded as an enlarged section of the rising pipe, for that is what they virtually are. They give a greater store of very hot water for the use of the kitchen. Where cylinders are thus employed (see Y on sketch), the circulating cistern, H, may be of smaller size than when there is no cylinder. Or, if the cylinder be large, H may be dispensed with. But in a 4-story house the pressure will be about 16lb. on the inch at kitchen ceiling level, and a cylinder to stand that pressure comfortably for domestic use would not have to be one of a very large capacity; hence to have a sufficient store of hot water, the addition of the H cistern is necessary. The blowpipe *f* (a continuation of the rising pipe), is necessary in any case, and should be carried clean out through the roof. Doubtless "A New Subscriber" understands that the cold cistern only supplies water in place of that drawn off at the taps, and in place of the very small quantity evaporated at the blowpipe, the ball-cock of cold cistern regulating the supply, and the overflow pipe *z* showing if all is right. The H cistern must be fitted with a steam-tight cover, *o*. The boiler should have a sludge-cock, *s*, and there should be a stop-valve, *x*, on the top end of return pipe, so that all the pipes and boiler may be emptied without emptying the cisterns. These are merely hints, which I hope will help "A New Subscriber" to realise the necessity for the employment of a first-rate responsible plumber.—FRANK CAWS, Sunderland.

[64652.]—**Musical Watch.**—Since this query appeared in "Ours" we have had a watch in our shop to repair something the same as "G. E. H.'s." Perhaps this may be of interest to him. It is an English lever, repeater, and musical part, which plays once every hour (or it can be made silent). It is in silver cases, with silver dial pierced in centre, showing movement. As to age, I cannot be certain, as the cases look modern, bearing hall-marking letter for 1846-47; but the owner says it is supposed to have been in their family for a great number of years.—J. SKINNER.

[64662.]—**Collotype or Heliotype.**—The following is from the *Amateur Photographer* of March 9, 1888:—"A mechanical printing process, founded upon the action of a bichromated gelatine film:—A bichromated gelatine film is exposed under a negative, and then soaked in cold water, and it is found that the gelatine absorbs water proportionately as it has been shielded from light. The film is attached to a glass plate, and the back of it exposed through the plate to the sun, which renders it tough and insoluble. We have thus an insoluble film of gelatine raised into relief upon a *bed of tough gelatine*. This film is then inked by *means of rollers with two greasy inks of different* degrees, one hard and the other soft, and these inks only adhere to those portions of the gelatine acted upon by light, and which have not absorbed water. From these inked film prints are taken in the usual way with a press. The best manuals on the subject are Burton's "Photo-Mechanical Printing" and Wilkinson's "Printing Processes." The Society of Arts also publish a pamphlet at about 2s. on this subject.—SORREL.

[64666.]—**Joining Thick Wood.**—Among the suggestions offered to "Amateur," I do not see the following. I am curious to know if it is often or at all practised in England. It was certainly new to me when I learned it from a clever native carpenter in the Punjaub, and I do not find that it is known to carpenters in this neighbourhood. The two edges to be joined having been shot true, into one of them screw a number of screws to the depth of their thread, leaving the remainder projecting. Now in the other edge cut the same number of slots about 1in. or 1½in. long, a very little deeper than the projecting part of the screws, and only just wide enough to take the stem of the screw. In marking the position of these slots—say the left-hand one *p* in Fig. 2—make the distance *a a* equal to the distance *b b* between the end of the board and the nearest part of the corresponding screw. This fixes one end of the slot, and from the points so fixed all the slots are to be cut in the same direction, i.e., away from the end of the board from which the measurements have been taken, and of the same length. Now open out the other ends of the slots to a diameter large enough to admit the heads of the screws. The boards are now ready to be joined. Nearly fill the slots with glue, and give the edges a coat of the same; let down the screwheads into the holes till the edges meet, and with a few blows of a mallet on the end of the upper board drive it home. The edges slide together (Fig. 3), the stems of the screws pass along the slots, while their sharp heads cut into the substance of the wood. Moreover, the under surface of the heads being inclined, they act as so many wedges and effectually clamp the two joined edges together, so that no further clamping is necessary. In my sketch I have shown all the screws in the centre line of the board. In dealing with a 2in. thickness it would probably be better to fix them alternately ¼in. on one side and the other of the centre line. It is just as well to show by pencil marks on the underside how the slots lie, in case it may be desired to take the job to pieces again. For strength and neatness, I know of no joint to equal this.—H. A. G., Kingstown.

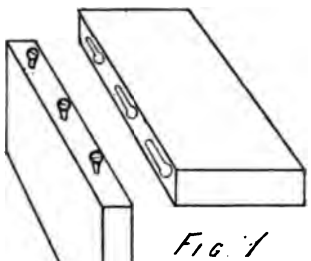


FIG. 1

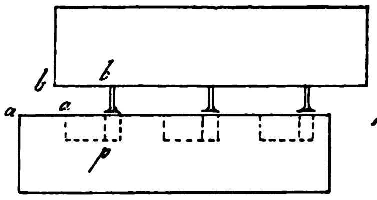


FIG. 2

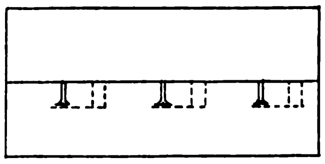


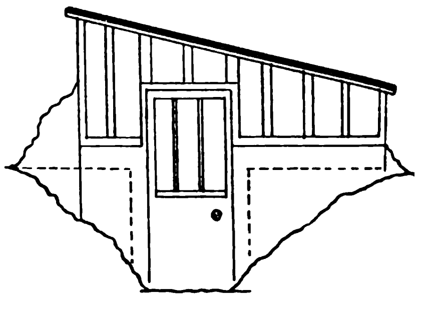
FIG. 3

[64674.]—**Hardening Leather.**—Saturate your leather with a solution of chloride of barium, then dip in water made sour with vitriol: a hard insoluble compound is thereby formed in the fibres of the leather. Glauber salts, Epsom salts, and several other salts are often used for the same purpose. Glucose or grape-sugar is used very ext sively. The real object of using these fore materials is to obtain an increase of weight, wh may, by skilful management, be increased 20 to per cent. I would give warning that by follow the practice above mentioned the quality of leat is most seriously injured. In a dry and wa atmosphere it becomes brittle, and if doub almost sure to crack.—W. BOUCHEIR.

[64677.]—**Cleaning Scale from Casting** Immersing for some minutes in dilute sulph acid (exact strength immaterial; about 1 to 10 does well), followed by scrubbing with wa and a hard brush, will remove almost all the h scale, and save the edges of turning tools wond fully. The same is applicable to forged wrou iron or steel.—URSA MINOR.

[64679.]—**Knife-Boards.**—If "T. C." "Eos" will get ½lb. of flour of emery (cost 1 and last 12 months), and a two-gallon bottle co then take a little of the emery moistened in wa (not too thin) on the end of the cork, laying kn on something level and firm, give a few sh strokes the long way of knife, and the stains quickly disappear; then with a piece of soft cott rag, quite dry, rub the wet emery off, and yo knife is done. Mind and polish off as soon as have rubbed with emery, or they will stain i very short time. If you do this you will hav polish on your knives that you cannot get wi Bath brick. My knife-board has been put aw a long time as useless.—SHEFFIELD.

[64681.]—**Pit for Tender Plants.**— "Vegetus" has any room at his disposal, the f lowing will suit him admirably—viz., Mr. Sme "Poor Man's House." As will be seen from t accompanying sketch, it is nothing but a good-siz frame put in the ground and banked up with eart all round, except at one end, where it is continue downwards, and a door put in. To construct thi all that is requisite is to level the ground. Cut trench about a yard deep, and the same in width and nearly as long as the frame (leaving at lea 9in. clear between the end of the frame and th edge of the trench). At the end where the door i to be, dig a pit, so as to have free approach to th frame. Then put the frame on the now levelle ground, and over the pit; heap the earth we round the three closed sides. Continue the re maining end of the frame as in my sketch (glass a the side and door is optional, although I have p it), and the whole thing will be complete. M Smee (the author of "My Garden") speaks ver highly of it, and adds in conclusion, "From th earthen walls the air is always kept in a hygr metrical condition, and as a result of the whol arrangement, healthy vegetation is secured wit the least possible amount of artificial heat."—S.S



[64684.]—**Ventilator.**—"A. J. P." will find very good pattern for cowl or ship ventilator Warn's "Sheet Metal Workers' Instructor," plate 18 and 19. Author's address is 94, St. Augustine road, Camden-square.—NO SIG.

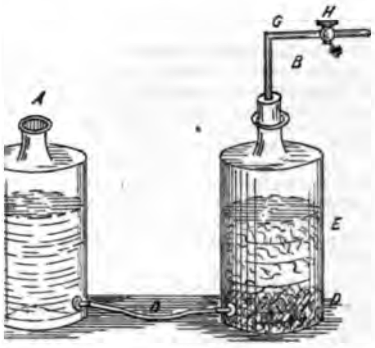
[64698.]—**Heat.**—From experiments made mines on the increase of temperature with th depth, the average rate of increase may be tak as 1° Fahr. for every 60ft. after passing the zo of variable temperature (being 90ft). As to th condition of the earth's interior, it still remains question whether the central portions are solid fluid, a great many arguments in favour of bo conditions having been adduced.—T. O. D.

[64699.]—**Soap-Bubbles.**—Dissolve one pa Castile soap in forty parts of distilled water a filter; agitate one part of the solution with tw parts of glycerine, and let stand for some day draw off by siphon the clear liquid at the bottom. JOHN T. LAWRENCE, M.A.

[64701.]—**Chiretta.**—"J. B." will find th following formula for concentrated infusion chiretta just what he wants. One fluid drach equals one fluid ounce of the British Pharmacop strength. Take of chiretta, cut small, 2oz.; wat at 120° Fahr., 10oz.; rectified spirit or glycerin 1oz. Infuse chiretta in the water for two hou strain off 9oz., and add lastly the spirit or glycerin

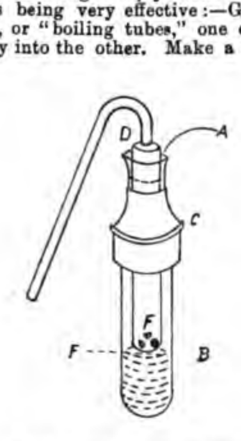
One to two teaspoonfuls in a wineglass of
ater.—N. G. BECK, Burgess Hill.

04.]—**Sulphuretted Hydrogen.**—One of
st forms of sulphuretted hydrogen apparatus
following:—In the figure, A and B are two
ottles connected together by an indiarubber
). In the bottle B is placed a layer of broken
r coke, D, which is not acted on by H_2SO_4.
this is placed the ferrous sulphide, E, in
nts. The neck of this bottle is closed with
through which passes a glass tube, G, bent
ight angle, and containing a stopcock, H.
orks having been found to be tight, A is
vith sulphuric acid, F. On opening the stop-
I, the sulphuric enters the bottle B until the
n both bottles is the same. On reaching the



s sulphide the reaction commences, and
en sulphide is disengaged. If the stopcock
closed, the continued evolution of the gas
ive the liquid back into the bottle A until
sengagement of the gas ceases, which will
ace as soon as the sulphuric acid no longer
s the ferrous sulphide. The bottle B now
as a reservoir of hydrogen sulphide, under a
e greater than that of the atmosphere,
can be increased at will by elevating the
A. In order to obtain a current of the gas,
fficient to open the stopcock, and the flow
regulated at will.—J. H. KIRK.

)7.]—**Sulphuretted Hydrogen.**—I have
he following simply-made apparatus de-
as being very effective:—Get two large
bes, or "boiling tubes," one of which will
asily into the other. Make a small hole in



tom of the smaller, put a lump or two of
tallic sulphide inside, and fit the mouth
indiarubber or paraffined cork and leading
Procure about 2in. of soft black rubber
not too thick, just fitting the smaller tube
and slip ½in. or so on.—URSA MINOR.

5.]—**American Organ.**—In starting to
two-manual American organ, a clear idea
general arrangement should first be ob-
and working drawings got out. I do not
'ull-sized drawings, but scaled out to some
ion which will enable the designer to get
ts together so that they can be got at. One
of working a two-manual was illustrated
on page 372, but I think the querist would
to compare it with that shown on p. 219,
. I do not personally like a two-manual in
he "swell-organ" is placed below the keys;
s purely a matter of taste. As pedals are
ed, the tubeboards should be of C scale;
ther of three rows or two, must be left to
l taste. There is this to be said: that
u have three rows, you might as well have
The division of the rows may be at C, but
scale boards it is usual to divide at F. The
ust be voiced by someone who has had
ce, though the querist may purchase a few
eds and experiment himself. For com-
s of stops and the tone of sets it is not
advise, but there should be at least one
h straight reeds to give the real strident tone due to the "brassy abomination." Perhaps Spanswick's book, published by Metzler, will give an idea, and Dr. Stainer's tutor (same publishers) will show how to combine the stops for a two-manual with pedals.—ORGANON.

[64720.] — **Podura.** — Your correspondent, "J. C.," has evidently got hold of *Lepisma saccharina*, whose scales are not much of a test for modern microscopes. The podura, or springtail, correctly figured on p. 497, last volume, may often be found on barrels and other places in cellars, also on woodwork in shady places out of doors, where, I believe, the late Mr. R. Beck found his noted specimens. They can take a good spring, and are not easily caught. Have found a test-tube and dash of chloroform the most effectual.—E. G. M.

[64730.]—**Photometry.**—The relative intensities of your two lamps may be found by the following method:—Place the lamps in a darkened room before a screen, and between the lamps and screen place a vertical rod or stick; adjust the lights until the shadows of the stick are illuminated to an equal degree. The intensities being in direct proportion to the squares of these distances, by squaring the distance of each lamp from the screen you will find which is the more powerful of the two.—T. O. D.

[64735.]—**Lightning.**—Mr. Percy Fitzgerald, in a lecture on "Stage Appliances," delivered before the Society of Arts a year ago, said: "For lightning a long tin tube with a spirit lamp is used; a powder is then blown through which takes fire as it passes through the spirit lamp, and gives out a vivid flash. A more effective mode is to cut out of the scene zigzag strips, in imitation of forked lightning; these are covered with varnished calico, and painted, and a light flashed behind." The powder is, I believe, lycopodium, or club-moss dust.—W. B. LEIGH.

[64740.]—**Birds' Eggs.**—I think you will find cotton-wool as good a material as any. Large eggs look well on moss.—T. O. D.

[64740.]—**Birds' Eggs.**—"L. E. O." will find cotton-wool very good for keeping birds' eggs in, and sawdust is very good. Don't use bran; it harbours grubs.—H. T.

[64741.]—**Spongy Platinum.**—Abestos dipped in solution of platinic chloride and then ignited, process repeated until deposit is sufficiently dense. If dry, a jet of hydrogen impinging on this is caused to ignite.—SM.

[64741.]—**Spongy Platinum** may be obtained by passing sulphur dioxide through water containing platinous chloride in suspension, the latter being prepared by heating the tetrachloride to about 300° C. Platinum black, which will ignite a jet of hydrogen, is most easily prepared, being obtained by igniting the double chloride of platinum and ammonium, formed by mixing solutions of chloride of ammonia and platinum tetrachloride.—R. H. ANDERSON.

[64741.]—**Spongy Platinum.**—Platinum ore is treated with aqua regia, after having been mechanically cleaned from any earthy matter it might contain. The aqua regia dissolves the platinum and a little iridium. The solution thus prepared is decanted from the residue, evaporated almost to dryness, and precipitated by the addition of a concentrated solution of ammonic chloride. The precipitate (which is double chloride of ammonium and platinum) must be washed with dilute alcohol, and then calcined. What is left is spongy platinum. It is only necessary to pass a stream of hydrogen or coal-gas over spongy platinum, in the presence of air or oxygen, to decide its combustion, as spongy platinum has the power of condensing oxygen in its pores to an enormous extent.—S. BOTTONE.

[64742.]—**Nitrous Oxide.**—Nitrous oxide is not corrosive, and its odour is very slight but pleasant. It does no harm if allowed to escape into the air. It is soluble in cold water, and more soluble in alcohol.—SM.

[64742.]—**Nitrous Oxide.**—Are you sure that you mean nitrous oxide (N_2O)? That gas does not fume in the air, and has no disagreeable smell. If you refer to nitric oxide (NO), you may pass it through a cold solution of ferrous sulphate ($FeSO_4$), which will dissolve it.—J. T. GEOGHEGAN.

[64742.]—**Nitrous Oxide** (?)—Is there not some mistake about this query? Nitrous oxide is obtained from ammonium nitrate by heating it in a retort; nitric oxide is formed by the action of nitric acid on a metal such as silver or copper. The former has a slightly sweetish taste and smell, while the latter, when mixed with oxygen or air, has a very disagreeable smell. If the latter gas is meant, then the best way to do what is required is to generate the gas in a flask with copper and nitric acid, pass it through the "wide tube," to the end of which is fitted a cork and bent tube, so that any of the gas that is not absorbed shall pass through a solution of ferrous sulphate, where it will be completely absorbed; or else let the bent tube go into a chimney, and so pass away into the air.—PRINCIPIA.

[64744.]—**Zinc.**—Chemically pure zinc may be obtained from commercial zinc by dissolving it in excess of sulphuric acid, treat with sulphuretted hydrogen, filter, add sodium carbonate, wash and ignite the precipitate, mix the residue with charcoal obtained from sugar; on distilling pure zinc is obtained. A porcelain retort should be used for the distillation.—T. O. D.

[64744.]—**Pure Zinc.**—Commercial zinc contains a small quantity of lead, iron, and sometimes traces of copper and arsenic. The best method for obtaining zinc in a state of purity consists in passing sulphuretted hydrogen through a slightly acid solution of zinc sulphate, filtering from any precipitate which may be formed; and, after boiling the solution in order to expel the sulphuretted hydrogen, precipitating the zinc by a solution of sodium carbonate. The precipitate, when ignited, is converted into zinc oxide, which must be distilled in a porcelain retort with pure charcoal, such as that prepared from loaf sugar. You will get it at Becker's, Maiden-lane, or Townson and Mercer's. The cost is about 6s. per lb.—PRINCIPIA.

[64746.]—**Spirit Varnish for Glue.**—Dissolve shellac in wood naphtha or good methylated spirits and you will obtain as good a "liquid glue" as it is possible to make by these means.—S. BOTTONE.

[64746.]—**Spirit Varnish for Glue.**—I use the common shellac cement, and find it very suitable. There is no recipe required. Dissolve shellac in methylated spirit to the thickness of ordinary glue.—B.SC., Plymouth.

[64747.]—**Cement.**—A little superfine plaster of Paris mixed with weak alum water.—DENS.

[64747.]—**Cement.**—Make a mixture of plaster of Paris or chalk with an isinglass cement, such as Le Page's glue.—SM.

[64747.] — **Cement.** — Indiarubber (not vulcanised) dissolved in benzine will answer the conditions required.—B.SC., Plymouth.

[64747.]—**Cement.**—Fasten your brass to your glass by means of a thin cream of good fresh plaster of Paris in water. When quite set and dry, pour over it a little melted paraffin wax.—S. BOTTONE.

[64748.]—**Small Boiler.** — The shell is strong enough for over 100lb. pressure; but you will not want more than this. The heating-surface is so small that it would not be advisable to have a larger cylinder than 1½in. by 3in. stroke.—T. C., Bristol.

[64749.] — **Gold-Lettering on Cloth-bound Books.**—To put the gold-leaf on, the white of egg is kept till it becomes putrid—say, six months, and this makes a very strong gum, then the gold-leaf is stamped in with a warm die. This may be an old process, but a secure one.—H. T.

[64749.]—**Gold Lettering on Cloth-bound Books.**—I have made a fairly good job in the following way:—I dusted powdered resin lightly over book, and laid gold-leaf on; then, with heated stamp, pressed gold on. Ordinary printers' type set in handles (separate for each letter) will do. To use them, dip in boiling water, press on a pad of blotting-paper to dry, and stamp but one letter at a time.—A DUFFER.

[64750.]—**Diaphragm.**—Use ferrotype plate (supplied by photo warehouses). No wax is necessary. It does not matter which pole is inserted in the coil.—SM.

[64750.]—**Diaphragm of Telephone.**—Ordinary ferrotype plate. Better wind wire on flat bobbin and put it on magnet.—MECHANIC.

[64750.]—**Diaphragm of Telephone.**—Thin sheet-iron, the "ferrotype" of photographers, is the thing. If the covering be good the coil need not be waxed; but, as the wire is c.c. and not s.c., a thin coating of paraffin wax would probably improve it. Either pole may face the diaphragm.—B. HARCOURT.

[64750.]—**Diaphragm of Telephone.** — The best thing you can use as a diaphragm is ferrotype-plate, which you can procure from any photographic chemists. It would be better if your wire was silk-covered, as you would get more wire in the same space. It is not absolutely necessary to dip the coil in wax. You can put the magnet which way you like, as it makes no difference.—H. HEWLETT.

[64750.]—**Diaphragm of Telephone.**—Diaphragm consists of a thin plate of iron, such as those sold by photographers as ferrotype plates. It would be better, as your wire is only cotton-covered, to insulate it with boiling paraffin wax. It does not matter which pole of the magnet is nearest to the diaphragm. I believe that the "New Telephone Company" use a disc of parchment with a small iron stud in centre.—J. T. GEOGHEGAN.

[64750.]—**Diaphragm of Telephone.**—You may use either a thin iron plate (such as photographers use), or a parchment diaphragm with a small disc of soft iron, about the size of a sixpence, in the centre for your telephone; insulate the bobbin in melted paraffin wax. It does not matter which pole is nearest the diaphragm. I believe, however, the United Telephone Company's instruments are fitted with the north pole of the magnet nearest the diaphragm.—G. MACBETH.

[64750.]—**Telephone.**—Obtain a thin flexible disc of iron, and firmly fix in front of the north end of the magnet, leaving an air space of about $\frac{1}{100}$ of an inch. By waxing the wire you increase the insulation. I presume your line is very short; if not, it is necessary that you should devise some means to strengthen the currents flowing through the line.—F. BOURNE.

[64750.]—**Telephone Diaphragm.**—The best metal to use is ferrotype plate, to be obtained at any photographer's, care being taken not to buckle it in the slightest degree. The coil will be better for being insulated in melted paraffin wax. It is absolutely indifferent which pole of the magnet is nearer the diaphragm.—S. BOTTONE.

[64751.] — **Plan Colouring.** — Have you previously damped your paper and stretched it on the drawing-board so that it is taut when dry? If not, do so.—SM.

[64751.]—**Plan Colouring.**—The best mixture is practice in laying on the colour. Don't take too much in your brush at a time. Don't leave standing pools behind your brush. Sweep all superfluous fluid before your brush, and finish at the lowest corner by absorbing with the point of brush any little pool you may have swept down there. Also remember that if you want to produce a clean flat effect you must work on paper that is strained, not pinned to the board.—FRANK CAWS, Sunderland.

[64751.]—**Plan Colouring.**—The only way to avoid the puckering of large flat tints is to mount the paper first. This is done on a drawing-board. First clean the board well, then lay down the paper back upwards, and damp thoroughly with a sponge; give it five minutes to stretch, then turn it over on the board, put the T-square along one of the edges of the paper up to within ½in. of the margin; then raise up that margin of ½in. until it is at right angles with the board and the rest of the paper; then take a triangular piece of glue and rub it along in the angle formed by the paper margin and the board, occasionally damping the glue in the mouth; turn down the margin and rub it down on the board, and so on with the other sides. The paper will dry and be ready for use in a few hours.—B.SC., Plymouth.

[64757.]—**Chrome Alum.**—Best obtained by adding sulphuric acid to potassic bichromate, and passing sulphur dioxide through the solution.

$$\underset{295}{K_2Cr_2O_7} + \underset{98}{H_2SO_4} + 3SO_2 = K_2SO_4 + Cr_23SO_4 + H_2O$$

In place of sulphur dioxide, any easily oxidisable substance—as alcohol—may be used; but in this case more sulphuric acid is required. Evaporation produces crystals of the two salts. The potassium sulphate crystallises first, as its solubility is 1 in 10, whereas chrome alum dissolves in seven parts of water. You can buy it more cheaply than you can make it. The white crust was probably zinc sulphate.—SM.

[64757.]—**Chrome Alum.**—I have had no trouble in forming these from the exhausted bichromate solution. All that is necessary to do is to see that the solution is really worked out; in which case it will be bright green. If it is red, then acidulate with dilute sulphuric acid, and leave a strip of zinc in it. Set aside in a gallipot in a place which is free from dust, and in a few months' time you will get as fine a lot of crystals as you wish for. I have some which I made about nine months ago, and they are as bright and clean as when they were taken from the liquid. When you have obtained the crystals, take them out of the liquid and wash them two or three times in cold water, which will clean away any dust or zinc sulphate. I have seen some which were not washed, but simply taken from the solution, dried, and wrapped in paper, and in about two months, when the paper was opened, all that remained was a light violet powder.—PRINCIPIA.

[64757.]—**Chrome Alum**—Is formed by passing sulphur dioxide through a solution of potassium bichromate containing sulphuric acid. $K_2Cr_2O_7 + H_2SO_4 + 3SO_2 + 23H_2O = [K_2Cr_2(SO_4)_4 + 24H_2O]$. By slow crystallisation very large octahedra of chrome alum, containing 24 molecules of water, can be obtained. The sulphur dioxide must, of course, be passed through the bichromate solution as long as it is absorbed. Chrome alum is also obtained by action of sulphuric acid alone *on* the bichromate, oxygen being evolved at the *same time.* $K_2Cr_2O_7 + 4H_2SO_4 = K_2Cr_2(SO_4)_4 + 4H_2O + O_3$. Thus chrome alum is formed in the bichromate battery. It is best obtained by the first method, however. I have never found chrome alum crystals to effloresce on exposure to the air. It will in all probability only crystallise out from battery solution, if there is enough water present, otherwise chromium sulphate will be deposited, which also crystallises in octahedra, and has the formula $Cr_2(SO_4)_3 + 15H_2O$.—R. H. ANDERSON.

[64757.]—**Chrome Alum.**—Crystals of perfectly pure chrome alum may always be formed by mixing a solution of sulphate of sesquioxide of chromium with sulphate of potassium, and setting the solution aside to crystallise; the crystals keep very well, unless in a very dry atmosphere, when they effloresce slightly. But unless required for the purpose of analysis the crystals formed by redissolving the crystals formed in the bichromate battery and recrystallising are sufficiently pure, and very much cheaper.—S. BOTTONE.

[64758.] — **Engine.**— I suppose this is a condensing engine; but no particulars are given as to speed, pressure, cut-off (if any), and size of cylinder; it is, therefore, impossible to give any advice. It is, however, evident that to obtain the best result it would be advisable to put in a compound-engine working at not less than 80lb. pressure. There is a mill in this neighbourhood working thus on 2¼lb. coal per I.H.P.—T. C., Bristol.

[64758.]—**Engine.**—Locomotive type of engine and boiler combined is not the most suitable for night and day running. If your boiler has some years of life at 40lb., you should, if the beam engine is not quite worn out, get a H.P. for 3lb. of coal (if a condensing engine). If the coal is much above this, it will pay to get a new engine and boiler, say a compound tandem. Boiler pressure from 80 to 100lb.—W. M. J.

[64759.]—**Iron Cistern.**—The proper position of stays is at the centre of pressure, which is at one-third the height from the bottom—not top, as is your impression. Such a tank as you require would be made of $\frac{3}{16}$in. sheet, with three stays in the length, and two in the width, of ⅝in. rod and angle iron at top.—T. C., Bristol.

[64759.]—**Iron Cistern.**—A cast-iron tank, if made of ⅜in. plates, the depth of the tank, and three plates to the 10ft., the plates well ribbed, and the flanges stiffened with brackets, wants no through stays, but two on the top the cross way, and one the long way, made of 1in. round iron with the ends made large enough to receive two bolt holes, and if convenient turn down these bars at the ends to clip the edges of the plates, and bolt them down with two bolts at each end. With such ties the cistern will be strong enough.—W. M. J., Dublin.

[64760.]—**Electric Bell.**—You must connect each window and door with separate contact. The fault you complain of is without doubt owing to wrong connection or short-circuiting somewhere. I will lend you some contacts willingly if you send address and plan of fixing.—MECHANIC.

[64760.]—**Electric Bell.**—More detail is wanted to answer this question rightly. Does a separate connection come from the cells to the window, or does the current have to pass through the first bell and then to the second one? If so, the circuit is made intermittent there; but probably the addition of another cell would cause both to ring. Should this not do it, give fuller particulars, and I will try to assist.—M.M.I.SC.S.

[64763.]—**Mounting Microscopic Objects for use with High Powers.**—The cover-glass is pressed down as close to the object as possible, the thinnest glass being used for slide and cover-glass. —H. T.

[64764.]—**Mathematical.**—This problem belongs to combinations. It is the number of combinations of n things taken 2 at a time, because for every two points joined a straight line is formed. The general formula for n things taken r at a time, is $\frac{|\underline{n}}{|\underline{r}\,|\underline{n-r}}$. Taken 2 at a time the formula becomes—

$$\frac{|\underline{n}}{|\underline{2}\,|\underline{n-2}} = \frac{n(n-1)\,|\underline{n-2}}{|\underline{2}\,|\underline{n-2}} = \frac{n(n-1)}{1\cdot 2}.$$

—M. ISADER, Lewes.

[64764.] — **Mathematical.** — The expression $\frac{n(n-1)}{2}$, giving the number of lines required to join each point to every other of n points in space, is a particular case of the expression $\frac{n(n-1)(n-2)\ldots\ldots(n-r+1)}{|\underline{r}}$, giving the number of combinations of n things taken r at a time. The theoretical investigation of the general formula may be found in any textbook of algebra. The particular case may be investigated independently thus: The number of lines drawn from one point to all the others is $n - 1$; so if each of t n points be taken as a starting point, and lin drawn therefrom to all the other points, the wh number of lines drawn will be $n(n-1)$; b every pair of points has been doubly joined, a li having been drawn from the first point to t second, and a fresh line from the second point the first, and so $n(n-1)$ is just double the quired number, which is $\frac{n(n-1)}{2}$.—HEST BAN

[64766.]—**Water Power.**—The turbine cou be connected direct to the 9in. pipe. The flow water is equal to about 18H.P. (theoretically), say, 15H.P. from the turbine.—T. C., Bristol.

[64767.]—**Leclanche Cells.**—Your cells ha evidently been short-circuited; disconnect the for a day, and see if they regain their strength; not, wash them in water, and recharge.—H. HEWLETT.

[64767.]—**Leclanche Cells.**—From the descri tion of this querist's battery, the cause of complai seems to be excessive working, doubtless being d to the battery being short-circuited. If battery properly connected up, he should examine the wir carefully, and see the insulation is not rubbed worn off at any part. Perhaps wires are poorly i sulated, and he has got leading and return wir both under one staple; if so, they should be sep rated. Creeping is easily prevented by greasi top of porous pot and neck of glass jar.—W WHITEN.

[64767.]—**Leclanche Cells.**—This query, bea ing the signature of a very old correspondent, would tell him the fault most probably lies in t contents of the porous cells: the manganese a carbon was not washed well before it was put I always wash mine until the water is perfec colourless; then pack it into the cells. The powd getting to the zincs causes great local action. M M. Roberts, of the G.P.O., was the first to noti this, I think; at any rate, he mentions it in a pap given before the Soc. of Tel. Eng. on "Batterie If you should like to refer to it, it will be fou in Vol. VI. p. 257 of the *Journal* of that society. M.M.I.Sc.S.

[64769.]—**Deflection of Beams.**—I am gl you are pleased with the books I recommende but as I haven't them myself cannot refer, and am unable to say more than that the formula vari with the section of the beam. If you have "Mole worth's" book you will see the formula given $D = \frac{W L^3 M}{E I}$, where E is the force correspondi to modulus of elasticity, which is given 24,920,000lb.; M varies as to way of carrying a loading beam from 1 to 16, and I is moment inertia due to the section. In the example give the formula is evidently one applied to a particula section, probably given in the context. The modulu given appears to be different to that in Molesworth —T. C., Bristol.

[64770.]—**Steel Castings.**—I am not initia into the method by which the steel is made; b it is really steel, and not malleable cast. Fro practical use of these spanners, I consider them i many cases a miserable failure, owing to blow holes, and much prefer the wrought spanners, even malleable cast. Have forgings made in the usual way.—T. C., Bristol.

[64771]—**Heating Small Boiler.**—In reply t "F. A. M.," I have yet to see a satisfactory an economical burner for heating purposes, in whi petroleum is used as a fuel. As regards the com parative cost of coal and gas for steam-raising, thi depends greatly on the quantity of steam to b raised. If the mechanical difficulty in using soli fuel on a very small scale could be overcome, coa would be beyond comparison the cheapest fuel;— so much depends on the condition of each case that no exact rule can be given except that, othe things being equal, 1lb. of coal is equal to abou 20c.ft. of gas.—THOS. FLETCHER.

[64772.]—**Steel Castings.**—You can get th best steel castings made for about 30s. per cwt, which is far cheaper than attempting to mak them. The steel firms have had to pay dearly fo their experience, and even yet I know firms wh have been in it for many years who cannot mak castings free from blow-holes. How, then, can a amateur attempt it with any hope of success? There is no work published on the subject, and though I have been in some of the largest stee works in the country, I cannot give you any infor mation that would be of much practical value. If you are determined to learn, the only course ope is to manage to get employment in a steel foundr and work up.—J. H.

[64774.]—**Cylinder Friction Machine.**—I hope correspondents will forgive me interfering in matters electrical; but why does "King Tom" intend making a friction machine with its attend ant annoyances when made? If he will take good advice, he will make a Wimshurst influence machine, and for a friction machine be content with a glas od and silk rubber.—T. C., Bristol.

—**Cylinder Machine.**—Warm some
an iron spoon, and add tinfoil as long
issolved; when cold it should have a
nsistency. If too hard to spread, add a
mercury; coat the rubber with a film
d spread the amalgam on it with a knife.
lap should reach within half an inch of
on the conductor. The rubber should
sulated (except for lecture demonstra-
be connected with the earth. Shellac
the best insulator.—SM.

—**Cylinder Electric Machine.**—To
tric amalgam, take 2 parts of zinc and 1
elt together. When nearly cold, add 5
ercury and rub up together in an iron
th a little tallow. This can be applied
ber with a springy knife or spatula. The
each to within 2in. of the comb. If you
lect both + and – electricity, you must
e rubber as well as the prime conductor
of a glass rod. A good insulating var-
le by mixing Chinese red with white hard
the constituency of thick cream. See
ok, "Elec. Inst. for Amateurs," adver-
Sale" column.—S. BOTTONE.

—**Cylinder Frictional Machine.**—(1)
on ladle, 1 part tin, 2 parts zinc, and
oaching solidification add 6 parts mer-
n cold, pound fine. A thin layer of this
is sifted over the leather of rubber
s been previously greased with tallow)
smoothed with a broad knife. Note:
e of rubber is covered with leather, not
ilk flap fastens to the top of the cushion.
to 2in. above points. (3) Insulated
t necessary, unless it is wished to pro-
ive electricity, in which case a separate
must be provided, which is in metallic
with surface of rubber. Use thick
for support. (4) Place an ounce or two
hellac in a clean bottle, and cover it with
l spirit. This, when dissolved, is the best
L. T. G.

—**Cylinder Frictional Machine.**—
am is prepared by fusing 1 part of zinc
tin, and adding 2 parts of mercury, keep-
ss agitated till cold. It should then be
lered, and may be applied to the rubber
it with grease, which must be free from
The silk may come within 1in. or 2in. of
conductor. (3) The rubber may be in-
ut, when working the machine to obtain
electricity from the prime conductor,
must be connected by a chain with the
o obtain "negative" electricity from the
nnect the prime conductor with the
) Varnish may be made by pouring
l spirit over shellac, and leaving it in a
e for a day or two.—J. T. GEOGHEGAN.

—**Cylinder Frictional Machine.**—
e best amalgam according to Ganot:—
ether 1 part of zinc, 1 part of tin, and add
2 parts of mercury. Shake up the mass
l in a wooden box, with chalk." But it
ther to make it than it's worth. For
ou can get enough to last you a long
y optician will supply it. Pound it up
nto a stiff paste, and apply to the cushion
ut regular layer. Take your silk within
e conductor, and if you find sparks fly
; and the points of the conductor, cut off
so. No, there is no need to insulate the
less you particularly want to collect the
lectricity. The usual way is to give the
good an earth connection as possible.
by a chain to the nearest gaspipe—that
way. The glass by itself would be quite
o insulate as long as you can get at it
ipe the film of damp that it collects from
A coating of thin shellac varnish I have
useful to prevent the moisture deposit-
me advise you to scrupulously avoid all
harp edges in your machine (the points
ne conductor, of course, being excepted),
uld greatly weaken its strength.—C. T.

– **Defective Electro-Magnet.**—It is
lear what the shape of this is by the
. If, as I imagine, it looks like a letter
the central stroke, then the defect lies
hree things:—1st. The iron, being cast,
rd, and takes magnetism badly. 2nd.
s bared in places, and the current leaks
the iron. You can verify this by seeing
e iron sparks, if touched with one pole
ery, while the other end is in connection
end of coil. 3rd. The cast-iron reel is
shield to the bolt core, which forms the
between the top and bottom plate.
ery are you using? Six quart chromic
would enable such a magnet, if well
old a ton.—S. BOTTONE.

—**Cold-Soldering Process.**—The pro-
usly given for this depended on the use
amalgam. None of the so-called cold-
rocesses can be considered as true sol-
; rather the use of a metallic cement, which will adhere to any surface capable of combining with mercury. The harder amalgam for the purpose is made of 5 or 6 parts pure silver, 3 or 4 parts grain tin, and 3 to 5 per cent. of bismuth. This alloy must be melted and cast into ingots, the ingots reduced to fine filings, and these filings mixed as required with sufficient mercury to form a very stiff paste, which hardens in about an hour, and retains its white colour for years when exposed to air.—THOS. FLETCHER.

[64779.]—**Condensing Exhaust Steam.**—I suppose you mean condensing the exhaust from the engine. You cannot do this unless you have a supply of water equal to about 30 times that used by boiler. If you have this, you can use a surface condenser and air-pump, but the first course will be considerable. Why do you buy water if you have a well—why not use that from the well?—T. C., Bristol.

[64780.]—**Written Chinese Characters.**—You will find St. Aulaire and Groeneveldt's "Manual of [illegible] Running-Hand Writing," published by [illegible]der, of Amsterdam, a very useful work. It deals professedly with Chinese writing as practised in Japan, but is equally suitable for students of Chinese. If you care to furnish me with your address I may perhaps be able to render you some assistance, as it would be hardly practicable to reproduce Chinese written characters in these columns.—R. H. GEOGHEGAN, late University Chinese Scholar, Oxford.

[64782.]—**Engine.**—Take the axle out of bearings, clean it and both bearings from grit, &c., and smooth them with emery and oil. Then smear well with grease and oil. It ought then to allow the lubrication to circulate and run easily without cutting.—COPPER.

[64782.]—**Engine.**—If you cannot take out the brasses and file them up, as well as clean brass well off the shaft, you had better get some pure blacklead and mix that with tallow and use it for a time. This will help polish the surfaces as well as being itself of an anti-frictional nature.—T. C., Bristol.

[64783.]—**To Weld Steel.**—"Blacksmith" must use powdered borax or a mixture of borax and sand; he will then succeed.—T. C., Bristol.

[64783.]—**To Weld Steel.**—There are many various things for welding steel. Borax is good; but the best thing that I ever had was a mixture made by W. Owen, Helena-street, Smethwick. I could shut files together with it, or any cast steel. —A BLACKSMITH.

[64784.]—**Electrical.**—Core, $4\frac{1}{2}$ by $\frac{7}{16}$; bobbin, $2\frac{1}{2}$ by 4; primary, 2 layers 20 silk-covered; secondary, not less than 4oz. 38 silk-covered. Solder about 12in. No. 24 to inner end of secondary, and bring through reel, as the inner thin end is so apt to be broken and lost.—DADDY.

[64784.]—**Electrical Coil.**—To make an intensity coil which shall work 6in. vacuum tubes, and give $\frac{1}{4}$in. spark in air, you should wind an iron core of about $\frac{3}{8}$in. diameter, with four layers of No. 20 s.c. copper wire for a length of about 4in. This should be most carefully insulated by boiling in melted paraffin wax. Over this, each layer being separated by thin paper well paraffined, must be laid $\frac{1}{4}$lb. No. 36 silk-covered copper wire, each layer diminishing a trifle in length. Before the heads are put on, the coil should again be soaked in melted paraffin. No regulator should be inserted in such a coil; but if it be desired to give shocks (which would be almost unbearable without) a separate water regulator should be employed. No good effects can be obtained without a 50-leaved condenser.—S. BOTTONE.

[64785.]—**Wheatmeal Bread.**—The making of dough consists in a uniform saturation of the flour with water. The soluble portions, sugar and dextrin—the proportion of which is increased by the action of the diastase on a portion of the starch—are dissolved, and the gluten, by absorption of water, commences to swell. This would, if baked, yield a tough and heavy bread; but by the addition of yeast, fermentation is induced, whereby the sugar is converted into alcohol and carbon dioxide. This gas increases the volume of the dough, and its escape being hindered by the toughness of the gluten, it forms small bubbles, which are expanded during the baking, producing the sponginess of finished bread. Meal turns musty from the growth of a fungus—*Mucor mucedo.* —SM.

[64787.]—**Dying by an Effort of Will.**—The reply to this query should appear April 1st to be in keeping with the query itself. "George Macbeth" must be singularly innocent if he has been gulled, or thinks he can gull others, by these facts which have been proved.—S. BOTTONE.

[64789.]—**Domestic.**—Speaking tubes, most decidedly, both for cheapness and efficiency. I cannot answer the other question.—B. HARCOURT.

[64790.]—**Magnets.**—"Invalid" will want a very strong magnet to attract anything more than a needle at 4in. distance, unless the steel article is hung on a long thread. A good magnet placed under the hand will move a needle on the back of the hand, if this is meant.—B. HARCOURT.

[64790.]—**Magnets.**—A good magnet, costing from 8s. to 10s., will attract a needle to itself through a distance of 4in. to 6in. But no magnet will pull a needle out of the flesh if it be bedded in it, as this would imply the certainty of the magnet pulling the needle point forwards. An electro-magnet to pull half a ton can be made for a few shillings, but even this cannot be depended on for the purpose named.—S. BOTTONE.

[64790.]—**Magnets.**—Push a needle through a small piece of cork, that it may just float on a basin of water; it can then be attracted towards a magnet through anything but sheet iron at a considerable distance. Then if the needle is allowed to lie across the poles of the magnet for a little time with eye end of needle on the marked pole of magnet, and again floated on water, it will arrange itself in the magnetic meridian, pointing nearly north.—DADDY.

[64791.]—**Engine.**—You are puzzling yourself about nothing. Exhaust the steam into steam-chest of low-pressure cylinder as usual in a single engine—viz., a little before end of stroke in h.p. cylinder. Nominal power is useless.—T. C., Bristol.

[64792.]—**Dynamo for Plating.**—A plating dynamo to give four ampères could be most conveniently constructed of the Siemens H form, with laminated armature, $1\frac{1}{2}$in. diameter, 4in. long, wound with 5oz. No. 16 wire. The field-magnets should be wound with 10lb. No. 20 wire, connected in shunt with the armature. For one to give 100 ampères at about 5 volts pressure, a Pacinotti ring armature, about 8in. diameter and 4in. deep, wound with about 6lb. No. 6 wire, and fitted into Manchester-type fields, wound with 30lb. No. 14, connected up in shunt with the armature. You will find full description and method of calculating winding for dynamos in my "Electrical Instrument Making for Amateurs." See Sale Column.—S. BOTTONE.

[64793.]—**Patterns.**—This is a matter requiring experience both of the work and the man who works. Thus—"Tom Brown 90 hours, and Jim Smith 130 hours, making identical patterns." Let us hear "J. H." on this matter.—T. C., Bristol.

[64793.]—**Price of Patterns.**—The most correct way is to estimate every separate pattern on its own merits, going through all parts in detail—so long for building up, preparing teeth, gluing on, putting in arms, &c. A wheel of fine pitch involves more work than one of coarse pitch, and a bevel than a spur. Machine wheels cost comparatively little. Many years ago it was a rule in some of the London shops to pay 18s. per foot for wheel patterns, the sizes being taken as the diameter, plus the depth. Men accustomed to wheel work could earn a balance at a much lower figure than this, say from 12s. to 14s.; but averaging wheels of all classes, and made by different workmen, I doubt if they can be done at a much lower price than 18s. Machine blocks cost from 4s. to 12s. each, according as they are spur or bevel, and small or large. Core boxes cost about the same as blocks.—J. H.

[64796.]—**Mice and Birds.**—If the cages cannot be made of mouse-proof wire, I would suggest fixing a circular plate of sheet metal of 6in. or 8in. diameter on the wall, and attaching the cage support to the centre of the plate, so that the cage may hang 3in. or 4in. away from the wall. A little trace of grease on the plate occasionally will make it more effective.—B. HARCOURT.

[64797.]—**Zinc Plate.**—Sealing-wax; apply heat underneath—gas jet will do. Afterwards clean off with chisel, taking care not to scratch plate, then polish. I did the face of two grandfather's clocks this way.—MECHANIC.

[64798.]—**Swing Back.**—Certainly not. The lens must always be normal to the view.—SM.

[64798.] — **Photography — Swing Back.** — Presumably, the querist means spring front, as "swing lens" is unknown. A swing back is the best, because with it you can take a view down into a valley or a quarry, which can't be done with a swing front because the baseboard of the camera (which must then be perfectly level) stands in the way of sinking the lens; but certainly a swing front is better than no swing at all.—B.SC., Plymouth.

[64798.]—**Photography—Swing Back.**—No, for optical reasons, such as distortion, central object appearing one side of plate, &c. Unscrew lens from flange, and experiment by moving lens in direction required with your hand as far as space between mount and flange will permit. For instance, you wish to take a landscape, foreground much nearer than background, you swing the front of lens down; consequently you must raise camera by drawing front leg of stand towards you, look at screen, and result will convince you.—X.

[64799.]—**Condensing Exhaust Steam.**—A "Berryman" will do all that is required. Apply to Wright and Co., Tipton, Staffordshire, for particulars.—W. M. J., Dublin.

[64801.]—**Boiler.**—It would be safe to work it at 30lb. to 40lb.—COPPER.

[64801.]—**Boiler.**—I suppose you do not want more than 100lb. pressure? It is quite safe at that.—T. C., Bristol.

[64802.]—**Angle Plummer Blocks**—Are very good for small engines, as they take up some of the forward wear when let together. If the engine is of any size, make the brasses in three pieces, with suitable set screws or wedges for taking up the forward wear. Downward wear is very little.—T. C., Bristol.

[64802.]—**Angle Plummer Blocks.**—An angle plummer block is designed to permit the wear to be taken up by stripping the brasses in the direction of the thrust or pull. For taking up the wear of horizontal engine crank-shaft plummer blocks, the brasses are in four pieces, with a means of adjusting both laterally and vertically. The mitre block is a kind of half-way arrangement, and for the raking pull of a heavy belt normal to its joint, it is quite a necessity.—W. M. J., Dublin.

[64803.]—**Diamonds.**—According to Emanuel's book on "Diamonds and Precious Stones," nobody has succeeded in discovering the matters which lend a tinge or colour to the gem. Liebig has given as his opinion that it arises from uncrystallised vegetable matter.—F. WOODS.

[64806.]—**Carbon.**—Powder gas carbon, mix to a paste with solution of sugar, press in metal box, tie down lid with wire, pack in sand in a crucible, make the whole red hot in a fire, allow to cool, and fish out your carbon block.—SM.

[64807.]—**Photography—View Meter.**—You are asking too much. Read up the Photo Journals and Almanacs on the subject, and design one for your 10 by 8; you can then make yourself the sketch and dimensions you ask for.—B.SC., Plymouth.

[64808.] — **Coil.** — TO MR. BOTTONE.—The bichromate or chromic-acid cell would be the best. The size for such a coil, about 8sq.in. of negative (carbon) surface. The water regulator, with its brass knob (Fig. 6), is to regulate the current. Put water in the tube, then the lower the rod is pushed down the tube (into the water) the stronger the shock. If the coil is damp it does not work well. See that all your connections are bright and good, and then I think you will find your coil all right.—S. BOTTONE.

[64809.]—**Stereotype Casting.**—Thin brown paper is moistened and pressed on the surface of the type by means of a stiff brush charged with glue and whiting. Sheets are added in succession till the desired thickness is obtained. A facing of French chalk is also used.—SM.

[64812.]—**Blow Lamp.**—You cannot beat the ordinary block tin or sheet brass lamp with the plain sloping spout, burning methylated spirit, as there is no burner for colza or paraffin that will allow of enough flame for such large solderings as 1in. or 1½in. lead pipe.—DENS.

[64813.]—**Drying Wood.**—Lay thin, narrow strips of wood, say ¼in. thick by 1in. wide, between the boards at distances of about 2ft. apart, and then load the uppermost board of all with stones or weights. The stuff being kept straight while drying, will not go rounding and hollow afterwards. —J. H.

[64814.]—**Blacking Zinc.**—I also tried most of the recipes given in the "E.M." some years back. I found them all excellent. This I found the best:—Sulphate of copper 1lb., water 1 quart, sulphuric acid ½oz., sugar 1oz. To be brushed over the cleaned zinc.—S. BOTTONE.

[64815.]—**Dynamo.**—On my 5c.p. dynamo I use 2oz. No. 24 silk-covered copper wire for the armature, and 12oz. No. 24 ditto on the fields. I connect up as a shunt machine and run at 3,000 revs. per minute to get one ampère at 6 volts pressure. You can light a 6-volt lamp; but it is useless to expect to light a 25-volt lamp from such a machine.—S. BOTTONE.

[64817.]—**Testing Oxygen.**—By the usual process of gas analysis—i.e., absorption of the O by pyrogallate of potassium, leaving the N.—SM.

[64817.] — **Testing Oxygen.** — Burn in a measured quantity of the oxygen an excess of phosphorus; the experiment being conducted in a graduated receiver, standing over water. When combustion is completed, and the phosphoric anhydride thus produced has been all absorbed by the water, the remainder is nitrogen, providing, of course, the oxygen contained no other admixture.—S. BOTTONE.

[64820.]—**Thermometers.**—The fullest particulars will be found in Vol. XI. p. 539, and p. 375, Vol. XIII. of the "E.M." I would copy it for "Neva"; but the description occupies two and a half columns.—M.M.I.SC.S.

[64820.]—**Thermometers.**—A wider glass tube is attached to the thermometer tube by a cork, and filled with mercury in excess of the quantity required to fill the thermometer tube. By successive gentle heatings and coolings the mercury will drop into the thermometer tube. When the tube is nearly filled, boil the mercury in the thermometer tube to expel the last traces of air. After cooling remove the wider tube. After heating the thermometer tube slightly above the temperature required to measure, allow the instrument to cool slightly, and then seal the end up, with the blowpipe flame if possible.—T. O. D.

[64820.]—**Thermometers.**—Heat the bulb over a spirit-lamp, dip the end of the tube under mercury, and remove the lamp; as the tube cools the mercury will be drawn up. Having thus introduced some mercury into the bulb, it must be boiled until both the bulb [illegible]pillary tube are filled with mercury vapour. [illegible]e end of the tube is again plunged under mercury, and as there is no air in the tube the mercury vapour as it cools will form a vacuum, and the mercury will rise and fill the tube and bulb. The bulb is again heated to a temperature slightly above that the thermometer is required to register, and the end of the tube is sealed up.—J. T. GEOGHEGAN.

[64820.]—**Thermometers.**—These are made by blowing a bulb on a piece of tube; the bulb is warmed, and the open end of the tube is dipped into mercury, when, as the tube cools, a small quantity is forced up to supply the place of the air which has been forced out by the heat; this being repeated until there is a sufficient quantity of mercury in the tube, the bulb is then heated until the mercury rises to the top of the tube, when it is sealed up with the blowpipe, and is then ready for graduating. To graduate, it is placed in a vessel of melting ice, and when the mercury is stationary that is marked 0° C. or 32° F.; it is then placed in the steam of boiling water, in order to get the boiling point, which is marked 100° C. or 212° F. The space between the boiling and freezing points is divided into 100° for C., and 180° for F.—PRINCIPIA.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

Since our last W. H. Palmer has replied to 64259.

64180.	Oval Tub, p. 469.
64182.	Maintaining Spring for Small Turret Clock, 469.
64193.	Incandescent Lighting, 469.
64216.	Coal-Washing Machines, 470.
64219.	Flowering Surfaces on Metal, 470.
64229.	Deal Frame, 470.

64433.	Grinding Machine, p. 564.
64448.	Bass Flute, 565.
64456.	Linseed Oil, 565.
64478.	Church Bells, 566.
64479.	Bearing Surface. 566.

Packing for Ice.—Sawdust to pack ice in is believed to be the best material; but this is very difficult to obtain in some parts of the country where there are no sawmills. A correspondent of the *Country Gentleman* comes to the rescue in such cases, and recommends, next to sawdust, oat straw cut short, if the oats have been thickly sown so as to make the straw small and soft, capable of packing well, without air crevices. If uncut, or cut rather long, it is liable to contain small crevices through which the air may find its way; but if cut only a fourth of an inch in length, it may be placed nearly as compact as sawdust. Next to oat straw is fine soft hay. Wheat straw is too stiff, and will not pack solid, although by very short cutting it will answer if a greater amount is used. Good fine sawdust, well packed, need never be more than a foot in thickness; chopped oat straw will answer, well packed fifteen inches; but chopped rye or wheat straw should be twenty inches or two feet. Unchopped fine hay or oats will be quite as good as chopped wheat straw. Much will depend, however, on the care and skill with which the packing is applied, so as effectually to prevent the entrance of air through small crevices.

TELEGRAPH poles are preserved in Norway by making an auger hole about 2ft. from the ground, in which 4oz. or 5oz. of sulphate of copper in coarse crystals are placed and plugged in. The chemical is gradually absorbed by the wood until its whole outer surface turns of a greenish hue. The sulphate requires an occasional renewal, and is said to be a perfect preservative.

QUERIES.

[64822.]—**Bucket Speed of Water Wheel.**—Would "Millwright" kindly give the bucket speed of his wheel or the revs. per minute in addition to the particulars already given?—J. W. N.

[64823.]—**Discoloured Lens.**—The object-glass of a large telescope has got a cloudy appearance. The discoloration is evidently between the glasses of which the lens is composed. How can I separate, clean, and cement together again, or should it be sent to an optician? What would be probable cost of cleaning, &c.?—INTERMEDIATE.

[64824.]—**Telescopic Photography.**—How is a telescope, or binocular, used with an ordinary camera to obtain enlarged images of distant objects? How focus telescope and camera when used together? — INTERMEDIATE.

[64825.]—**Horizontal Parallax—Sun and Moon.**—Would "F.R.A.S.' (if not outside his notice) kindly give me the mode of reducing the sun's (and moon's) H.P. into miles, the sun's parallax being 8·9″,? How is this expressed as 92½ mills. of miles?—FELIX.

[64826.]—**Steel for Scissors.**—Will some reader oblige me by answering the following questions? Of what steel should scissors be made? Is it shear steel? Where does the modification come in in the process of manufacture to make the steel into shear steel? I shall also be glad of any information with regard to the steel from which scissors are made, should it not be shear steel, but some other, and also as to the making of scissors, English and foreign.—CUTLER.

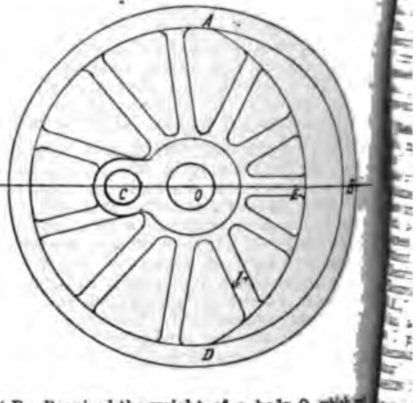
[64827.]—**Brass Castings.**—I want to cast an engine cylinder 4in. stroke by 2½in. bore, and a fly-wheel 10½in. diam., and some more small parts in brass. I have the means of melting the brass, but that is all. I want to know how to make the mould, what sand or loam to use, and the *modus operandi* generally.—X.

[64828.]—**Silvering Reflectors.**—Will any fellow-reader kindly tell me how to resilver copper reflectors, such as are used for lamps? I have several I would like to do, as I have a small plant for silver-plating, but do not know how to do them.—FITTER.

[64829.]—**Case-Hardening Bessemer Steel Wheel.**—Can any reader tell me how to case-harden Bessemer steel wheels? I have tried the ordinary methods for hardening steel, but with very poor results.—A. S. MILLS.

[64830.]—**Delta Metal.**—Would some kind reader let me know the following about Delta metal? Is it cheaper or more expensive than brass? Is it as easy to melt and cast as brass? Would it be a good substitute for brass generally in a model horizontal machine?—DELTA.

[64831.]—**Mathematical.**—A wheel of width T revolves about its centre O, having attached to it at C a



weight P. Required the weight of a body Q which will balance the effect of P, its area being bounded by the inside of the rim A B D, and an arc A E D described from C (1) when the spokes are neglected, (2) when the weight contains the intercepted portions of a spoke of rectangular section *l* by *m*, the thickness of the balance weight being any quantity not greater than T, O C = C O B = A.—E. C. A.

[64832.]—**Hydraulic Ram Leathers.**—Will any of your readers give me a few hints on making these? What sort of leather to use; at what temperature should the leather be kept, and how long should they be kept under pressure. Is there any machine in the market, say, for 14in. leathers?—ANTHRACENE.

[64833.]—**Brass Furnace.**—I want to build out of doors in a shed a small brick furnace in which I could melt 4lb. to 6lb. of brass, copper, or tin. Would some reader be kind enough to let me know by a small rough sketch the size and shape I ought to make it, so as to get a good draught, and as hot a fire as possible? Could I braze the joints of a small model boiler in it when it is finished?—NEMO.

[64834.]—**Tricycle.**—Having an enlarged knee joint (right leg) I cannot ride one, not being able to bend the leg, but can use the left. Could I buy an up-and-down motion one and have a rod screwed to the right pedal so that I could work it by the right hand, or would one of the Road-scullers answer better?—W. P.

[64835.]—**E.M.F. of Cell.**—What is the E.M.F. of a copper and zinc couple in the chromic-acid solution as used for zinc and carbon cells? How does it compare with the zinc and cooper in sulphuric acid, given by Sprague at [illegible] volt, and with the zinc and carbon in bichromate given by him at 1·9 volt?—A. J. ADAMS.

[64836.]—**Converting Electro-Motor into Dynamo.**—I have an electro-motor of the B 1 [illegible] type, armature [illegible]in. by 1in. How can I convert the above motor into a dynamo to drive a 2½c.p. lamp?—CARIS.

·**Watch Repairs.**—Will some experienced r please say if all jewel holes, through as well stones (e.g., those of the balance), the cylinder ıls, and ruby pin of levers should be oiled? n get an assortment of pivots, or, if not, de- easiest way to replace a broken one, naming oels?—BEGINNER.

·**Bunsen Battery.**—Would Mr. Bottone or kindly furnish me with some particulars as to ınternal resistance, and constancy of a Bunsen ic acid only being used in the porous cell, as with the ordinary form, and also inform me ıal resistance a well-made No. 2 Leclanche cell ı?—ORATOR.

-**Salt in Marine Boiler.**—Can any of orm me as to the best means to proceed to clear boiler in a steam fishing boat from salt? It is with it, and most difficult to get at.—W. J.

·**Science and Art May Examination.** e of our chemical friends kindly give one or and distinguishing tests for morphine and urea, the Science and Art Examinations? Some of n in textbooks are not very satisfactory, or the former, and particularly when morphine ic acid are mixed, as was the case last year.—

·**Ruhmkorff Coil.**—Much has been said Ruhmkorff coil in the "E. M." But all that has bout it does not make it clear to me how much be put on a coil for primary. Nor can I make r No. 16, 18, or 20 would be best (that is sup- coil to be built for a spark), and as to the num- rs I am quite as far in the mud. For the same ɔs some would advise 2 layers No. 18, while ght say 4 layers No. 20. All seem to agree tin. c. copper wire. Now I want to know why 3 ver mentioned, or would it spoil a coil to have nber on it? Also whether a coil would be ı 2 layers of No. 18 than it would be with 4 8; or would it be better with 2 layers No. 20, t to be for a spark?—COILTONIAN.

·**Water Tap.**—Will some kind reader tell way to grind the seat of a screw water tap ɔurse) in its place? The pressure of water is , and whether from a little grit in the water, atever cause, the seat gets tough, and no re- ther washers seems to prevent it leaking. I using a short rod of hard wood, fixed in a brace, now what is best to fix on the end for a grinder. ıall disc of copper or lead, or would the wood nd whether emery, sand, Bath bricks, or what be used to grind with? Is there any better V.

·**Small Boiler.**—I have an iron boiler, 14in. . diam. The shell is $\frac{3}{8}$in. thick, with manhole top, $2\frac{3}{4}$ by $2\frac{1}{4}$. The top of boiler and top of $\frac{1}{2}$in. thick, $\frac{1}{2}$in. rivets 1in. apart throughout; r chimney screwed in firebox top with nut dn- . There is a safety-valve $\frac{5}{8}$in. bore with bar The bar is 8in. long. The ball $1\frac{1}{4}$lb.; it hangs entre of valve. Would that make pressure o square inch? From what I have read in hould stand more than that. Should be very now what it will stand. Also the weight of hang on the bar, as I require a little more H.

·**Electro-Brassing.**—Will any kind friend l practical experience of the above kindly help ı get a perfect covering of brass of irreproach- on cast or wrought iron, but I cannot get deposit. I am using an Elmore dynamo, and ıll strengths of current, varying strength of in metal, cyanide, and ammonia. Also all heat up to nearly boiling, but as yet cess. My recipe for bath is from Cassell's in the Service of Man." I have read Watt's etallurgy," Gore's ditto, and my six years' d can gain no help. What I want to know is: posit of, say, 1-16in. be obtained? (2) Where bably failed in obtaining it? Would that who is now writing "Polishing and Nickel- r us please to give me a hint?—ELECTRO-

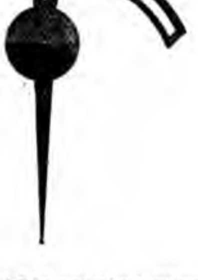
·**Battery.**—I have a Daniell's battery of the d for driving an electric clock made in the ıanner. A cone of lead, about 3in. high and the base, having a lead tube soldered on the , is placed in a glass jar, so that the tube rises bove the edge. In this cone is put sulphate of ich, when melted, forms a saturated solution to way up the jar, the rest is clear water. A flat bout $\frac{3}{4}$in. broad, is hung horizontally about $\frac{1}{2}$in. r solution, and this forms the positive pole, ing the negative. There is no metal copper ous pot. I am told that this battery should ɔh power as a Daniell cell of the ordinary make e; but at present I can only get a very fine m it. I believe, however, that there should be else beside the sulphate of copper in the cell. tell me what it is, or give me a hint for im- battery?—CHRONOS.

·**Dynamo.** — TO MR. BOTTONE.—I have ıl dynamo with the H armature. Size of F.M.'s $3\frac{1}{2}$in. long, armature $3\frac{1}{2}$in. by $1\frac{1}{4}$in. Armature ı No. 20 s.c. wire, quantity unknown, insulation M.'s wound with 6 layers of No. 15 c.c. wire, of each layer good (except for the size of wire ıp exactly the same as a 20c.p. dynamo that I Connected up as a shunt-wound machine there ks at the brushes when run at a high speed, nor e points of two wires leading from the two but by placing the wires between the lips ıachine is running you feel a series of short, s, such as you would get from a small shock- Connected as a series-wound machine I do not ıe shocks while connected this way? I con- terminals of the 20c.p. dynamo with the ter- ıe small machine to see if it would work as a it would not mote worth a cent. It simply face of the armature down to the face of the here stopped as though it was tired. Will you ndness to p me right?—MEPHISTO.

[64847.]—**Fuller's Battery.**—Exactly a week ago I started 2 cells on this principle to ring a bell 30ft. away. I followed the directions given in back vols., making a saturated solution of bichromate of potash, then putting $\frac{1}{8}$ its bulk of sulphuric acid to it, drop by drop, as suggested by Trouvé. The inner cell with the zinc plate, 8 by 3, had mercury at the bottom, and was then filled up with water only. After being short-circuited a few hours it rang the bell nicely, doing so for five days, then stopping. I searched back vols. and found some of the contents of porous cell was to be removed and pure water added, and sulphuric acid and bichromate crystals put in outer jar. This I did, and although two days have gone it will not ring the bell, so I have emptied the cells and find, although the outer cells contained a rich orange-coloured solution, that in the porous cells was a nasty green, almost black. I examined the carbons each day, but not the slightest deposit of crystals on them, although plenty of chrome alum fast on bottom of outer jar. The zincs, though, where they entered the mercury at the bottom of the cell were nearly eaten through or dissolved; $\frac{1}{8}$in. thick when put in, now the bottoms are as thin as writing paper and ragged edged. Should this be? I always understood this battery would go at least six weeks without attention, so should be glad if those qualified would point out any error in construction and advise how to set them going again. They could not have been overworked, as the bell would not be rung ten times a day, and the fault is not in the bell, because it is working splendidly with some spare old Leclanchés.—M.M.I.Sc.S.

[64848.]—**Magneto Machine.**—I have constructed a magneto electric machine, but cannot obtain a satisfactory result. My magnet is 6in., parallel sides $1\frac{1}{8}$ by $\frac{1}{2}$. The coils are $1\frac{1}{2}$in. long, cheeks 1 7-16in. diam, filled with No. 26 c.c. Birmingham gauge copper wire. My driving pulley is $2\frac{3}{4}$in. diam., pulley on armature (or yoke) 7-16in. My coils are tapped into the armature. A brass tube driven fast into the centre of the armature, one end of which is plugged up with hard wood, and a small spindle screwed into the wood, but in no way connecting to brass tube, into the other end of which I have driven the contact breaker and spindle which carries the electricity to the tin conductor in the box corner. I have wound my coils some way from armature, connecting the two first ends together, one of the last ends to the spindle, the other to the brass tube. I can get a moderate shock from the machine, but have to run a high speed. I have altered the contact spring many times, but with no better result. Would any of our electrical friends kindly advise me what would make the desired difference?—GALVANI.

[64849.]—**Centre Seconds Watch.**—I have just become possessor of a very good centre-seconds Geneva watch. I may mention it is an "independent" seconds. The seconds hand jumps a second at a time. The balance wheel is a flat, thin band of gold. On the regulator pointer there are two brass studs screwed, one forming part of the curb. Soldered on to these studs are two arms of brass, about $\frac{1}{8}$in. long, and connected at the other end by a short piece at right angles—something in this shape. What use is this appendage? I have asked several watchmakers, but they cannot inform me. Will some one initiated in watch mysteries please explain.—GWENT.



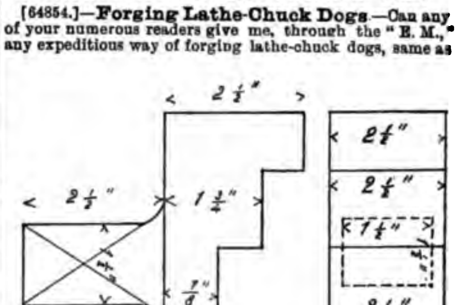
[64850.]—**Steam Pressure.**—When steam pressure on boiler stands at 50lb. per square inch, does the same pressure exist at the bottom of boiler, beneath the water? When steam pressure indicator stands full at the maximum to which it is marked—say, 50lb. per square inch—water gauge shows full, no blow-off of steam from safety-valve, not even when weight is lifted—supposed to be 50lb.—what is the reason for such a state of things, and what is the best course to take? Twice I have been in engine rooms and found such a state of things. The engine drivers in both cases declaring there was nothing wrong. In both instances I got out of the engine rooms sharp, as I did not like the look of things.—ENGINEER APPRENTICE.

[64851.]—**Coil.**—Many thanks to the gentlemen who answered my last, but I am afraid I was hardly clear enough. The primary base board and condenser belong to one of Ladd's 4in. spark coils, core $1\frac{3}{8}$ by 13, diam. of primary $2\frac{1}{4}$, three layers. I also have tube and discs to fit old primary. I believe the fault lies with old wire. It certainly is not the break or condenser. As I shall have to make a new primary, had I not better diminish the diam. and wind on secondary to fill tube, and what would be the best proportions of primary and core maintaining above length? Secondary to be $2\frac{1}{2}$ miles.—T. G.

[64852.]—**Sail for Canoe.**—I thank "Golden Slippers" for the full description of sail for canoe, but cannot see how to fix reefing gear to sail, because, according to shape of sail, it would be impossible to reef the sail by means of a block fixed near the end of the main head, which is only 6ft., where the leech is 9ft. 9in. If I have misunderstood the instructions, or if they are intended for another kind of sail, I would be very much obliged to "Golden Slippers" if he would put me right.—FIFE.

[64853.]—**Induction Coil.**—I sincerely thank those gentlemen who were kind enough to answer my queries. I have since completed coil with proper break and get $\frac{1}{2}$in. or $\frac{5}{8}$in. spark. Coil is made up thus:—Length of core $9\frac{1}{2}$in., 2 layers 16 c.c., one layer tape, all well soaked in melted paraffin; paper tube 3-16in. thick, soaked also in paraffin; layers of secondary insulated with one layer of foreign post soaked also in paraffin, end well baked and paraffined mahogany, wires and screws nowhere touching wood, but insulated with plugs of ebonite, condenser 50 sheets tinfoil, 8 by 6 separated by sheets of paraffined paper. If I unwound this coil and rewound with 2lb 36 or 38 s.c., what length of spark ought I to get? Would any correspondents kindly suggest alterations?—SOLO.

[64854.]—**Forging Lathe-Chuck Dogs.**—Can any of your numerous readers give me, through the "E. M.," any expeditious way of forging lathe-chuck dogs, same as above sketch? The way we are doing them at present is to weld or stamp on small tail, cutting steps out of solid iron and dressing with hammer. After welding tail on, can it be stepped and finished under drop hammer with dies, and if so, I should be greatly indebted to any of your readers if they will kindly give me a sketch of said dies, and mode of operation, or any other mode of forging dogs expeditiously.—ONE IN A FIX.



[64855.]—**Dirty Water in Steam Boilers.**—I have a boiler of copper with 50 brass tubes in it. The water I use is soft, and is drawn up by the pump through a carbon filter to insure its being perfectly clean. Notwithstanding this, after a few days' run, the water becomes quite red, as if it had been filled with iron rust. I have emptied the boiler frequently, but it always gets thick again in a short time. The plates are riveted with iron bolts, but they do not appear to be in the least corroded, and there is no scale either in the boiler or tubes.—H. E. P.

[64856.]—**Egg-Ended Boilers.**—I have a large number of these at work, burning small coal and dust, mostly dust. Could any reader tell me if it is possible to construct a species of gas-furnace, whereby a large quantity of dust might be shot direct from coal tubs into a producer and the resulting gas burned under the boiler or boilers? Any information or a sketch or plan would be most thankfully received by a—BENGALI EXILE.

[64857.] — **Cheap Red Sealing-Wax and Crayons.**—I want to know how to make a cheap red sealing-wax with the lowest priced materials that it can be made with. I also want to know how to make cigar-shaped sticks of white chalk, not crayons from clay. The chalk is liquefied in some way and cast in moulds. It is used in schools for black-board use. Would some one of "ours" kindly state what raw materials must be obtained and the process of manufacture for above two articles?—W. JACKSON.

[64858.]—**Copper Boiler.**—I am anxious to know what steam pressure a copper boiler with domed ends, and of the following dimensions—viz., 8ft. long by 4ft. 6in. diam., and constructed throughout of $\frac{1}{4}$ copper, would be capable of sustaining with safety. Perhaps "T. C., Bristol" or some competent friend of "Ours" will oblige me with reply, or refer me to some work which will give me the desired theoretical calculations?—HYGIENE.

[64859.]—**Dynamo.** — TO MR. BOTTONE. — I have castings for a dynamo of the following dimensions:—Armature, laminated, $1\frac{1}{2}$in. diam., 3in. long (exclusive of wire space at ends), F.M. cores 4in. long by 2in. by $\frac{1}{2}$in. thick, and pole pieces 3in. by $1\frac{1}{4}$in. by $1\frac{3}{8}$in. Will you please give me quantity of wire and speed to get best results as a shunt machine, and how many volts and amperes would it give?—W. E. L'ESTRANGE.

[64860.]—**Accumulators.** — I wish to use a force equal to three quart bichromate batteries for experimental purposes, as lighting small lamps, working coil, &c. Will any reader kindly tell me which would be best to use, batteries or accumulators charged from dynamo? How many Planté accumulators, plates 3ft. by 6in., would it need to supply the place of above batteries? Would a 10c.p. dynamo be efficient to charge such accumulators? Any advice would oblige—AMATEURS AND OTHERS.

[64861.]—**Rock Boring.**—I have a 100-volt Elwell and Parker dynamo with 8H.P. engine for driving same. Can I adapt this to drilling in rock for blasting purposes? I shall require it (power) conveying about 600yds. from machine. Can any of "ours" help me in this? What kind of motor shall I require, strength of cable, &c.? I know it is used for pumping and other classes of work, and I should like to make mine do this, if such a thing is possible.—ELECT BORING.

[64862.]—**Malt Extract.**—Will "Chemist" or some other kind correspondent tell me how I may make the above, as there are three in our family that are taking it, and I find it very expensive to buy? I have unlimited supply of crushed malt, and would like to make it myself at home.—T. H. P.

[64863.]—**To Mr. Bottone.**—1. I intend dividing reel for medical coil into eight sections with seven thin vulcanite discs, using 38 s.c. wire for secondary. Would this method of construction make a powerful shock coil? Is this number of sections right? 2. How may the primary current of a coil be used with the most beneficial results for toothache and neuralgia?—F. DAWSON.

[64864.]—**Small Boiler.**—Can I bend round a piece of Delta metal, $\frac{1}{4}$in. thick, 30in. long, and 35 round, so as to make a round cylinder, or would the metal crack and split? If so, how can I make the cylinder? I want it where the ends are fixed on to be steam tight.—O. T.

[64865.]—**Position of the Sun.**—The sun, I believe, in some 26,000 years passes through the whole circle of the Zodiac, and is now in and passing through the sign Pisces. Can any of your astronomical readers inform me about the year, date, or period that the sun entered the sign Pisces, and what sign it will next enter?—THOMAS MAY.

[64866.] — **Compound Winding.** — TO MR. S. BOTTONE.—I wish as an experiment to compound-wind a small Gramme dynamo. Will you kindly tell me how much wire it will require on the fields? The armature is 5in. diam. and wound with No. 18. I would like to use No. 20 for the shunt coils, as it is already partially wound with that size wire. Outputs to be 50 volts, 8 ampères.—B. S. T.

[64867.]—**Gilding on Glass.**—Can any of our readers suggest a good way of gilding the back of a piece of glass to produce a matt surface? I have mounted some photographs on glass, and wish to gild the intermediate spaces. All methods I have tried have failed to produce an even surface. The process must have no effect on the photographs?—R. W. W.

[64868.]—**Painting Figures on Clock Dials.**—Will some one kindly inform me what sort of paint or varnish it is that the figures on clock dials are painted with, and how to apply it? Also how to make the enamel so as to fill up some places where the old enamel has chipped off.—MAITLAND RICKCORD.

[64869.]—**Solution for Removing Whitewash.**—Will some kind reader give me a recipe for a solution which will soften old whitewash on stone walls which require to be cleaned, or whether any other means would be best to adopt?—T. R. M.

[64870.]—**Glycerine in Leclanche Cells.**—What is the object in putting glycerine in the solution in Leclanché cells, and, if found to be advantageous, what is the best quantity to use, and is it in no way detrimental to the cell?—SAMOTHES.

[64871.]—**Microscopic—Angular Aperture.**—Will some one be kind enough to state how the figures of angular aperture, usually given by opticians, may be converted into their equivalent figures of numerical aperture?—ELLIS NOBLE.

[64872.]—**Electro-Gilding.** — Will anyone tell me how to make up a small quantity of gilding solution, so as to obtain a rich colour? Also how to obtain a clear white in my plating solution, which now deposits with a dull yellowish tinge, and requires scouring.—G. C. T.

[64873.]—**Cement for Glass and Brass.**—Can any one kindly say what is the best recipe for uniting glass and brass? I want to fix the brass collar to the top of a bottle bichromate battery?—K. C. O.

[64874.]—**Glazing China.**—Can any reader inform me of the material used, and the method of using, for glazing china, &c., and what would be the best for dyeing or staining same brown?—W. F.

[64875.] — **Optical Illusion.** — Can anyone give working details of the optical illusion described on page 477 of last volume? I want to arrange something of the kind for a fancy fair.—A DUFFER.

[64876.]—**Boring Hard Steel.**—Will "Eos" or anyone kindly say if there is an alloy or anything suitable for boring a minutely small hole in a hard class of steel, ½in. deep, and where it can be procured?—STEEL.

[64877.]—**Cleaning Cretonne Curtains.**—Which is the best method of cleaning cretonne curtains? Washing takes the colour out.—R. F. A.

[64878.]—**Linen and Collodion.**—I want to saturate linen or calico with collodion. What can I add to the collodion that will prevent stiffness when dry?—A. L.

[64879.]—**Valve Gear.**—Could any reader favour me with a sketch of Walschaert's valve-gear for locomotives?—BENGALI EXILE.

[64880.]—**Mounting Insects.**—Will anyone tell me how to mount small insects whole? I find with some that the least pressure of the cover glass takes away all shape.—FFINLO.

[64881.]—**Commutator.**—Will some one kindly give practical directions how to make a really good commutator for ring armature? Also how it is secured on the shaft.—B. S. T.

[64882.]—**Electro-Depositing.**—Will any reader be kind enough to give me recipes for the following solutions for gilding, silvering, and copper-plating by the aid of Daniell's battery?—AURO.

[64883.]—**Polishing Amber.**—Can anyone inform me the best way to polish amber after having been turned in a lathe?—AURO.

[64884.]—**Lemons.**—I am using the juice of about three lemons a week for bile. I take it in tea night and morning. Will "Lydney Dispenser" say if I am doing right?—SHEFFIELD.

German Ingenuity.—According to the *Times*, the following letter from a German wine exporter is being circulated among the wine merchants and others in India, Ceylon, and other parts of the East, and perhaps in Europe also:—"Your esteemed firm being mentioned to us as importing large shipments of cheap champagne or sparkling hock, we beg to address directly our offers to you. We can highly recommend you our cheapest quality at 12s. 6d. net cash per dozen quarts (Saumur bottles, which are smaller, can be delivered with a little reduction), packing included, c.i.f., Rotterdam or Antwerp, which is sold chiefly in your market. We beg to observe, moreover, that you can have this wine made up with any brand you wish. We shall be pleased if you will feel inclined to make a trial, and remain, dear Sir, yours truly. . . . . P.S.—If you require some other goods which you know to be of German origin, we are at your *disposal.*"

ANSWERS TO CORRESPONDENTS.

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*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to Hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

GOOD FRIDAY.

NEXT WEEK the ENGLISH MECHANIC will have to go to press some hours earlier than usual, in order to complete publication before Good Friday. All advertisements must therefore reach the office before 5 p.m. on TUESDAY NEXT, instead of by 1 p.m. on Wednesday as usual.

The following are the initials, &c., of letters to hand up to Wednesday evening, March 21, and unacknowledged elsewhere:—

J. C. WHITE.—Alfred Ledger.—J. Goldie.—Athenian.—Hammer.—M.—A. R.—A. J. Dew.—W. P. Maycock.—J. R.—F. Watson.—Bertha.—Chemist.—T. W. B.—A. J. C. Provis.—Lowestoft Smith.—D'Elgo.—Lewis.—One in a Fix.—Practical Bookbinder.—Engineer, Langholme.—Photomaniac.—Ursa Minor.—Capt. Battersby.—Bijli.—F. C. Allsop.—H. T.

JOHN NOBLE. (We have frequently given the particulars of the examinations for certificates as engineers on board steam-vessels. No one can sit unless he has had three years' experience in building engines, and one year at sea in the engine-room on the "watch," or four years at sea in lieu of the practical training in construction. If you have the preliminary training procure the "Engineers' Handbook" from Reed and Co., Sunderland, and you will find all the information required.)—H. E. P. (Perhaps it is due to the soft water. Boilers are in the best condition when, other things being equal, their plates are protected by a thin scale, about eggshell thickness. We could only guess at the cause, and will therefore insert a query, as some reader may have had similar experience.)—AMATEUR MODEL MAKER. (Presumably Parson's high-speed engine was referred to. That was illustrated and described in Vol. XLIII. See especially pp. 354, 443, and then pp. 240, 421. It will run at over 12,000 revolutions a minute.)—GREASY BOILER. (Grease is detrimental to a boiler, because it is converted into acids which corrode the plates. Mr. Wilson, in his "Treatise on Steam Boilers," says: "It has also been found that the grease carried over from the engine cylinders, in using the condensed steam unchanged for a lengthened period, acts injuriously in pitting the plates and iron tubes of the boilers." If you have "always understood" grease was good for a boiler, you have not understood it from anything in these pages.)—S. E. P. (Will not some of the devices recently described suit you? See the index published last week, and if you find no likely reference, look in the indices of back volumes, as the method has been frequently described.)—YEAR OLD SUBSCRIBER. (Perhaps one of the pocketbooks will give you the desired information; but you ought to have read all about it in the twelve months during which you have perused our pages.)—A LATE BEGINNER. (Have you looked at the index of the last volume, or read recent numbers even?)—ERNEST C. D. (We do not know. The inventor probably did not until he tried. It would depend on the distance, and the spans; but we should think, as a guess, No. 14 galvanised steel wire would do.)—STEAM. (The proportions vary; but as you do not state the purpose, any of the ordinary solutions will no doubt answer. 2. Do not understand what you mean by "amalgamating the ends of copper wire," and you do not quote the pages on which the recipes appeared.)—A. C. M. (Would you not find the sketch required in any of the dealers' catalogues?)—H. R. (Messrs. Trübner, Ludgate-hill, E.C., would no doubt procure it for you; but we think you would have to subscribe for a whole year.)—NOVICE. (Do not understand you. It is the nature of the gas to escape. Syrup tends to prevent it, but produces a more persistent froth.) — AMATEUR. (By waxing them, we suppose. There is a patented process of enamelling photographs in No. 1170, p. 597.)—TERRANOVA. (What do you mean? That is where the skill of the harmoniser comes in; but there are certain rules which must be followed, and we are quite sure they are explained in the work from which you quote.)—EXPERIMENTER. (There are no such things as self-acting fountains. You will find designs of so-called self-acting fountains in Nos. 402, 405, 459, 582, 801, 967, 973, 974, &c.)—BEE. (Answered very recently in the reply columns. For a book, procure Graham's "Brass-Founder's Manual," Crosby Lockwood and Son, about 2s. or 2s. 6d.)—A. H. R. (The value depends on the condition; but as the title-page seems to be missing, it cannot be worth much.)—ORIENT READER. (Essence of anchovies is made by boning the fish and reducing to a pulp in a mortar. Strain through a hair sieve, and boil what will not pass through for about a quarter of an hour with a suitable quantity of water. Strain that, and add salt and flour with the pulped fish; then simmer for three or four minutes, and when nearly cool add some vinegar and bottle the essence. You can vary the process to taste.)—MILO. (Do you mean ink, or blacking, or harness polish? What is it to do? There are recipes in back volumes.)—ATTICUS. (Surely in a place like Cardiff such information could be obtained. It is not of sufficient interest for insertion in our pages.)—E. C. M. (What is to prevent the steam condensing when kept in contact with the water? What object is it desired to attain? 2. The steam would either blow past the piston, or lift it, or remain until it condensed. No doubt the fans would turn; but as to the "power" we are afraid that would be very little, while there would be a very great expenditure of fuel. 3. Use some cheap printer's ink, and thin it with thin varnish.)—TYRO. (See index just issued.)—GAMMA. (A prism. See Ganot's "Physics," or back volumes.)—H. T. (One part glue, four parts glycerine. Given many times.)—E. B. (You will find some information from personal experience; but why not take the official publications and the "Australian Handbook," issued by Gordon and Gotch.) — SAMOTHES. (Presumably you mean the famous experiments on the Bedford Canal, in which it was demonstrated that the surface of an apparently level strip of water partakes of the curvature of the earth. See No. 342, and earlier numbers.)—SODA. (That is to say, how you are to conduct your business. Having secured protection or a patent, you must manufacture the article and "push" it, as other people, by advertising it, or by introducing it to those who sell such things.)—NOVICE. (Read the letter on the "Reversibility of the Wimshurst Machine" in last week's number, and the full instructions for making such a machine which have been given in back numbers.)—SALT. (Cast your lead keel with bolts in it, and pass through holes in the bottom of your model yacht.)—JAMES A. FARRAND. (Apply to the advertiser. We know nothing about it. If he wants to sell, he will surely explain.)—H. NASH. (Thanks; but we have already described it—some years ago.)—A. C. JOY. (Will you kindly elucidate your query?)—T. LEEDHAM. (No, they would be illegitimate in the eyes of the law.)—FFINLO. (Wet the dog's coat thoroughly with paraffin oil, taking care that the parasites get a dose. After a few minutes wash thoroughly with one of the dog soaps. From your description they are dog lice. Any system of zoology would have shown you that the dog belongs to the order Carnivora.)—W. H. RUSSELL. (For cutting and polishing pebbles see pp. 521, 543, Vol. XLV. We do not think there is a work on the subject.)—ALLOY. (If you limit the temperature why not refer to a table giving the melting points of alloys?)—ONE OF OURS. (As gas is not available, try the French charcoal stove illustrated in No. 1154, p. 225.)—F. A. D. H. (Make a short coil of insulated wire, and pass a current through it while you move it slowly along both limbs, bringing it nearly off at each end. Two or three times will be sufficient.)—WOOD TURNER. (As you say you have the engine, why not try? We should think it would not be powerful enough for anything but light work.)—FIRE GRATE. (If you have an "improvement" applicable to all kinds of fire-grates, why not take out provisional protection, as it is called, and then endeavour to get some maker of fire-grates to take up the "improvement"?)—LONDON CLAY. (Maxton's "Manual of Engineering Drawing" will probably help you. It is published by Crosby Lockwood and Son, Stationers' Hall-court, E.C.)—TWENTY YEARS' SUBSCRIBER. (If the property is freehold, your elder brother can legally take all, as he has done. If leasehold, all should be divided equally. You had better, in the latter case, consult Mr. Wetherfield, the legal editor of the *Weekly Times and Echo.*)—THOS. GWILLIM. (Write to Mr. T. Henri, 5, Northumberland-avenue, London, S.W. His spectacles are the best we know.)—VERAX. (Legal queries must be addressed to Mr. Wetherfield in the column he edits in the *Weekly Times and Echo.*)—F. S. FOWLE. (It would certainly be better to reply—at any rate, to the questions asked—in these columns. At present many readers, and we ourselves, are a little in the dark.)—LUMEN. (Stock Exchange gambling is quite outside our province. Very few people *can* understand the lying statements of the "bucket-shop" keepers.)—J. C. SOMERSET. (The substitution of a dormer window is the obvious and only effectual remedy.)

Mr. C. B. Harness, the eminent Medical Electrician and Inventor of the world-famed Electropathic Belt (price [illegible] post free), may be consulted daily free of charge, personally or by letter, at the Electropathic Establishment of the Medical Battery Company, Limited, 52, Oxford-street, London, W. (corner of Rathbone-place). All in search of health should call to-day if possible, or write at once. Thousands of testimonials. Note only address above.

Brilliant Lacquer Dyes.—These can be produced (according to the *Metallarbeiter*) in the following manner:—Half drachm of boracic acid, 15 drachms of white shellac, 15 drachms of mastic, and 15 of Manilla copal are dissolved in 1½ pint of absolute alcohol. It is left at rest for at least 18 hours, and during that time is occasionally agitated. Three drachms of Venetian turpentine is then added, and shaken until the latter has been thoroughly mixed and dissolved, after which the whole is thoroughly fitered. The colourless lacquer can be dyed with all kinds of non-acid colouring matters which are soluble in alcohol, and which should be previously dissolved.

Paperhangers' Paste.—Paperhangers' paste is best made by first heating the water to boiling, then adding flour, stirring constantly to prevent the formation of lumps. The flour may be passed through a sieve, so as to insure it more equal distribution. Agitation is continued until the last has rendered the mass of the desired consistency, and after a few [illegible] further [illegible] it is ready for use. In order to increase the [illegible] d[illegible] resin in proportion of [illegible] of the weight of the flour [illegible] its souring, oil of cloves or [illegible] acid should be added.

The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, MARCH 30, 1888.

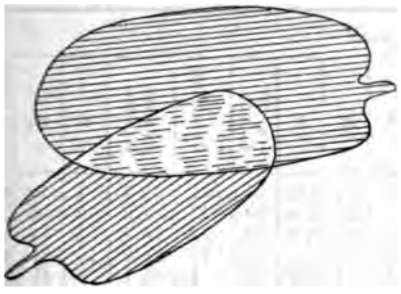
MICROSCOPICAL ADVANCES.— XXXIV.

By Dr. ROYSTON-PIGOTT, M.A. Cantab., F.R.S., F.R.A.S., Memb. Roy. Coll. Physicians; Fell. Cambridge Phil. Society; formerly Fellow of St. Peter's College, Cambridge.

Researches in High-Power Definition.—Interferences, Disappearances, and Reappearances.

THE commonest order of interference phenomena is seen when parallel lines in two sets intersect each other. These appearances are longer or shorter as the angle of intersection is more or less acute.

Examples.—If two scales of azure blue cross each other rather obliquely, beautiful interference phenomena are developed exactly resembling Podura markings, and these markings are longer or shorter, according to inclination of the parallel ribs. Dr. Carpenter has copied my figure, p. 727 ("Revelations," &c.), without acknowledgment. These interference markings are striking demonstrations how they may be produced by intersecting ribs on scales in general. (See annexed figure.)



They are often beautifully seen in intersecting scales of the *Lepisma saccharina*, and in many others.

When double ribs intersect, the phenomena become more recondite. The true aspect of a rib, considered as a fibre, is a set of parallel dark margins of extreme fineness, and surprising equality using central illumination; but the slightest eccentricity produces a black shadow, much thicker on one side than on the other.

If we suppose two fibres crossing each other nearly in the same plane, a new phenomenon starts into view; these dark margins become interrupted at regular intervals, and then wholly disappear. (Parallel rays illumination answers best.)

Examples.—Still using the ribs of the *Podura domestica*, direct light, and an extremely fine "*oel*" *glass*, by Zeiss, under a power of 1,500, there glance forth long ridges, or rugæ, displaying a sharp, glittering definition. Indeed, the ribs appear glassy, with an exquisite polish. But the slightest focal change presents a different aspect (demonstrating exquisite construction of the optical parts). The long ribs appear absolutely structureless. But in a deeper focal plane they appear double, whereas in a much higher plane the markings spring ...h.

..., now, the angular aperture of this ...ous lens be reduced as well as that of the ...lenser, and if I raise the focal plane by minute changes, there appear lozenge...ed interferences of a dark colour, which ...any places appear perfectly continuous. ... will now introduce an experiment which ...prised me exceedingly—the appearance of ...ularly abrupted interference lines.

Data.—Wray "half inch" of 44° as condenser; eye-tube 10in.; C eyepiece; nice daylight, though cloudy. Index collar 39°. Pow. and Leal. immersion, ⅛ water. Result: the ribs are mottled blue and rose colour, but continuous, beautifully shaded off with regular chromatic patches, pink beads peeping between.

Another ⅛ of exceedingly fine quality, its screw collar having two and a half full turns. Light, as before (immersion with water). Highest possible focal plane; no beads are seen whatever, only the standard optician's markings.

The development of these focal lines in a plane above the ribs, and of a discontinuity in the rows of spherules, in this scale (*P. domestica*) is the most exquisite order of transcendental definition ever accomplished by their discoverer and observer. Castor-oil succeeded well, gold chloride better. Broken lines of dark spherules made also their appearance, as in the accompanying figure.

The focal lines play from right to left with a change of focus and a change in the obliquity of the illumination.

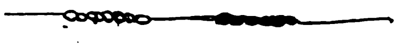
Disappearances and Reappearances.

Bénèche, of Berlin, constructed for me a very fine 1-16th imm. This glass just touches the cover glass of a fine slide of *Podura domestica*. Its very best adjustment causes the cover to lightly compress the scale in view. The contained scale oil is seen to flow within and permeate the flattened sac. Instantly a row of very dark beads vanishes. Using the screw-collar as a fine-focussing adjustment, bead after bead, one at a time, can either be obliterated by extra pressure or be recalled. That part of the molecules which remain touching the cover maintain a dark appearance. They lie in rows, by twos and threes, forming anastomosing V's. The contacts can also be made to reappear or disappear at will by varying the pressure.

Under the most careful collar correction intensely black spherules appear to occupy, like dust-shot, the surface of each rib. But it seldom happens that the thickness of the cover glass precisely allows the exhibition of transcendently fine definition.

Notwithstanding the severe treatment of these delicate structures by compression, the scales in two days entirely recovered their former appearance, so that I ventured with this precious scale once more to drive the oil along its many channels. (These scales are always full of Podura oil.)

The mystery of the recondite structure of these scales is thus completely revealed.



V-shaped rows of dark spherules in contact anastomose. Pressure brings both upper and lower sets into a rare prominence. Crossing bars are composed of double beads. The markings are obliterated when the oil drowns the ribs, and oil globules flash up and down showing focal points of light. The scale can, so to speak, be kneaded; but the original form is again recovered after resilience and rest have played their parts.

Once, when resilience had re-established form, I caught sight of a doubled-up scale, showing its true natural edge and its profile at the line of flexure, marked with sharply-defined ribs, quite black, curving over the convex edge, displaying minute hollows between each rib. I once observed the same thing with a 1-50th on *Pod. curvicollis*.

All observers had hitherto declared the line of flexure absolutely straight and smooth, without any protuberances at the folded edge. This would happen if by hard pressure the scale were flattened down.

(*To be continued.*)

ASTRONOMY FOR AMATEURS.*

THE large and steadily-increasing army of amateur astronomers has been the main origin, we suspect, of sundry useful works which have been added to astronomical literature within recent years, for although all cannot afford to purchase really good instrumental appliances, many are now studying the science, or its rudiments at any rate, simply to understand something of the aspects of the starry heavens. The work which has been edited by Mr. Oliver is a "practical manual of telescopic research in all latitudes adapted to the powers of moderate instruments," and it is of especial value, because the various subjects are treated by specialists, the contributors being T. W. Backhouse, S. W. Burnham, J. Rand Capron, W. F. Denning, T. Gwyn Elger, W. S. Franks, J. E. Gore, Sir H. Grubb, and E. W. Maunder, while many valuable suggestions were offered by amateur and professional astronomers whose names are well known to our readers. As the editor pertinently observes, "for successful results to be obtained with small or moderate instruments, it is absolutely necessary that the work be selected with strict regard to the powers of the tool and the capabilities of the worker." The observer whose instrumental power is limited to a three-inch telescope cannot expect to do good work in measuring double stars, and one whose keenness of vision may be excellent, but who is unable to distinguish colours definitely, should not attempt to work on stellar chromatics. This is a manual for the practical worker—amateur though he may be—and as such it differs from those works which are rightly regarded as popular treatises on astronomical subjects. It is meant to fill, and it does fill, a place of its own, while the editor recommends the young telescopist in search of the beauties of the firmament to begin with Proctor's "Half-hours," Capt. Noble's "Hours with a Three-inch Telescope," and later on to procure Webb's invaluable "Celestial Objects." In his preliminary chapter Mr. Oliver observes that astronomical science owes much to the work of amateurs, by which term he means those who have but a limited equipment, and he proceeds to point out how those who are willing to take up the study of any branch can best serve to promote astronomy. Referring to "Amateurs abroad," we think the editor is scarcely just to Australia when he says that the telescopes to take advantage of its cloudless skies are few and far between. Our own columns have contained many excellent letters from correspondents in Australia, and we believe Mr. Tebbutt's example will before long be widely imitated. Chapter II. is by Sir Howard Grubb, and deals with the choice of a telescope and the method of working it, with a note on small observatories for amateurs. This chapter has some useful additions in the shape of notes by Mr. W. S. Franks. Sir H. Grubb says that one of the mistakes made by beginners is the crowding on of too much magnifying power; and he points out that the lowest possible power which will show an object is always to be chosen. Having given hints on the selection and use of the telescope, Chapter III. (by Mr. Maunder) naturally is devoted to the Sun, though the great luminary is probably not a subject that many amateur observers would care to take up, except from the spectroscopic and photographic points of view. (We may mention here that Mr. Oliver is preparing a work which will be a practical manual of astronomical spectroscopy and photography, and be entitled "Celestial Physics.") The next chapter is rather a long one, and is devoted to the Moon. As no initials are appended we presume it is a compilation by the editor of various contributions sent him—some notes from Mr. Gwyn Elger no doubt; but it is an epitome of selenography, with an index map of the lunar surface. Chapter V., the Planets, bears the initials of Mr. Denning, and the next, devoted to "Comet-Seeking," is also by the same writer. The chapter on double stars bears the well-known initials, S. W. B., and is, therefore, evidently by a past master in the art of double-star observing, while it is accompanied by a useful appendix from the pen of Mr. J. E. Gore, who also apparently contributes the bulk of the chapter on variable stars. Chapter IX., on Star Colours, is signed with the initials of Mr. Franks; and that on Stellar Distribution is by Mr. Backhouse. Mr. Rand Capron contributes a short chapter on the Aurora, and those on the zodiacal light and meteors are, we presume, compiled by the editor. It will be understood from what we have said that the information contained in this volume is suited to the wants of the amateur who is taking up some branch of practical astronomical work, and we need only add that the editor has done his work well, and has produced a manual which will be welcomed by many who own a telescope, or are thinking of purchasing one.

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* Astronomy for Amateurs. Edited by JOHN A. WESTWOOD OLIVER. London: Longmans.

ASTRONOMICAL NOTES FOR APRIL, 1888.

The Sun.

Day of Month.	Souths.	At Greenwich Mean Noon.		
		Right Ascension.	Declination North.	Sidereal Time.
	h. m. s.	h. m. s.	° ′ ″	h. m. s.
1	0 3 45·47 P.M.	0 44 51	4 49 22	0 41 5·93
6	0 2 17·12 ,,	1 3 6	6 43 34	1 0 48·70
11	0 0 54·41 ,,	1 21 26	8 34 56	1 20 31·46
16	11 59 39·20 A.M.	1 39 53	10 22 43	1 40 14·23
21	11 58 33·09 ,,	1 58 30	12 6 14	1 59 56·99
26	11 57 37·65 ,,	2 17 17	13 44 44	2 19 39·76

The method of finding the Sidereal Time at Mean Noon at any other Station is described on page 403 of Vol. XLVI.

Sunspots appear at uncertain intervals, but, the minimum being now past, should be watched for on every clear day.

The Zodiacal Light is still visible in the west, after sunset at the beginning of the month.

The Moon

Enters her Last Quarter at 41·3m. past noon on April 3rd, and is New at 9h. 7·7m. a.m. on the 11th. She will enter her First Quarter at 11h. 52·2m. a.m. on the 19th; and be Full on the 26th at 6h. 22·1m. in the morning. At this last-named date High Tides may be looked for.

Day of Month.	Moon's Age at Noon.	Souths.
	Days.	h. m.
1	19·8	4 1·7 a.m.
6	24·8	8 34·2 ,,
11	0·1	0 13·4 p.m.
16	5·1	3 57·0 ,,
21	10·1	8 14·3 ,,
26	15·1	12 46·7 ,,

The Moon will be in conjunction with Mercury at 11h. p.m. on the 8th; and with Venus at one o'clock the next morning; with Saturn at 1h. p.m. on the 19th; with Mars at 10h. p.m. on the 24th; and with Jupiter at 1h. a.m. on the 28th.

Occultations of (and a near approach to) Fixed Stars by the Moon.

Day of Month.	Name of Star.	Magnitude.	Disappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.	Reappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.
			h. m.		°	°	h. m.		°	°
16	χ^2 Orionis	6	9 27 p.m.	Dark	98	139	10 26 p.m.	Bright	261	300
19	θ Cancri	6	7 34 ,,	Dark	54	70	8 45 ,,	Bright	278	308
22	B.A.C. 3837	6	6 9 ,,	Dark	122	90	7 32 ,,	Bright	193	173
25	65 Virginis	6	†4 19 a.m.	S.S.W.	339	17				
28	χ Ophiuchi	6	5 46 ,,	Bright	64	96	‡6 44 a.m.	Dark	279	316

† A near approach. ‡ Moon has set. A description of the construction and use of the above table, illustrated by a diagram, will be found on p. 403 of Vol. XLVI.

Approximate Times of the Greatest Eastern Elongations of Saturn's Five Inner Satellites visible at Greenwich.

Day of Month.	Satellite.	H.	Day of Month.	Satellite.	H.	Day of Month.	Satellite.	H.
3	Mimas	1·6 a.m.	12	Tethys	10·6 p.m.	21	Mimas	10·0 p.m.
3	Enceladus	8·7 p.m.	13	Dione	1·8 a.m.	23	Enceladus	1·3 a.m.
3	Mimas	12·3 ,,	14	Dione	10·0 p.m.	23	Dione	12·4 p.m.
4	Dione	8·8 ,,	15	Rhea	9·2 ,,	24	Rhea	10·2 ,,
4	Mimas	10·9 ,,	15	Tethys	10·1 ,,	25	Dione	8·8 ,,
6	Rhea	8·3 ,,	18	Enceladus	10·6 ,,	29	Enceladus	9·7 ,,
7	Enceladus	11·4 ,,	19	Mimas	12·7 ,,	30	Tethys	12·7 ,,
11	Tethys	1·3 a.m.	20	Mimas	11·4 ,,			

An illustrated description of the above table will be found on p. 404, Vol. XLVI.

Jupiter's Satellites.

Day of Month.	Satellite.	Phenomenon.	H.	M.	S.	Day of Month.	Satellite.	Phenomenon.	H.	M.	S.	Day of Month.	Satellite.	Phenomenon.	H.	M.	S.
1	III	Ec D	3	37	40 A.M.	11	III	Tr I	12	54	P.M.	20	II	Tr I	1	50	A.M.
1	I	Oc R	3	45	,,	12	III	Tr E	2	22	A.M.	20	II	Sh E	2	51	,,
1	*III*	*Ec R*	5	12	54,,	12	*II*	*Tr I*	11	30	P.M.	20	*II*	*Tr E*	4	16	,,
1	*I*	*Sh E*	11	53	P.M.	12	II	Sh E	12	16	,,	21	*II*	*Oc R*	10	21	p.m.
1	I	Tr E	12	53	,,	13	II	Tr E	1	56	A.M.	23	I	Sh I	3	21	a.m.
3	*II*	*Ec D*	12	8	30,,	15	*I*	*Ec D*	4	21	11,,	23	I	Tr I	4	1	,,
4	II	Oc R	4	31	A.M.	16	I	Sh I	1	27	,,	23	I	Ec D	12	43	15 P.M.
5	*II*	*Tr E*	11	34	P.M.	16	I	Tr I	2	15	,,	24	I	Oc R	3	32	a.m.
7	*I*	*Sh I*	5	5	A.M.	16	I	Sh E	3	39	,,	24	*I*	*Tr I*	10	27	p.m.
8	I	Ec D	2	27	37,,	16	*I*	*Tr E*	4	27	,,	24	I	Sh E	12	1	,,
8	*I*	*Sh I*	11	33	P.M.	16	*I*	*Ec D*	10	49	37 P.M.	24	I	Tr E	12	38	,,
8	I	Tr I	12	29	,,	17	I	Oc R	1	46	A.M.	27	II	Sh I	2	56	a.m.
9	I	Sh E	1	46	A.M.	17	*I*	*Tr E*	10	53	P.M.	27	*II*	*Tr I*	4	8	,,
9	I	Tr E	2	40	,,	19	III	Sh I	1	11	A.M.	28	II	Oc R	12	39	p.m.
9	*I*	*Oc R*	12	0	P.M.	19	III	Sh E	3	2	,,	29	*III*	*Oc D*	9	41	,,
11	II	Ec D	2	42	29 A.M.	19	*III*	*Tr I*	4	22	,,	29	III	Oc R	11	8	,,
11	*III*	*Sh E*	11	4	P.M.	19	II	Sh I	12	21	P.M.						

Ec Eclipse; Oc Occultation; Tr Transit of Satellite; Sh Transit of Shadow; D Disappearance; R Reappearance; I Ingress; E Egress. The printing of a phenomenon in *italics* indicates that its visibility is rendered doubtful, either by the brightness of the twilight, or by Jupiter's proximity to the horizon.

Mercury

Is a morning star throughout April, but rises too short a time before the Sun to be at all favourably situated for the observer. He is, *moreover*, an uninteresting object in the telescope, and his angular diameter decreases from 7·4″ on the 1st to 5·2″ by the end of the month.

Day of Month.	Right Ascension.	Declination	Souths.
	h. m.	° ′	h. m.
1	23 5·3	7 48·2 S	10 24·5 a.m.
6	23 27·4	6 0·7 ,,	10 26·8 ,,
11	23 52·2	3 37·7 ,,	10 31·9 ,,
16	0 19·5	0 43·6 ,,	10 39·5 ,,
21	0 49·1	2 37·8 N	10 49·3 ,,
26	1 21·2	6 21·9 ,,	11 1·7 ,,

The path indicated by the above ephemeris begins in Aquarius and extends over a very considerable part of Pisces. It lies in a very barren region of the sky. Mercury will be in conjunction with Venus (1° 10′ south of her) at 4h. a.m. on the 14th.

Venus

Is also a morning star all through April; and the remarks which we have made above as to the unfavourable nature of Mercury's position apply equally to hers. Her form continues daily to grow more circular in the telescope, and her angular diameter diminishes from 11·2″ on April 1st to 10·4″ on the 30th.

Day of Month.	Right Ascension.	Declination.	Souths.
	h. m.	° ′	h. m.
1	23 9·1	6 54·1 S	10 28·2 a.m.
6	23 31·9	4 36·0 ,,	10 31·3
11	23 54·5	2 14·4 ,,	10 34·2
16	0 17·1	0 9·2 N	10 37·1
21	0 39·6	2 33·3 ,,	10 39·9
26	1 2·2	4 56·6 ,,	10 42·7

Starting from the confines of Aquarius a Pisces, Venus then describes a path in some spects similar to that of Mercury. The co junction of the planets during the early mo ing of the 14th has been referred to above.

Mars

Comes into opposition to the sun at 6h. on the 11th, and although he has unfortur South Declination, is as favourably plac e observer, as he will be for some time to come. is angular diameter on the 1st is 17·6″, and is, about the time of actual opposition ineases to 18·4″, diminishing insensibly to ″ by the end of the month. For all pracal purposes the disc of the planet is now cular, and the chief markings may be tected with moderate optical power. He is ible during the whole of the working hours the ordinary observer's night.

Month.	Right Ascension.		Declination South.		Souths.		
	h.	m.	°	′	h.	m.	
1	13	36·8	7	26·1	12	53·6	p.m.
6	13	30·0	6	54·4	12	27·2	”
l1	13	22·8	6	21·3	12	0·3	”
l6	13	15·5	5	48·5	11	33·3	”
21	13	8·4	5	18·0	11	6·6	”
26	13	1·9	4	51·4	10	40·4	”

The retrograde arc above indicated is scribed to the North-east of Spica Virginis.

Jupiter

uths during the morning hours, but rises on e 1st about 11h. 20m. p.m., and more than . sooner by the 30th. Hence towards the end April he is fairly visible by midnight. Most fortunately, his great South Declination is ribly against his observation with the telepe ; his proximity to the horizon, even when the meridian, rendering the use of high gnifying power impossible. His equatorial meter increases from 39″ on April 1st to 5″ on the 30th.

Month.	Right Ascension.		Declination South.		Souths.		
	h.	m.	°	′	h.	m.	
1	16	18·1	20	22·7	3	38·3	a.m.
6	16	17·3	20	20·4	3	17·9	”
1	16	16·2	20	17·4	2	57·1	”
6	16	14·8	20	13·6	2	36·1	”
1	16	13·1	20	9·2	2	14·7	”
6	16	11·2	20	4·2	1	53·2	”

tarting thus from a point in the southt corner of Ophiuchus, Jupiter will be relling towards β Scorpii through the ire month.

Saturn

now approaching the West, and should be ked for as soon as ever it is sufficiently dark e seen to any advantage. He souths after Sun has set at the beginning of April, but n the meridian in bright sunshine at the . of it. He is in quadrature with the Sun 2h. p.m. on the 19th, and hence is exceltly placed for seeing the shadow of his be upon the rings, beyond which his th Pole now sensibly projects. His angular uatorial diameter diminishes almost impertibly from 17″ on April 1st to 16·2″ by the h.

Month.	Right Ascension.		Declination North.		Souths.		
	h.	m.	°	′	h.	m.	
l	8	7·6	20	48·8	7	25·3	p.m.
	8	7·7	20	48·5	7	5·7	”
l	8	8·1	20	47·6	6	46·4	”
	8	8·6	20	46·1	6	27·3	”
	8	9·3	20	44·1	6	8·4	”
	8	10·2	20	41·5	5	49·6	”

he short arc thus described by Saturn during il begins at a point a little to the southof μ^2 Cancri, and trends in the direction and the Præsepe in the same constella-.

Uranus

es into opposition to the Sun at 1 p.m. on 4th, so that he is now as favourably placed the observer as he will be for some time to e, being visible throughout the whole of working night of the ordinary amateur rver. His diameter subtends an angle of 4″ throughout April, and his planetary disc at once differentiates him from the surrounding stars.

Day of Month.	Right Ascension.		Declination South.		Souths.		
	h.	m.	°	′	h.	m.	
1	12	57·5	5	23·9	12	14·4	p.m.
6	12	56·7	5	18·9	11	54·0	”
11	12	56·0	5	14·0	11	33·5	”
16	12	55·2	5	9·2	11	13·1	”
21	12	54·4	5	4·5	10	52·7	”
26	12	53·7	5	0·1	10	32·3	”

This short retrograde arc is described in that blank part of Virgo which lies to the right of the 4-5th magnitude star θ in that constellation, and commences at a point roughly three diameters of the Sun to the west of that star.

Neptune

Is now lost in the glare of the Sun's rays, and has left us for the season.

Shooting Stars

Are somewhat more numerous in April than in either March or May. Showers may be anticipated between the 9th and the 13th ; from the 19th to the 23rd, and again from the 26th to to the 30th.

Greenwich Mean Time of Southing of Ten of the Principal Fixed Stars on the Night of April 1st, 1888.

Star.	Souths. h.	m.	s.	
β Cancri	7	28	7·17	p.m.
ι Ursæ Majoris	8	9	6·34	”
α Hydræ	8	39	34·37	”
Regulus	9	19	47·23	”
α Ursæ Majoris	10	14	3·38	”
δ Crateris	10	30	56·03	”
ε Corvi...	11	21	25·35	”
γ¹ Virginis	11	52	57·09	”
α Canum Venaticorum ...	12	7	43·04	”
Spica Virginis...	12	36	0·09	”

The method of finding the Greenwich Mean Time of Southing of either of the stars in the above list for any other night in April, as also that of determining the local instant of its Transit at any other station, will be found on p. 404 of Vol. XLVI.

ON THE "E. M." AND OTHER TELEPHONES.*

By S. R. BOTTONE.

HAVING been requested by several of the readers of "Ours" to reproduce certain articles in which the telephone invented by Mr. H. B. T. Strangways was originally described, I hasten to comply. In order to render the articles as complete as possible, and to facilitate comprehension by such as have not traced the telephone from its infancy, I propose giving a brief outline of the principles on which the action of the telephone depends, as well as glancing at such forms as, from their originality or clearness of articulation, merit consideration.

§1. *Sound.*—When elastic bodies are caused to undulate or vibrate, and these vibrations communicate themselves to the delicate membrane known as the "drum of the ear," sound becomes perceptible. Not all vibrations are capable of thus awakening sound in the human ear, the extreme limits lying between 16 vibrations per second on the one hand and 40,000 vibrations on the other. It is also noteworthy that the power of hearing acute sounds (those which require a very great number of vibrations per second to elicit them) varies in different individuals. Many a time have I heard the air literally thrilling with the sharp, shrill shriek of bats on a summer's eve, while a friend, whose attention I endeavoured to direct to the sound, declared that absolute silence reigned. Sounds differ from each other in several points—viz., they may be high or low, loud or soft, pure or compound, musical or noisy. The difference between high and low sounds, or "pitch," depends on the number of vibrations made per second by the vibrating body ; the loudness depends on the size of the vibration set up, or *amplitude*, so that a small drum, even if vibrating at the same rate, cannot give such a loud sound as a big one.

On the purity or mixture of pitches depends the "timbre," "clang-farbe," or "clang-tint" of the sounds heard. Musical sounds may be defined as those in which the vibrations succeed each other in given rhythmical order. Noises are set up by vibrations having no rhythmic relation to each other.

§ 2. *Reproduction of Sounds.*—It is evident by a consideration of the above section that it is possible to *reproduce exactly*, at any time and at any place, any given sound—be it loud, soft, high or low, rich or poor, musical or noisy —providing we can reproduce at, or convey to any given spot, the vibrations which originally gave rise to that sound ; and, moreover, that the sounds thus reproduced may be made softer by diminishing the amplitude of the reproduced vibrations, without altering the number or variety of vibration, the pitch and general characteristics remaining the same. On the other hand, if the amplitude of the vibrations be increased, the loudness of the reproduced sound will be increased in like manner ; and, lastly, if any of the vibrations be suppressed or strengthened, a modification in the general character of the sound reproduced will take place.

Perhaps some of the older among my readers may remember a musical illusion of a very pleasing character which was exhibited in London some years ago, in which a grand piano standing in the centre of a raised daïs emitted music without any visible performer. The sounding-board of this instrument was in elastic connection with a long cylindrical rod, the lower end of which rested on the sounding-board of another piano, which was being played upon in a room in the basement of the building. The vibrations set up by the performer on the piano on the lower floor were communicated in all their complexity and variety to the sounding-board of the instrument above, with, however, a little loss in amplitude, so that a similar sound, but somewhat weaker, appeared to arise from this second piano.

ELECTRIC ALARM CLOCKS AND WATCHES.

ALARM clocks which can be set to mechanically sound a gong at a specified time have been for many years past used by those who have required to be awakened in the morning from their too-sound slumbers in order that they may proceed to their work, and into a great number of households have such clocks found their way for this special purpose ; but since electricity has been introduced into so many homes for electric bell-ringing, fire and thief alarms, and telephone working, a demand has arisen for clocks so fitted that upon two contacts being mechanically closed at a set time they shall ring an electric bell. Such a clock can be used for other purposes than for that already mentioned. For instance, time signals can be given in any part of a factory, hospital, or other building, the bell being placed in any required situation away from the clock, as it is not necessary in an electric system that the clock and bell should be together. The clock may be in one department in which it is of most use, and the bell in the room or department in which it is required. The battery power may be supplied by those cells which are already being used for giving the current necessary for ringing the call-bells, working the telephones, or igniting the gas throughout the building ; thus a clock may be caused to sound an alarm in any one room or department, or, indeed, for the whole building, at a specified time, or it may be so arranged that alarms may be given by this one clock in different rooms, each room at a different time, the several bells being connected to separate contacts on the clock. In the United States of America clocks electrically fitted are largely used in connection with the system of call-bells and thief alarms ; the whole system being controlled by one contact which, upon the household retiring for the night, is automatically closed by the clock until morning, the detector being then switched off by the clock. The servant can proceed open the doors and windows without fear of uselessly arousing the slumbering inmates.

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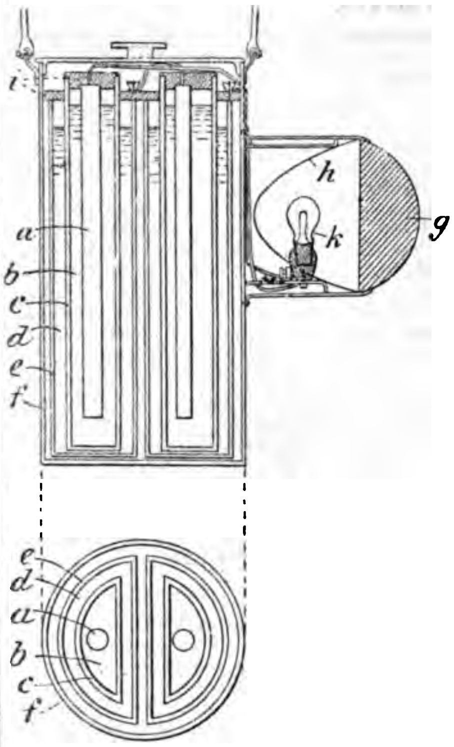
Clocks whose motive-power is electricity are in use to some extent, as also are those instruments which, by a special mechanism, electrically control a system of dials placed in various parts of a building or (in some cases) a town: again, there are clocks now made that never run down, the spring being kept at a uniform degree of tension with regard to the escapement that such an operation as a periodical winding is not required, the winding being effected by means of an electro-motor within the case of the clock, a constant current battery of a few cells supplying the necessary current.

But it is not so much of clocks so fitted that we now write. Our illustration represents a watch which is fitted to give an alarm when connected with an electric bell in a way similar to the clocks above mentioned. It has been introduced by Messrs. King, Mendham, and Co., of Bristol. It possesses certain advantages over a clock, inasmuch as it is portable, and can be worn in the pocket by day, and is connected up to a bell and battery in the act of placing it upon its stand at night. It is provided with an insulated ring fitted with a small platinum stud, against which the hour-hand as it moves over the stud makes contact, closing the circuit and ringing the bell. The graduation being carried right round the watch-dial, it is possible to set the alarum to go off at the minute, which cannot always be done with a clock, though the contacts may be arranged as carefully as possible. Such an arrangement is specially useful to travellers, as a small battery and bell can easily be carried, which, besides the watch, are all that is required. It has been suggested that when a traveller does not wish to burden himself with such a battery and bell, nothing would be easier than for him to connect on his watch and its stand, by a short length of double wire, to the springs of his bedroom push, which is connected to the system of electric bells throughout the hotel, thus calling up the servant, who, in his turn, can awaken the sleeping owner.

WALKER'S ELECTRIC SAFETY-LAMP.

IN the annexed engraving we illustrate the Miner's electric safety-lamp patented by Mr. S. F. Walker, of Cardiff, which, we believe, has been found to work well in practice. The battery consists of one or more galvanic cells, according to the amount of light required, and the form of lamp used. The cell is constructed by taking an outer containing vessel, made wholly of carbon, or of any metal, and inside this carbon cell or metal cell, placing a cell or diaphragm of porous earthenware, or other suitable material; within this porous cell the positive or generating element is suspended, and it may be of zinc, iron, or any other substance, which will form with the substance of which the outer containing vessel is composed, a galvanic cell. The zinc or other substance is immersed within the porous cell, in dilute sulphuric acid, or any other suitable electrolyte; and in the space outside the porous cell, within the outer containing cell, is placed a suitable oxidant, such as bichromate of potash, nitric acid, or any other substance proper to the combination and that will neutralise the hydrogen gas. If only one cell is used in connection with the lamp, it is made of a cylindrical, square, or any other suitable form; but if two or more cells are used, they are made of such a form that when placed *together they take* the same form that the single cell would have. Thus, if two cells, semi-cylindrical; if three or more, of such a form that their section through their shortest dimension is a sector of a circle. Or, if there are two or three cells, they may be oblong, so that when placed together they form a square; or, if there are four cells, square in section, and of such dimensions that when placed together they build up into the form of a larger square. The cells, whether one, two or more, are placed within an outer containing vessel, which may be of metal, ebonite, or any suitable material, taking the precaution to insulate the cells from each other and from the outer containing vessel if the latter be a conductor, and also to prevent the liquids in the cells escaping. The outer containing vessel is fitted with a cover, which may be of metal, ebonite, or other suitable substance. In some cases the incandescent lamp is attached to this cover. In the centre of the cover is a flange or collar, with a bayonet joint rising from it, and in the circular space inclosed by this collar, are arranged two springs or plunger connecting pieces, insulated from each other and from the cover. An incandescent lamp with terminal connections known as bottom caps is used; that is, the ends of the filament are connected to two brass plates beneath the lamp, so that when the lamp is affixed to the cover, these brass plates make connection with the springs or plungers below, and the incandescent lamp is held in place by the bayonet joint, and a projecting pin on the base of the lamp. Outside the incandescent lamp is fixed a glass shade or cover, made with a flange, and held in place by another flange on the cover, made airtight by means of another washer. This space between the incandescent lamp and the projecting glass may be filled with water or an inert gas. The plungers or springs have connecting wires under the cover, which may be attached to springs, making connection with the springs connected with the cells. In other cases the incandescent lamp is fixed to the bottom of the containing case, in a similar manner to that described above, or on one side. In either case the final connection which causes the current to pass through the incandescent lamp may be made by placing the cover before described on the containing vessel. To effect this, the connections from the incandescent lamp and from the cells are brought up to suitable springs or connecting-pieces above the rubber pad, so that when the cover is off the tension of these springs holds them out of contact with each other, but when subject to pressure from above, as by putting the cover in place, they come into contact with each other and allow the current to pass. In the cover is another rubber or other suitable pad, which, being pressed down upon the pad which clo the cells, excludes the surrounding air at t same time that contact is made. Between t cover and the cells is an indiarubber pad, other suitable substance, so that when screw down it shall prevent the egress of the liqu should the lamp be inverted. In some case switch is used inside the outer containi vessel, turned by a suitable handle outside, turn the lamp on or out; and in certa cases, as in the lamp for deputies, firem &c., who are required to test for gas, testing apparatus is added, which may b platinum wire within a wire gauze and heat by a portion or the whole of the lamp curre this being controlled by a suitable switch tached to any convenient part of the body the lamp. A suitable locking arrangement provided, so that the cover of the lamp sh not be removed except in the lamp-room. a a handle for the miner to carry it by. Wh it is fixed, the lamp is placed on one side the containing vessel in the focus of a pa bolic reflector, and the aperture of the reflect is closed by a lens, arranged to throw a ho zontal beam when the lamp is held in a verti position. The figure shows the battery, lan reflector, and lens, complete, with the lamp the side of the vessel, and with a section sho ing the arrangement of the cells when two used. *a* is the positive element, of zinc or ot metal; *b* is the inner solution; *c* the por cell; *d* the outer solution; *e* the carbon metal cell; *f* the outside containing vessel the lens; *h* the reflector; *i* the stopper of ind rubber, or other suitable material; *k* is the candescent lamp.



THE AMALGAMATED SOCIETY (ENGINEERS AND TRADE D PRESSION.

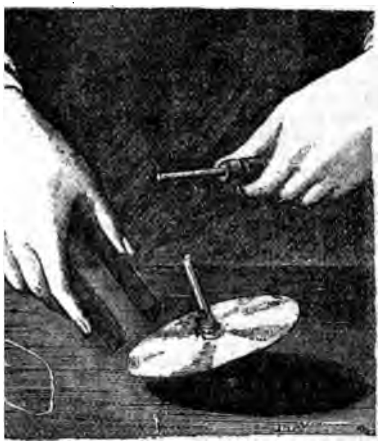
A TEN-GUINEA prize essay competition "The Best Means to Employ the Surpl Labour in the Engineering Trade," is bei arranged by Mr. E. Monkhouse, for the three b essays on the above subject, open to all tick holders. Members and non-members are invit to compete. In addition fifty-two other prizes w be offered to ordinary ticket-holders, twelve them suitable for ladies. Total, fifty-five priz valued £245; tickets 6d. each. Ordinary tick holders will have the chance of winning o essayists two, and bookholders three prizes. Tick supplied by the branch secretaries and offic Bookholders will be allowed a liberal commissi on the tickets they sell.

Mr. Monkhouse will be glad if any memb will assist in carrying out this prize essay comp tition, and will be pleased if they will communic with him. It is no easy task to move a large sp wheel with 52,000 teeth, however smooth the be ings may be; but a few willing hands worki together in unity, to make a pinion, and gear properly with the large wheel, we may not o move it, but keep it going in the right directio and we hope to a good purpose. A committee w be selected from the members, who will vouch f the competition being fairly and honestly carri out. Mr. Monkhouse, now a member of the De ford Branch, and 36 years in the society, w transact the business as secretary. All lette should be sent to E. Monkhouse, 6, Thornt Villas, Bromley, Kent.

MANET'S INDUCTION TOP.

THE induced currents developed in masses metal in motion in magnetic fields a splendidly shown by the classic experiment wi Foucault's disc. But this latter is somewhat costl and complicated, and so we think it of interest make known to our readers an incomparab simpler apparatus, and which we figure herewit This device well shows the existence of the indu tion currents that manifest themselves throu mechanical repulsion, and that, although pa doxical at first sight, are quite easily explained.

This little device, which is constructed by M G. C. Manet, manufacturer of electric apparat consists of a sheet-iron disc mounted upon an a and set in rapid rotation by means of a cord, li the ordinary humming-top. At rest, the disc *attracted* by a horseshoe magnet that is present to any point of its surface; but if, when it revolving rapidly, either of the poles, or both them, be presented to its surface, a *repulsion* w at once ensue, and the top will take an inclin position and keep it as long as its momentu is sufficient. When the velocity is less than certain degree, dependent upon the thickness the disc, upon the magnet, upon its distance, n, &c., the repulsion ceases, and the disc is ed and fixes itself against the magnet, thus ing the magnetic properties of soft iron. The ation of this phenomenon is very simple. the magnet is brought near to the disc in , the latter revolving at great speed in the tic field produced by the magnet, becomes t of induced currents which are so much the er in proportion as the velocity of rotation ter. A mechanical action is then exerted en the disc (the seat of the currents induced



ation) and the magnet, the origin of the tic field. The disc cannot be in equilibrium y moment unless the magnetic attraction isely equal to the repulsion produced by the ts induced in the disc.

uch repulsion is preponderant as long as the as a sufficient velocity, nothing is more l than the fact (apparently paradoxical) isc of soft iron being repelled by a magnet.

n the velocity becomes insufficient, the ion becomes preponderant again, and the attracted anew. If the magnet is presented ot at one of the surfaces, but at the edge, the very plane of the disc, the repulsive will not occur, but an attraction will be ed, as if the disc were at rest. This experi- confirms the preceding explanation, for, in se, the induction currents cannot form, as o is moving in the very plane of the lines e of the field produced by the magnet.

ay be asserted, *a priori*, that the repulsion be still stronger if a disc of copper were uted for the iron one; but the experiment then be less curious, for the apparent x would cease to exist. However this may r. Manet's induction top is a simple and t demonstrating apparatus that will find a n all collections for elementary instruction. *Nature.*

RICHARDSON ON IDEAL FOOD.*

the Memorial Hall, Farringdon-street, E.C., on Friday evening, the 16th inst., Dr. B. W. rdson, F.R.S., delivered the third of the series of six lectures, entitled "The Study ds as a Question of Supply."

Richardson, in commencing his lecture, said n the search for the Ideal Foods, they ought sider and compare the various parts of the hat received those foods, so that they might ain what foods were most natural to it, and foods might be considered most decisively in their nature. He had therefore, in his cture, discussed that question, first in regard teeth, and finally in regard to the digestive of the different classes of animals. And the sion they had come to at the close of the e, from the study of those two great sources ervation, was that the human body was made Ideal Food, which came after the character it. It was shown that neither the teeth nor igestive system was adapted properly for l food, nor for a purely vegetable diet, but e of fruit. At the close of his last lecture he een asked to show and compare, in one or diagrams, the characteristic features of the ive system respectively of a fruit-eating l and man. That was a most pertinent and tant question, and a very interesting one to r. Prior, therefore, to proceeding with the t matter of the present lecture, he would before them three diagrams, in response to estion thus addressed to him.

would take the intestinal canal of the gorilla, the series of high-class apes, and the nearest to man, as affording a good illustrating of a purely fruit-eating animal; and they would there see the close analogy between the two digestive systems. There was a slight difference in the liver, a small cleft existing in that of the gorilla which was absent in the human subject. This, however, did not interfere with the functions of digestion. The stomach was the same shape. The pylorus, or tube leading into the small intestines, was a little longer in the gorilla with a greater curve. The small intestines were of the same character; but in the large, the final intestine, there is a little difference. In the first place, in man there was a small extension, a little process, as it was called, coming off from the intestines, which was wanting in the gorilla; and in this animal the large intestine was relatively considerably longer than in man. It was also less corrugated, with less folds and a simpler, plainer tube than in the human subject. These, then, were the sole differences between the two; and doubtless if man became a fruit-eating animal, pure and simple, these differences would soon disappear. The food of the gorilla was uncooked, and eaten in different states of ripeness; it was also eaten entire with the skin and internal parts, and thus there was a great deal more of undigested residue than in man; and that would lead to larger accumulation in this intestine, and therefore increased size and length. There was also one further difference. In man the small intestines offered a very large surface for absorption. On the screen was portrayed a portion of the human small intestine, laid open, and they would observe that the surface throughout was raised into folds. These folds gave increased surface, so that the final digestion and absorption of the food was made quicker and more perfect. These intestinal folds were wanting in purely fruit-eating animals. Digestion with them was completed in the stomach, or upper part of the canal, so that the further process was not wanted; hence with them this tube was quite smooth. Wherever Nature wanted to give surface for any purpose in the body, she did it by folds, as, for an example, in the convolutions of the brain. It would seem, then, that the food taken by man had led to the requirement of greater surface than was present in the lower—the pure fruit-eating animal. This was the only distinction he could discover between the one class of animals and the other. So that they might be quite safe in saying, if asked, that the difference in the digestive systems of man and these lower animals was infinitely small, and that the adoption by man of a purely fruit diet would in course of time bring the two systems to a level. Whether this would be to the advantage of the higher animal or not, he would not presume to say.

The present lecture would treat of the natural and national supples of food. In order to get at the Ideal Food, they must not only understand the body that utilised the food, but they must understand the food itself—what food meant, what drink meant—what they really were. It was only within the past fifty years that men of the highest rank had arrived at the truth in regard to this question. The whole world was greatly indebted to the eminent chemist, Baron Liebig, for the admirable division he made of foods and their different qualities. When they came to look at foods by the light of their modern knowledge, they found that there were four great classes of foods required; and to learn this simple lesson was one of the greatest importance. Everybody ought to learn it and understand it; every child ought to know the nature and qualities of food. They wanted, in the first place, water, and in very large abundance. Water was essential, and in very considerable quantities, for it played a most important part as forming the basis of the body and of the foods they ate. It made the foods soluble, for without it they could not swallow them. It carried the food to the different parts of the body so that each part could take what it required. Water equalised the temperature; it carried warmth with it to all parts, and again, by evaporation from the body, kept it cool. When a moist surface was exposed to warmth, it began to steam, and anything included in that surface was kept cool by the water. Water, therefore, warmed the body and cooled it; but it also served for building-up purposes. It formed 68 per cent. of the whole body, and there was no known substitute for this important constituent of man. It was the first necessity of all: of the vegetable eater as of the animal eater. It was wonderful how long the body would live on water. Men had lived solely on water for many weeks at a time taking nothing else. All the experiments made by fasting men were of this kind; it was water that kept their bodies going—though, of course, they were working at low pressure. Dr. Tanner did not fast, strictly speaking, because he took water; and often in disease people lived for many weeks and months with very little food, but taking water freely.

Next, they required a specific kind of food to burn—what, in the strictest sense, might be called the fuel of the body. This was also an essential requirement, something that would undergo combustion in the body, and keep up the animal heat. It was essential that the temperature of the body should be kept up to a certain point; if not, disease would ensue. The temperature considered natural by Fahrenheit's scale was between 98 and 99; and if man lived at the Poles or at the Equator, he did not vary more than one or two degrees with regard to this animal temperature. If the body went beyond that point, fever was produced, and a febrile state; and if it got below it, they had something approaching the insensibility and fatal sleep produced by intense cold. So, in some diseases, the temperature down down so rapidly, from the loss of water, as in cholera, that a practised hand might tell the nature of the disease almost by the feel of the body. He thought he could himself so tell—the general evidences, the coldness, was so marked. They had, therefore, to provide that, in the extremes of climate, this equable temperature of between 98 and 99 should be present; and to insure this something must be taken to burn—to burn in the sense of fire, as in a grate, a candle, or a lamp. But this fire was a slow fire—a slow fire, but a real fire; and so striking a resemblance was there between this fire and that of a candle or a lamp, that positively the products of combustion were the same. If they examined the products of the burning candle they would find carbonic acid gas and water were given off, and these two were given off by the living fire of the body. They could see the water escaping in the breath in cold weather; and the horses in the omnibuses when they stopped blew off volumes of steam. This slow burning in the body might compare with the burning which went on in dried wood—that slow burning decay which gave a slight luminosity to the wood or the plant substance. Sometimes there was a sort of spontaneous combustion, as when hay-ricks caught fire. In the human body this slow combustion was brought about by the oxidising of certain foods. They took this food into the blood, where it came in contact with the air from the lungs, and was carried to the extreme parts of the body, and a combination took place between the oxygen of the air and the substance to be burnt; and then this slow-burning was set up, and gas was produced and thrown off by the breath, with water both by the skin and lungs. They wanted foods, then, for slow combustion.

Before Baron Liebig's time, the difference was not known between an egg and the butter one might put into it. Liebig pointed out that in foods we had two great classes—in fact, three; and that in one of these classes combustion took place. These were substances like starch, sugar, and oils, butter, the fat of animals, the oils of vegetable substances, and fruits and nuts. Some nuts contained a large proportion of fat, which would burn when put into the fire. Dr. Arnit drew up a very interesting and curious table dealing with these substances, and made a comparison between man and a steam-engine. The steam-engine in action took in fuel, coal and wood, both being old, dry vegetable matter. Man, an animal body, in life took in food—viz., recent or fresh vegetable matter and flesh, both being of kindred composition and both combustible.

The steam-engine took in water. Man took in drink—water. The steam-engine took in air. Man took in breathing air. The steam-engine produced steady boiling heat at 212° by quick combustion. Man produced animal heat at 98° by slow combustion. The steam-engine produced steam—carbonic acid and vapour. Man produced foul breath, carbonic acid and vapour. The steam-engine produced ashes, part of the fuel it had burnt. The animal produced refuse, part of the food it had burnt. The steam-engine produced motive force, by simple alternate push and pull of the piston, which became work of endless variety. The animal produced work by the simple contraction and relaxation of the muscles, which, through the limbs, did work of endless variety. In the steam-engine a deficiency of food, water, or air first disturbed and then stopped the motion. In the animal a deficiency of food, drink, or air first disturbed, then stopped the motion—life.

They had, again, another set of substances to supply a further set of foods, and they got these from albumen and its sources—substances that did not burn directly, though they would yield heat on an emergency. In the white of an egg they had a fine illustration of the substance that builds. All substances like jellies, the flesh of animals, and the gluten of wheat, went to build up the tissues and soft structures of the body. These were wanted in comparatively small quantities.

They had, again, another series of foods for the building up of the harder structures. The hard, firm, strong skeleton was made up partly of a jelly-like substance and partly of lime, lime phosphate, oxide of calcium—a metal or base. This was a very beautiful metal, like aluminium, so light and yet so very strong. If they placed a bone on the fire, after a time the jelly-like portion burned, and under a great heat all would be consumed but earthy part. It was the earthy part which solidity to the jelly. But if you took a bone and laid it in diluted hydrochloric acid, a great change would take place: the earthy part would dissolve out, and the bone become soft like seaweed, so that it could be tied into a knot. Sometimes they might see children whose food was deficient in lime afflicted with rickets, the bone being too soft to sustain the weight of the body. In fowls, again, the deficiency of lime would be observed in the softness of the shell of the eggs. These four distinct classes of foods were required; and unless they knew what these classes were, and their nature and meaning, they would get a very poor knowledge of proper food. They would never reach the Ideal Food unless they mastered these facts of natural philosophy.

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* From the *Vegetarian*.

They would now consider what might be called a model diet; a standard of proportion of these different parts; a scientific diet, containing these four classes, water, heat-giving, structure-building, and mineral substances. This could hardly be called a meal in the strict sense of the word. Dividing the scale into 100 parts, or ounces of water, they would want 75°; heat-givers, 25°; flesh-formers, 4°; of mineral foods, 1°. These might be called the individual requirements; but it would be an interesting matter to consider the national requirements. What quantity of food England, Ireland, and Scotland—say, 37,000,000 of people—would require for a day. He had worked it out, and found that they would require in water food 13¾ million gallons; in fuel food, 46¼ million pounds; of animal food, 9¼ million pounds; of mineral food, 1,750,000 million pound. Whether they went to the animal world or vegetable world—whether Mr. Hills had to supply it on his ideal system—the purveyor of flesh-foods on his system—that was the quantity that would have to be supplied. It would be very serviceable to go on a little further with these illustrations, and look at the different constituents in certain of the most common articles of food. Taking the sirloin of beef, for instance, of water there were 50°; fuel, 30°; flesh-formers, 15°; minerals, 5°. In mutton, prime parts; water, 54°; fuel, 16°; flesh-formers, 27°; mineral, 3°. Pork: water, 40°; fuel, 48°; flesh, 10°; mineral, 1·5°. Cheese was remarkable for being very nearly of equal substances—that was to say, in pure cheese, with the cream in it, like Stilton and Gorgonzola, the parts were very nearly equal: water, 35°; fuel, 32°; flesh-formers, 29°; and mineral, 4°. He thought this important for vegetarians to bear in mind; he did not think they were wise in giving up cheese. Old folks used to call cheese a "very sturdy elf, digesting all things but itself." Cheese and brown bread formed a very excellent meal. In the matter of haricot beans, vegetarians would be on their own ground, and these contained of water, 14°; of heat-giving matter, 58°; of flesh-forming matter, 23°; mineral matter, 5°. What was the nature of this flesh-forming matter? Was it albumen, or fibrin, as in flesh-meats? No, it was casein just as in cheese. The Chinese utilised their knowledge of this fact, and made a very curious food—a cheese out of peas and beans. There was a very pretty experiment they might perform if they thought fit. If they took a little fresh bean-flour, and powdered it very fine, then put to that a small quantity of soda and shook them together in a phial with warm water, it would appear a rather milky fluid. If a few drops of dilute hydrochloric acid were now slowly dropped in, they would observe fall down to the bottom the most splendid curds, which, when pressed, made cheese. Some day this would become a great industry, and people would utilise this knowledge to make vegetable cheese, as the Chinese did. Oatmeal contains a very small quantity of water, only 5°; no less than 73° starchy matter for fuel food; flesh-food, 20°; and 2° mineral. In oatmeal they had an excess in proportion of fuel food. People often said to him, without knowing what it meant, "I cannot take oatmeal—it is too heating." It was a common saying, but perfectly true. Oatmeal was too nourishing; it was not fit for a person of plethoric habit; it was too heating a food, and wanted mixing with something else. Its large amount of fuel food, 75°, was out of proportion to the natural requirements. Wheat contains 14½° water; fuel, 71°; flesh, 12½°; and mineral, 2°. They had in wheat a perfect type of food; the proportions were not quite exact, it was not a standard food in itself, but it contained all the elements for making one. They would observe that running round the wheat grain was a series of cells, and would see, too, how beautiful was their shape. What did they contain? Fibrine—what was called gluten or vegetable fibrin. Just as the haricot-bean contained casein, as in cheese; so these cells contained fibrin, a blood constituent. The quantity was about 12½°. Inside this layer was a number of very beautiful six-sided cells, containing starch, or starchy substance; and this formed the great mass of the grain, or 71°. In wheat there was but little water—not enough for all purposes, only 11½°; it would have been necessary to remedy this deficiency *by* taking water.

There was only one other point that he would call attention to before concluding, and that was the immense importance to this country of taking care that no danger should arise as to our supplies of bread stuffs. He had observed in the papers that Captain Warren, son of the Chief Commissioner, had delivered a lecture on the dangers to which they were exposed from want of attention to this subject. This was a serious matter; but it was not a new one. He held in his hand a lecture, delivered in 1880, in which he estimated that there was not more than two or three weeks' supply of cereals. It was one of the most solemn questions they had to face. It seemed to him that they ought to keep this supply of food in their own hands, and ought to lay by a proper store of corn, so that they might never be run to extremities. They ought to keep one year's supply in this country in advance, in order to be prepared for all emergencies.

Mr. Benjamin Whitworth, in acknowledging a vote of thanks, said he never knew he was a steam-engine before. Mr. Richardson's lecture had been an exceedingly interesting one, and a very useful one. As to his last remarks in favour of keeping a store of wheat equal to twelve months' supply for the feeding of the people of this country, he could not agree with him there. He thought that, with all their means of supply, not from one country alone, but every country almost in the world, they did not run any danger whatever from want of food so long as they kept the mastery of the ocean. If they kept a sufficient navy to protect this country from foreign invasion, they could never want food supplies. They must remember that with great improvements in steam-navigation, they could bring wheat from New York in six or seven days. It could be brought even from India in 21 days through the Suez Canal. They must remember, too, that wheat of all sorts deteriorated very much by keeping for a long period. It would cause great depression in the farming interests of this country if they had twelve months' supply on hand. They would be so depressed with that terrible quantity, and the price would be so low, that they would not cultivate grain at all. And then it was not wheat alone that farmers could supply to this country, but oats and barley could be made into human food, that was now supplied for their horses and for other purposes. So that there was not very much fear of any famine so long as they had the enormous powers of carrying from foreign countries which they now possessed. He supposed that Dr. Richardson will eventually show them that this system of animal feeding was an exceedingly expensive one to this country. He had a strong impression, from his own experience for the last two or three years, that they would be a great deal better if they ate less animal food and more vegetable food. And unquestionably it would be very much cheaper; it would be a source of economy to the whole of this nation, and they would therefore be better able to keep up with other nations in the very keen competitions for almost all manufactured goods. There would be no starvation in this country if people lived on vegetable foods; but unfortunately there was so much prejudice against confining oneself principally to a vegetable diet, that it would require perhaps 40 or 50 years before they could educate the public mind to adopt the principles of Vegetarianism in this country.

WEIGHTS AND MEASURES AND TEN PER CENT. SOLUTIONS.[*]

UNTIL all the chemists and druggists agree to sell photographic chemicals by the gramme, and until the photographic stores agree to sell French weights and measures, we shall be more or less compelled to use the English methods. Let us first of all compare the advantages of the apothecaries' and avoirdupois weights, so that we may be able to come to some definite conclusion as to which should be used. In spite of the assertion of many of our friends that the apothecaries' weight is never used now, I need only point to some of our leading textbooks on photography to convince you of the contrary. To take one instance. At page 150 of Heighway's "Practical Portrait Photography" (last edition), we read:—"N.B.—It is important to remember that in all English photographic formulæ the solid and fluid measures of apothecaries' weights (i.e., 480 grains to the ounce) are used." And in Burton's "Modern Photography," and many other textbooks, the same weights are recommended.

Let us now examine the two systems. The solid measures of the apothecaries' weight are:—

20 grains = 1 scruple = 20 grains.
3 scruples = 1 drachm = 60 grains.
8 drachms = 1 ounce = 480 grains.
12 ounces = 1 pound = 5,760 grains.

The scruple and pound are rarely used, hence the formula now becomes:—

60 grains = 1 drachm.
8 drachms = 1 ounce = 480 grains.

In avoirdupois weight the proportions are:—

$27\frac{11}{32}$ grains = 1 drachm.
16 drachms = 1 ounce = 437½ grains.
16 ounces = 1 pound = 7,000 grains.

Here it will be noticed that the drachm is less than half that of the apothecaries' in weight, but fortunately the avoirdupois drachm is rarely used. Hence the formula now becomes:—

437½ grains = 1 ounce.
16 ounces = 1 pound = 7,000 grains.

It may be just as well to state here that the apothecaries' ounce ought always to be written with the symbol; but the avoirdupois ounce [illegible]; and also that the grain is exactly the same in both systems, and therefore a drachm of 60 grains is the same also. Now which of these two systems ought we to adopt?

In favour of the apothecaries' weight, I would put before you the following points.

1. The total absence of fractions.
2. The convenient weight of the drachm of 60 grains, standing, as it does, between the grain and the ounce, and preventing the grains from running into the hundreds.
3. The fact that the apothecaries' ounce is in official use in the United States and Russia.
4. Most of the photographic formulæ are given in the apothecaries' weights, and that these weights are recommended in most books.
5. The scales sold at photographic stores always contain apothecaries' drachm weights.
6. The drachm is very nearly four grammes (3·88)—i.e., an error in excess of only 1¾ grains, or less than 3 per cent.
7. In making up 10 per cent. solutions it is very convenient to adopt six grains to the fl. drachm, and six times eight, or 48 grains, to the ounce of 480 grains.

In favour of the avoirdupois weight we may state:—

1. That drysalters and wholesale chemists always sell drugs by avoirdupois, and never by apothecaries' weight.
2. That chemicals other than those made up in prescriptions are invariably sold by avoirdupois.
3. The solid and the fluid measured ounce (of distilled water) both weigh 437½ grains. This is especially convenient in weighing out fluids.
4. The pound weighs exactly 7,000 grains.
5. In many shops, especially in the country, the only weights which are kept are avoirdupois.

In comparing the rival claims of precedence, we notice that the strong point in favour of the apothecaries' weight lies in the use of the drachm. It is exactly 60 grains. It is divisible by 10, 15, 20, and 30, and by all the integers, except 7, 8, and 9, without a remainder. It represents, practically, 4 grammes. It is the eighth part of a troy ounce; and lastly, if a grain be equal to a minim—and it is nearly, being only $\frac{3}{32}$ of a grain less—then a solid drachm will represent a fluid drachm. Now, as a rule, the weights sold at the photographic stores are square, flat weights, stamped with the gr., and symbols; and although they contain weights up to 4 drachms, or even eight drachms, they rarely contain any weight marked with the ounce sign on them. Taking this into consideration, and that the Council of the British Pharmacopœia have recommended the avoirdupois weight as their standard (although the medical profession have, almost to a man, ignored their recommendation in prescribing), and considering besides the fact that chemists and druggists make up orders for chemicals by avoirdupois weight unless the order be in the form of a prescription or the symbols are used, and, lastly, taking into acco[illegible] how very useful a drachm weight representing [illegible] grains is, I venture to suggest that we sho[illegible] make a compromise—viz., that we retain the g[illegible] and the drachm (of 60gr.) as we find them in the boxes sold at photographic stores, and that we [illegible] them for weighing out salts; but that in w[illegible]iting formulæ we should express them in grain[illegible] and avoirdupois ounces (of 437½ grains) only—in other words, that all solids should be weighed [illegible]y the avoirdupois grain, ounce, and pound only; so that the avoirdupois drachm of 27·34 grains [illegible] never mentioned, and when a drachm is men[illegible]tioned it should signify 60 grains. However, so[illegible]e people still prefer to adhere to the apothecaries' weights. In order to prevent possible confusion, I would suggest that when apothecaries' weights are intended, the word drachm or the signs should be used, but when avoirdupois weights are intended, the sign oz. should be used, and never symbols or the word drachm. As regards the grain, there can be no mistake, as its value is always the same.

Now a few words as regar[illegible] 10 per cent. solutions. This method of making [illegible]p formulæ is most convenient and quite scientifi[illegible] In nearly every country except England and [illegible]merica fluids are frequently weighed like the solids, the weight of the bottle or measure being first counterbalanced by shot poured into the opposite pan. In this way it is exceedingly easy to get correct 10 per cent. solutions. Of course, with us, a grain and a minim, though nearly the same, are by no means identical, inasmuch as the volume occupied by the grain varies with its specific gravity. I think it is much more practical always to take solids by weight and liquids by measure, and as long as everyone understands a 10 per cent. solution to mean 6 grains of a salt dissolved, not in a drachm of water, but in water made up to a drachm in the measure, there can be no possible harm in its adoption. Six grains in 60 minims is not a 10 per cent. solution, strictly speaking; but if it is stated so on the label, that is all right. The more correct way, of course, would be to take 6 grains of the salt by weight, and then dissolve it in 6 by 9, i.e., 54 grains by weight of distilled water. Then we have an absolute 10 per cent. solution by weight of the salt; but as Mr. Lionel Clark observed, "When we mix solids and liquids together we must first agree whether we mean a 10 per cent. solution by weight or by capacity. But this need not present any difficulty, for if an experimenter finds that he gets a certain result with a 10 per cent. solution on the '6 grains to the fluid drachm principle,' it is clear, so long as we adopt the same method, that we must get the same strength of solution, whether the original solution be theoretically correct or not. If we agree to take 437½ grains to represent the ounce, then each ounce by weight of distilled water will occupy 1oz. by measure.

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[*] By George Lindsay Johnson. Extracted from a paper read before the Camera Club Conference.

I may here add a very useful remark, to be found in Squire's preface to his well-known "Companion to the British Pharmaceutic." "H. S." says: "Graduated measures require testing before use, which is easily done with good weights and scales and distilled water. Every fluid ounce ought to weigh one ounce avoirdupois, but there are two lines to the liquid—one is that of capillary attraction to the sides of the vessel, the lower one the exact surface of the fluid. This should be on a line with the eye to measure accurately." Seeing, then, how easy it is to weigh out a grain in salt, and then to dissolve it in water or other fluid up to a given mark on the measure, I venture to propose that whenever we describe a 10 per cent. solution, we shall be understood to mean that each fluid-measured drachm of the solution shall contain 5½ grains of the salt, and that each fluid ounce by measure shall contain 44 grains, and that if the metric system be employed, each 10cc. of the solution by measure shall contain one gramme of the salt. And in order still further to avoid confusion, I recommend that the word "drachm" be omitted when referring to solids, and that whenever ounces be mentioned, if fluid ounces, 480 minims be understood; and if solid ounces, 437½ grains. I am aware of the inevitable imperfections of these methods; but at any rate, so long as we all thoroughly understand each other, no mistake of any importance can arise.

Food of the Japanese.—The last issue (Heft 37) of the German Asiatic Society of Japan contains a lengthy paper, with numerous tables of analysis, on the food of the Japanese, the authors being Dr. Kellner and M. Mori. They refer at the outset to the extraordinary differences of opinion amongst various writers as to the exact nature of the staple diet of the Japanese people. One writer says it is almost wholly boiled rice flavoured with small quantities of fish or pickled vegetables; another says that, as far as means allow, it is a mixed, and not a purely vegetable diet, and therefore physiologically ample; a third that it is almost wholly vegetarian; a fourth, that as much animal food is consumed in Japan as in Germany, Austria, France, and the Danubian Principalities; and so on. All the writers here quoted are modern men of science who have resided in Japan, and have therefore had ample opportunities for forming an accurate opinion. As to beef, however (there is no mutton in Japan), there can be no question that its consumption is very small. In 1882 only 36,288 beasts were slaughtered, or about 1 kilogramme of meat per head of the population, and it must be borne in mind that a large consumption takes place at the open ports amongst Europeans, and in the proximity of vessels. The conclusions to which the present writers—one of them, it will be noticed, being a native investigator—come is that the food of the Japanese people varies so considerably that, from a physiological point of view, no single proposition can be laid down respecting it. There are two main groups to be distinguished: in one, the people from poverty are compelled to be vegetarians, and use a diet which leaves much to be desired in its effect in strengthening the body; those in the second group are able to obtain animal food from meat, with some ease, and therefore use a mixed diet, which in kind and quantity appears ample. Between these two extremes we find all kinds of

SCIENTIFIC SOCIETIES.

ROYAL METEOROLOGICAL SOCIETY.

THE usual monthly meeting of this Society was held on Wednesday evening, the 21st inst., at the Institution of Civil Engineers, 25, Great George-street, Westminster. Dr. W. Marcet, F.R.S., President, in the chair. Dr. G. E. Scholefield and Colonel W. S. Young were elected Fellows of the Society.

The President (Dr. Marcet) delivered an address on "Atmospheric Electricity." He first alluded to Franklin's experiments in America in 1752, who succeeded in obtaining the electricity of a storm-cloud by conducting it along the string of a kite sent into the cloud. De Romas in Europe repeated the experiment, and having placed a wire within the twine his kite was attached to, obtained sparks of 9ft. or 10ft. in length. The characters of the two kinds of electricities were next described, the vitreous or positive, which was produced by rubbing glass, and the resinous or negative, obtained by rubbing sealing-wax or another resinous substance; and it was shown, by bringing suspended balls of pith within the influence of these electricities, that electricities of different kinds attract each other, and those of the same kind repel each other. De Saussure's and Volta's electroscopes were next described, pith balls being used in the former, and blades of straw in the latter, for testing the pressure of electricity. With the object of measuring the force of electricity, Sir W. Thomson's electrometer was mentioned, in which the electricity is collected from the air by means of an insulated cistern letting out water drop by drop, each drop becoming covered with electricity from the atmosphere, which runs into the cistern where it is stored up and made to act upon that portion of the instrument which records its degree or amount. The atmosphere is always more or less electrical, or, in other words, possessed of electrical tension, and this is nearly always positive; while the earth exhibits electrical characters of a negative kind. The effects of atmospheric electricity were classed by Dr. Marcet under three heads:—(1) Lightning in thunderstorms; (2) the formation of hail; (3) the formation of the Aurora Borealis and Australis. He explained how clouds acquired their electrical activity by remarking that clouds forming in a blue sky, by a local condensation of moisture, became charged with positive electricity from the atmosphere; while heavy, dark clouds rising from below nearer to the earth were filled with terrestrial negative electricity, and the two systems of clouds attracting each other would discharge their electricity, giving rise to flashes of lightning. In some cases a storm-cloud charged with positive electricity would approach the earth, attracting the terrestrial negative electricity, and when within a certain distance shoot out a lightning which would apparently strike the earth; but it would just as well have struck the cloud only there was nothing in the cloud to sustain any damage, while on the earth there were many objects a lightning would destroy, to say nothing of its effects upon animal life. Thunder is the noise produced by the air rushing in to fill up the vacuum made by the heat of the lightning flash. There may be sheet lightnings, zigzag or forked lightnings, and globular lightnings. The latter are particularly interesting from their assuming a spherical form. Illustrations were given of objects struck by lightning, the most remarkable being, perhaps, the clothes of a working man, which were torn into shreds, while the man himself was not seriously injured. Dr. Marcet next proceeded to show a flash of lightning, which he produced by throwing on a white screen the image of an electric spark 2in. or 3in. in length, enlarged by means of the lens of an optical lantern. Forked lightning 6ft. or 8ft. in length, with its irregular zigzag course, was most clearly demonstrated. After alluding to the protecting power of lightning conductors and their construction, Dr. Marcet explained the formation of hail and of waterspouts, and exhibited an instrument by Prof. Colladon, of Geneva, for showing the formation of waterspouts. He concluded his address with a few remarks on the Aurora Borealis and Australis, the formation of which was illustrated by De la Rive's experiment, which consisted of successive discharges of electric sparks through a partial vacuum while under the influence of a powerful magnet. Electric sheets of light were seen assuming the form of bands, and possessed of a certain rotating motion.

Mr. G. J. Symons, F.R.S., read a short communication on "The Non-existence of Thunderbolts," and briefly described the history of several so-called thunderbolts, the specimens obtained being of an amusing character, thus clearly showing that they were of a terrestrial and not a celestial nature.

In connection with this meeting a most interesting exhibition of instruments was arranged in the rooms of the Institution of Civil Engineers. The exhibition was devoted chiefly to instruments connected with atmospheric electricity. There were various forms of electrometers, including those formerly in use at the Greenwich and Kew Observatories. Numerous patterns of lightning conductors were exhibited, together with models of churches, houses, chimney-shafts, and ships, showing the various methods of protection. The Postal Department showed a number of lightning protectors used for telegraph purposes. Many objects damaged by lightning were exhibited, including lightning conductors, telegraph apparatus, portions of rafters, trees, &c.; also the clothes of a man torn off his body by lightning. An interesting collection of meteorites and some alleged thunderbolts were shown, the latter being of an amusing character. There were also several new meteorological instruments exhibited which had been brought out during the past twelve months.

One of the special features of the exhibition was a most valuable and interesting collection of over fifty photographs of lightning flashes. Many of these were taken during the great thunderstorm which occurred in London on August 17th last year, while others were taken in various parts of the world.

The exhibition also included a large number of photographs of damage by lightning, and photographs of clouds and meteorological instruments, as well as records of atmospheric electricity, &c.

ROYAL MICROSCOPICAL SOCIETY.

THE sixth meeting of the session was held on the 14th inst., at King's College, Strand, W.C., Dr. R. Braithwaite, F.L.S., vice-president, in the chair.

Mr. Crisp read a letter received from Dr. Hudson, the president, expressing the regret which he felt at his enforced absence in consequence of the effects of the accident to his knee, reported at the previous meeting.

Mr. Cooke exhibited a number of photo-micrographs of the odontophores of Mollusca, as an attempt to illustrate this group of objects by photography. He said that the photographs had been made from specimens arranged and selected by his friend Mr. Watkins, his own part in the matter being the photography. Mr. Watkins had in his collection about 1,400 specimens, from which the series had been made. The classification of Mollusca by means of the radula dated back to the work of Prof. Lovén, but had not received the recognition which it should, and in his opinion would, have in the future. He imagined that this want of attention was largely due to the extremely inadequate representations which had hitherto been made of these organs, for in the drawings usually made it had generally been the practice to select only one row of teeth, from which it was obvious that only a very imperfect idea could be obtained of the whole. The photographs had the advantage of showing considerably more. Then again, the figures in most cases omitted the shading, which was a very important part, so that they failed to indicate the thickness. The present series of photographs had been prepared with a very rude apparatus, mainly of his own devising, which, when closed, folded into a space of 1ft. 6in., but could be expanded to 5ft., thereby enabling him to get increased magnifying power without the necessity for using a large number of lenses. He had used Swift's 1in., ½in., and ¼in., and one of Zeiss's $\frac{1}{12}$in. immersion lenses with a projection eyepiece, giving for the whole a range of powers from 30 to 600. The results already obtained were such that he ventured to think that when that method of illustration became better known, and had been further improved upon, the system of classification by the radula would receive better recognition. Amongst instances in which the application of the method had led to valuable results, he mentioned that there had been described as being found in Australia no fewer than 52 species of the genus *Physa*, which ranged generally throughout the South Pacific. Specimens of these having come to hand, proved upon examination to be no *Physa* at all, but really a sinistral *Limnæa*, and when they were able to get more specimens, he thought it very likely that they would be able to get rid of the whole of those 52 species of so-called *Physa*. He ventured to ask any Fellows of the Society who could to assist them in procuring new specimens, as he found it a matter of extreme difficulty to obtain shells with the molluscs inside from the remote corners of the earth.

Prof. Stewart said he had listened to the remarks of Mr. Cooke with very great pleasure, and was delighted with the series of photographs which had been submitted for their inspection, which, he thought, were exceedingly well done, considering that in many cases great difficulty was encountered in consequence of colour and want of flatness in the object. He should like to ask what was the bearing of the structure on the evidence as to the character of the food? Was there anything which would tell them whether the creature was carnivorous or a vegetable feeder, and if the former whether it fed upon the softer kinds of flesh or was capable of boring through hard shell? In making a collection so large as that of Mr. Watkins a great amount of experience in mounting must have been obtained, and he should, therefore, like to ask what kind of medium had been found best for the purpose. He had a number of slides of this kind; but his experience was like that of most other persons, that after a lapse of time a great many specimens became deteriorated; but he had some which were said to be mounted in "Suffolk," whatever that might mean, and these were all in most excellent condition, both as to the way in which they were displayed and that in which they had retained their characters.

Mr. Cooke said, with regard to the character of the teeth as indicating the nature of the food, so far as the land mollusca were concerned there was a very marked distinction, the carnivora being conspicuous by having teeth with sharp arrow-like points; but in the case of slugs, which generally ate animal matter, but which would also eat anything else, and would even eat one another if other things failed, the radula presented a curious mixture of the sharp arrow-like forms with others of a squarer form approximating to that of the vegetable feeders. He could not say with certainty that the marine mollusca fell into the same classification, because—more especially in the case of deep-sea varieties—it was difficult to say what their food really consisted of. As regarded mounting, all the preparations from which the photographs were taken were mounted in glycerine jelly.

Mr. Suffolk disclaimed all knowledge of the peculiar medium mentioned by Prof. Stewart; but as he had been advising for a number of years upon questions of mounting, it was just possible that it might be something which he had at some period recommended.

Mr. E. M. Nelson exhibited and described a new form of mechanical stage, in which two points were moved by milled heads in rectangular directions, carrying the slide with them, the slide being pressed against them, when they were withdrawn, by the hand.

Mr. Crisp said it seemed to him to be a very great disadvantage not to have the object follow the mechanical movements in both directions.

Mr. Michael said he should not like to have to use a stage on this principle, at any rate for the work in which he was chiefly engaged. He could not agree with what Mr. Nelson had stated as to the side movement being seldom wanted; for his own part, he thought he used it more than he did the other.

Prof. Groves thought that one great disadvantage in the arrangement was that it necessitated the use of both hands to manipulate the slide, whereas the great advantage of the ordinary mechanical stage was that it left one hand free for focussing at the same time that the slide was being moved.

Mr. Crisp said that this, to his mind, was the fatal objection to Mr. Nelson's device, which really required three hands to work properly.

Mr. C. L. Curties exhibited a new combination condenser, which, in addition to the condenser, also contained an iris diaphragm, a spot lens, and a polarising prism. It would, of course, like all "combination" apparatus, be only used where portability was a desideratum.

Mr. Crisp exhibited a Collins's aquarium microscope which could be fixed by suction to the glass side of the tank, like the railway reading lamps; also Klönne and Müller's aquarium microscope for examining objects in a small aquarium or trough specially constructed for the purpose, and fitted with movable diaphragm slides. Also a new form of Thury's 5-tube microscope for class purposes, having a reflecting prism made to rotate, so as to exhibit the object upon the stage alternately to each of five observers.

Mr. G. Massee read a paper "On the Type of a New Order of Fungi—Matuleæ," illustrating the subject by drawings on the board.

Mr. G. Murray congratulated Mr. Massee on having recognised the features of this very interesting type. The Gasteromycetes were composed of a number of types which were linked together; but he should not have expected that those which Mr. Massee had mentioned were so closely related as he had shown them to be.

Mr. Bennett quite agreed with the last speaker that this was a very interesting paper. He had always considered that the Fungi must be regarded as a division of the vegetable kingdom quite distinct from the Algæ. Some years ago a method of classification was proposed which would have abolished the difference between them. This he always beileved to be a mistake, and, therefore, though perhaps they could not regard Fungi as a single series, it was encouraging to find one more proof of their connection *inter se* rather than with the Algæ.

Mr. Rattray gave a résumé of his paper, "A Monograph of the Genus *Aulacodiscus*," the subject being illustrated by diagrams, and by a tabulated list of groups of allied species.

Mr. Carruthers, whilst afraid that the account which had been given by Mr. Rattray might not have been very attractive to the audience generally, felt sure that when they saw the paper printed *in extenso* they would find it very interesting to study. The table exhibited showed the result of a very great deal of work with regard to that very interesting group of diatoms. The genus was one which had long been known, and perhaps specimens of *Aulacodiscus formosus* were in the possession of everyone interested in the subject. He wished that Mr. Rattray had been able to give them a demonstration of the central form, and to explain the processes which went to form the distinctive type. No one could look at the table without seeing that it represented the result of a very careful examination of all the published information relating to those groups, and Mr. Rattray had been afforded opportunities of getting together the whole known material with relation to that genus. What he had done was to describe the whole in harmony, and when they came to read the paper they would find it to be a very exhaustive monograph of that interesting genus.

The Chairman said that Mr. Rattray had been setting them an example which he hoped would be largely followed, for he was quite sure that no better service could be done by one man than by working out the whole history of a separate group in the way it had been done in the paper. There was a very large amount of work to be done in this way, and he considered that microscopists owed Mr. Rattray a debt of gratitude.

Owing to the lateness of the hour, Dr. Ward's paper "On Fasoldt's Test Plates," and other matters on the agenda were necessarily postponed until the next meeting.

The Chairman announced that the date of the next conversazione had been fixed for April 25th.

USEFUL AND SCIENTIFIC NOTES.

Native Cotton Manufactures in Japan.—A leading Japanese newspaper publishes some interesting facts respecting the increase in the production and manufacture of cotton in Japan in recent years—a subject which was discussed in the *Times* of August 27 last under the head, "Native Industrial Competition." It says that the entire production of cotton throughout the empire is estimated by official statisticians at 40,000,000lb., a quantity wholly insufficient to supply the requirements of the nation, and hence the importance of imported yarns and cotton cloths. Of late years the spinning industry has received a great impetus; there are now 22 factories at work, employing over 76,000 spindles. In addition, eight more factories have recently been started, although they have not yet got into full working order. These aggregate 117,000 spindles, so that within the past eighteen months the cotton-manufacturing power of Japan has increased 150 per cent. If it progresses at anything like the same rate, by the end of the next decade Japan, in place of being an importer of cotton, will be an exporter. But, although such rapid progress is not to be expected, Japan is peculiarly favourably situated for the growth of this branch of manufacture. It is near some of the great centres of cotton supply, produces cotton itself, and has abundance of cheap and skilful labour. The amount of cotton spun last year was about 1,320,000lb., which will, of course, be now largely increased, and it is said that Japanese capitalists regard the busines as offering sound and profitable investments, so that a still further development of the industry may be expected.

A Field Refrigerator.—A useful adjunct to the hospital department of the Army has been devised by Dr. F. W. Chapin in a refrigerator for field use with the army on service. It is an adaptation of the "Eureka" refrigerator, in which the chemical agent used is nitrate of ammonia, which has the property of rapidly cooling any liquid to which it is added. The nitrate, moreover, is recoverable from the solution by evaporation, and can be used over and over again without sensible loss. The apparatus consists of two collapsible indiarubber buckets, one of which contains a coil of indiarubber tubing. This coil is placed in one of the buckets, and is immersed in the nitrate of ammonia solution. The water to be cooled is passed through the coil and is rapidly cooled, and forms a supply for drinking or other purposes. For refrigerating purposes and for making ice some of the water which has already been cooled is run into the second bucket, and nitrate of ammonia is added to it, forming the freezing mixture. When the solution is exhausted it is removed for evaporation. The field refrigerator is collapsible, and when open and in use it measures 3ft. by 2ft. by 1ft. 6in.; closed for transport its dimensions are 3ft. by 10in. by 1ft. 6in., and its weight is under 100lb. when packed with a sufficient quantity of nitrate of ammonia for four days' use. It is said to be capable of producing 5lb. of ice per hour, and of cooling eight gallons of water to a temperature of between 30° and 40° Fahr. during the same period.

SCIENTIFIC NEWS.

IT appears that at several points in the United States some occultations were observed during the lunar eclipse in January last. The value of the work done, however, cannot be definitely known for some time.

Another minor planet, 273, was discovered by Dr. J. Palisa at Vienna on March 8. Dr. Palisa has now discovered sixty-one planetoids.

Mr. Prince's summary of the meteorological journal kept by him at Crowborough, Sussex, shows that the mean temperature of 1887 was below the average of many years in every month except June, July, and August. April, September, and October had especially low means—snow falling on the 11th of October. The low temperature appears to have been due to the exceptional persistence of north-east winds during more than a third of the year.

Miss Maria Mitchell, for many years Professor of Astronomy at Vassar College, Poughkeepsie, N.Y., has resigned, after teaching the science in that instititution for twenty-two years. Miss Mitchell was born in Nantucket, Mass., on Aug. 1, 1818, and began her astronomical work at the age of eleven by assisting her father in observing a lunar eclipse. In 1847 she discovered a comet, the King of Denmark giving her a gold medal in honour of the achievement. She has since added seven other comets to her list, being the first discoverer of them all. She visited Europe shortly after 1847, and was there the guest of Sir John Herschel and Sir George Airy, then Astronomer Royal at Greenwich.

The death of Mr. Thomas Elliot Harrison, which occurred suddenly, removes another link with the past, for he worked under, and subsequently with, Robert Stephenson, in constructing many miles of railway in the North. He was engineer-in-chief of the North-Eastern Railway—at the time of its creation by the amalgamation of no fewer than sixty-eight Acts of Parliament, in 1854, the largest line in the country. It was Earl Granville, we believe, who called him "Honest Tom Harrison," a title which does him the greatest of honour, for Mr. Harrison was born at Sunderland in 1808, and lived through a time when men were sorely tempted to make hay for themselves.

The Geologists' Association have made arrangements for an excursion to Southampton on Easter Monday and Tuesday, in conjunction with the Hampshire Field Club. The special object on both days will be to examine the fine cliff sections of fossiliferous Headon, Barton, and Bracklesham beds from Hordwell westward, now made accessible by the opening of the new railway to Bournemouth. The director of the excursion will be Mr. W. Whitaker, assisted by Mr. J. Starkie Gardner.

A course of lectures for sanitary inspectors has been arranged by the Parkes Museum for the special instruction of those desirous of obtaining knowledge of the duties of sanitary inspectors. The various subjects will be dealt with in a course of 12 lectures, given by well-known authorities, on Tuesdays and Fridays at 8 p.m. in the Parkes Museum, 74A, Margaret-street, commencing on April 10, and students attending the course will be granted free admission to the museum and library from April 1 to June 1.

The Institution of Naval Architects held its annual meeting last week, and after the reading of the annual report and the delivery of the president's address, several papers of more or less interest were read and discussed. Mr. Sennett read a paper on working and test pressures, and stated that the "factor of safety" was an allowance for want of knowledge. He regards the traditional hydraulic test of double the working pressure as having a retarding influence. Mr. Yarrow presented a paper in which he described a launch weighing only a ton, propelled by means of a highly volatile hydrocarbon. The propelling machinery was placed at the stern, and consisted of an ordinary direct-acting inverted engine. The vapour generator was placed immediately aft of the engine, and consisted of a copper coil, inclosed in a double sheet-iron casing, the intermediate space between these casings being filled with asbestos. Below the coil was an iron pipe, bent into the form of a ring, perforated with holes and arranged as in a Bunsen burner, so that a mixture of hydrocarbon and air could be forced into it and ignited on issuing through the holes. After the start the working was automatic. The working pressure of 70lb. per square inch could easily be maintained, and the boat could run from seven to eight miles an hour for several hours. The use of the hydrocarbon (one of the early products of petroleum) permitted the start of the launch at full speed in not more than five minutes from the lighting up. The subject of forced draught also attracted some attention, and there were two or three papers on screw propellers.

An "improved patent portable automatic self-generating petroleum air burner," the invention of Mr. J. J. Norman, was shown at work at 147, Queen Victoria-street, E.C., at the beginning of the week. The burners are modifications of the Bunsen, benzoline being forced through a very fine hole into a tube, where it is instantly gasified by the heat, and consumed by the aid of the air drawn in. The benzoline is stored in a strong, portable vessel, in which a pressure of 100lb. or more can be quickly obtained; but, as the patents are not yet completed, it is not advisable to say more about the design. The apparatus can be used for smelting and roasting all kinds of ores and metals, and has been used for inflation of war balloons and for heating rivets. It has the promise of being useful for many purposes.

An exhibition of the Stephonium, to which attention was called by a correspondent on page 58, was held the other day at Edinburgh. The *Scotsman* says that the airs which were played had been translated, so to speak, on sheets of cardboard that were inserted behind the wires—the notes being represented by little blue crosses, each one of which disclosed itself under one or other of the wires. From the positive pole of the battery a wire was led, terminating in a handle having a copper pointer; and in order to play the air required one had but to touch with this pointer as he went along the wires behind which the crosses appeared, and the bells chimed responsive to the electric contact instituted. The impression left by the exhibition was that the contrivance was exceedingly ingenious, with a possibility of considerable practical utility. The inventor, Mr. M'Gee, proposes that in the elaboration of the stephonium each wire may by a simple switch be made to play three notes—sharp, natural, and flat.

Prof. Roberts-Austen, in a paper presented to the Royal Society, describes some important investigations into the mechanical properties of certain alloys that are not without interest to electricians. The tenacity of pure gold is, he found, very much diminished by the smallest mixture of impurities, and that it is so in accordance with the position of the element in the table of atomic volumes. Thus those elements, the atomic volumes of which are higher than gold, greatly diminish the tenacity of the precious metal.

In the course of a Lumleian lecture delivered before the Royal College of Physicians by Dr. Howship Dickinson, he stated that the healthy condition of the tongue is by no means easy to limit or define. Not only does it change its aspect and character with often inconsiderable deviations from ordinary health, but it presents many differences within this state in different persons, and in the same persons at different times. There are congenital varieties in the number and prominence of the papillæ, and there are such habitual differences, whether congenital or acquired, in the amount of epithelium, that to some persons it is normal to have a clean tongue, to others not less normal to have a coated one. Thus, whether the tongue be looked at with the naked eye or with the microscope, the range of health is wide; the same degree of coating may be normal in one person and abnormal in another, so that it is impossible to set up an exact ideal and say that all departures from it are the result of disease.

MM. Frémy and Verneuil have recently submitted to the French Academy of Sciences some remarkable specimens of artificial ruby, which they have succeeded in producing by improvements on their earlier methods of synthesis. By the action of fluoride of barium on alumina containing traces of bichromate of potassium, they have obtained fine crystals, lining cavities in a friable white matrix from which they are easily separated. The crystals appear to be identical, both chemically and physically, with the natural ruby. They consist solely of alumina coloured with a little chromium. They present a beautiful colour, and are hard enough to scratch topaz. M. Des Cloizeaux has found that in crystalline form and optical properties they agree with the native mineral.

Amongst recent ingenious "devices" it may be mentioned that a method has been discovered of uniting small rubies into large stones—at least it is said that specimens have been sold in the United States.

M. Ernest Favenc, who is at present finishing a history of Australian exploration, is about to undertake a new journey, accompanied by a surveyor, who will be paid by two colonial geographical societies. M. Favenc, who defrays his own expenses, will start from Western Australia into the interior, along a track never before followed, and then turn southwards to the sea.

LETTERS TO THE EDITOR.

◆

[We do not hold ourselves responsible for the opinions of our correspondents. The editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, *332, Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

*** *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

◆

ERRATA—SATURN—TO DR. TERBY.

[28557.]—ALLOW me to correct two misprints in my letter (28530). I wrote of a "circular patch 2° (degrees) in diameter," not inches. Also "projected *on* a black sky," instead of as printed.

Many thanks are due to Dr. Terby for his very interesting and valuable communication on the planet Saturn (letter 28513). Unfortunately for me, our local weather during the planet's present apparition has been of the most wretched kind, giving only one moderately decent night in a fortnight on the average, and, therefore, I have been unable to secure as many or as important observations of Saturn as others of your correspondents must have done. I can, however, confim Dr. Terby's note (*f*) as to the easier visibility of the ring C in *f.* ansa on a number of nights. On referring to my notebook, I find that out of 15 observations this season ring C was strongest in *f.* ansa on 10 occasions; on *p* ansa on two occasions, and visibly equal on each on three nights.

There are moments when, as Dr. Terby remarks, one strongly suspects detail on this ring, but definition has been too unsteady to allow of verification; the seeing is only by fits and starts.

With my 8½ Calver, power 400, I for a few moments grasped the Struve ring on the 21st inst., at 10h. 45m. (a night of the best definition of this year), but only saw enough to be sure of its existence.

Would not some of "our" other correspondents, who have been more favoured by the weather, send us an account of their seeings?

Jno. Harvey Jones.

THE MOON'S WATER AND THE GLACIAL PERIOD.

[28558.]—THE apparent unsophisticated manner in which the Glacial Period, its causes, and effects are generally understood and commented upon has often been the cause of building up of crude ideas based upon that imperfect knowledge. One example has been the cause of much interesting correspondence in your columns.

Your later correspondents appear to be losing sight of the geological character of the question by merging into the astronomical matters concerning it. Dr. F. E. Cane's theory as to the cause of the Glacial Period is certainly new; but there are difficulties in the way of accepting it. How would he account for the mild interglacial periods when it is probable some northward migration of animals, that had been driven southwards by the cold, took place? Is Dr. Cane also aware that the Glacial Period is not the first we have evidence of? We have evidence—in England alone—of three distinct Glacial Periods: one of about Cambrian age; another of Permian age, as evidenced by the deposits of glacially striated boulders of that age; and, lastly, *the* Glacial Period. Would Dr. Cane's theory account for all these? He only deals with the last one.

There is another matter in his letter which I may be allowed to point out as erroneous. Writing on the changes of climate, &c., he says:—"When that event occurred it would be accompanied by intense Vulcanism, sufficient to throw up great mountain ranges."

I was not aware that mountain ranges were thrown up so suddenly. According to my reading on the subject, mountain ranges are formed of rocks which have been subjected to enormous lateral compression, aided afterwards by earth sculpture. Perhaps he will state which mountain ranges he thinks were upheaved. The last (of several) uplifts of the Himalayas, the Pyrenees, the Alps, the Andes, and the Rocky Mountains have all taken place in late geological times, certainly long anterior to the last Glacial Period; while the Highlands of Scotland and the ranges in Scandinavia, the Ourals, and the Carpathians are much more ancient, and have since been worn down. Perhaps, however, I have mistaken his meaning of Vulcanism. **H. E. Quilter.**

ANOTHER MAGIC SQUARE FOR 1888.

[28559.]—THE following, perhaps, is a better magic square than Mr. Hampden's, even when improved by "C. P.":—

22	832	202	802
682	322	502	382
742	142	922	82
442	562	262	622

It will be noticed that every number terminates with the figure 2. The sum is 1888 taken in every way described by "C. P.," "magic," "nasik," and "four-ply." (See "E. M.," p. 160.) Moreover, it contains the *smallest* possible even number (22), and the *greatest* possible even number (922) available for obtaining the sum of 1888. **F. S. S.**

[We are inundated with magic squares! This is really the last we can print.—ED.]

LOCOMOTIVES.

[28560.]—THE very valuable report made by our Australian correspondent, Mr. C. Rous-Marten, has set at rest the questions of great speed, and it seems, according to the *Engineer*, that 80 miles an hour is about the limit. Why this should be so I do not quite see, and should be glad of information.

As to the increase of steam pressure, which seems to be the order of the day, I should be interested to hear from Mr. Gobert.

Expansion of steam is pushed now to its full extent in our engines with 140lb. pressure. How, then, can more expansion be got with 160lb. pressure? It seems to me that the "compound" engine is the proper principle to work on, because they can push expansive working to any extent, and must be cheap on coal and repairs.

Scientific.

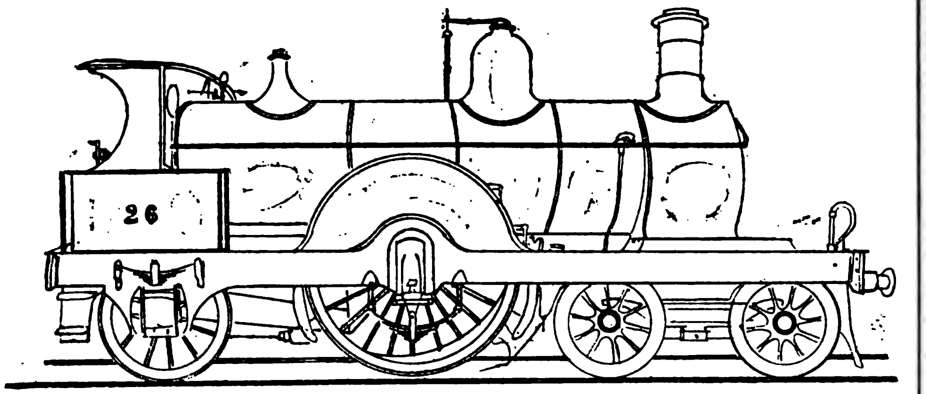
DRIVERS' CERTIFICATES.

[28561.]—DRIVERS and firemen are much exercised in their minds lately by a Bill before the House of Lords called the "Steam Boiler Bill." It does not seem so much of a "boiler" Bill after all, as one to make drivers and firemen pass examinations before an officer of the Royal Engineers (Col. Rich being, I think, named as the probable examiner). What I want to ask, Sir, is about how we are to be examined? As an old express man on one of our best roads, I hope this Bill won't pass; if it does, it will ruin me, certain. I am not up in knowledge enough to go through a stiff lot of figures, and I don't know a word of Latin. If this Bill gets into a "law," half, or three parts, of our enginemen and firemen to-day will have to come off their engines and give place to "book-worms," who may know a lot of theory, but haven't a bit of practice about them. One good job is the railway companies are going to oppose the Bill on our behalf. Let us hope more able pens than mine will say something on it.

An Old Express Driver.

MIDLAND SINGLE ENGINES.

[28562.]—AS I have noticed several inquiries in your columns about these engines, I send the principal dimensions and a photograph of a drawin from *Engineering.*



Diameter of driving wheels, 7ft. 4in.; trailing, 4ft. 2½in.; bogie, 3ft. 6in.; cylinders, 18in. by 26in., giving a tractive force of 95·7lb.; boiler pressure, 160lb. per sq.in.; length of boiler, 10ft. 9in.; diameter, 4ft. 2in.; heating surface—tubes, 1128·6sq.ft.; firebox, 117·0sq.ft.: total, 1240·6sq.ft.; firegrate area, 1968sq.ft. Weight of engine in working order:—

	tons.	cwt.	qr.
On bogie	14	13	2
On driving wheels	17	10	0
On trailing wheels	11	10	1
Total	43	13	3

The engine is double framed, the crank axle has bearings in both frames, the trailing wheels outside bearings only. The bogie is of the Adams type. There is an arrangement for throwing sand under the tread of the driving wheels by a jet of steam. The tender carries 3,250galls. of water and 2 tons of coal, and weighs when full 36 tons 1cwt. 1qr.

These engines work the express traffic between London and Nottingham with loads averaging 170 tons, including engine and tender; they burn 20lb. to 21lb. per mile of Derbyshire coal, and appear to be great favourites with the drivers.

Lincoln.

ORGAN SPECIFICATION.

[28563.]—The following specifiation is by the late Nathaniel J. Holmes, of London, for Macleod Parish Church, Glasgow. The builder is M. C. Anneesens, of Grammont.

Great Organ (Compass CC to C in alt.)

1.	Bourdon	16ft.	61	pipes
2.	Open Diapason	8	61	„
3.	Viola	8	61	„
4.	Hohl Flöte	8	61	„
5.	Dulciana	8	61	„
6.	Principal	4	61	„
7.	Harmonic Flute	4	61	„
8.	Grave Mixture	2⅔ and 2	122	„
9.	Trumpet	8	61	„
10.	Clarinette (free reeds)	8	61	„
11.	Mixture	3 ranks	183	„
12.	Clarion	4	61	„

Swell Organ (CC to C in alt.)

1.	Bourdon	16ft.	61	pipes
2.	Geigen diapason	8	61	„
3.	Röhr gedackt	8	61	„
4.	Viole de gambe	8	61	„
5.	Voix celestes (ten. C)	8	49	„
6.	Geigen principal	4	61	„
7.	Harmonic piccolo	2	61	„
8.	Sharp mixture	3 ranks	183	„
9.	Horn	8	61	„
10.	Oboe	8	61	„

Pedal Organ (CCC to F; 30 notes.)

1.	Open diapason	16ft.
2.	Bourdon	16'
3.	Octave bass	8
4.	Grosse quint	10⅔
5.	Tuba	8
6.	Tubason	16

Couplers and Accessories.

1. Great to pedals.
2. Swell to pedals.
3. Swell to great.
4. Swell octave on itself.
5. Tremulant to swell.
6. Swell pedal.

3 composition pedals to great manual.
3 „ „ swell „
Pneumatic action to swell clavier.

Summary.—Great organ, 915 pipes; swell organ, 720 pipes; pedal organ, 102 pipes; total, 1,737 pipes.

R. S. N.

ORGAN MATTERS.

[28564.]—It is to be regretted that the discussion on this subject, which at one time promised to be useful, has drifted into personalities. To revert to the question. It seems to be pretty generally admitted that finely-voiced pipes do lose something *of their character by* being inclosed; as Mr. Casson happily puts it, the swell-box takes the bloom off. Unfortunately, the great majority of organs are only too susceptible of improvement by any means which will conceal their coarseness, but this is not the case under consideration. It remains to be seen what the swell-box offers in exchange. It gives excellently well the idea of echo, distance, and contrast; it produces the charming effect, unique in music, from which it takes its name; it furnishes an indifferent imitation of *crescendo* and *sforzando*. These characteristics, while making it a most valuable addition to the organ, rather tell against its extension beyond its own department. The material point is, Does the swell-box give, or even aid in giving, the means of expression on the organ? This question, whether the working of the soul, as Humber calls it, is facilitated by the use of the swell pedal, has not been met by any of your correspondents. Certain it is that many otherwise able players seem to lack expression, while others' touch is instinct with life. No one who remembers the playing of such men as S. S. Wesley, Henry Smart, George Cooper, or Jeremiah Rogers (not to name living organists), will contend that the organ apart from the swell is an expressionless instrument; but it may perhaps be said that the swell offers such assistance in this matter of expression that it ought to be extended throughout. This is a question for musicians rather than organ-builders; it would be interesting if any of your correspondents conversant with the great master-pieces of organ music would say how they would play upon an ideally perfect organ such and such movements, so as to be heard to the greatest advantage.

As I think proper to write under a *nom de plume*, may I be allowed a word in justification? There is no question of the liberty to do so; I need only refer to the well-known rule of *The Times*. From your "Hints to Correspondents," it appears that your rule, Sir, is the same. Numerous cases of eminent correspondents, whose names would have deservedly carried weight, and whose identity has leaked out, will occur to everyone, proving incidentally what such men considered to be the proper mode of addressing the editor of a newspaper. I am not concerned to consider the case of gentlemen conspicuous in the musical world, but simply that of the ordinary private amateur: such a one may have had no inconsiderable experience in designing, building, and rebuilding organs, and have visited perhaps every instrument of note in Europe, and yet be utterly unknown beyond his own circle. Conscious of this, he may consider it both more modest and more dignified not to publish his name; further, he may perhaps follow a profession with which musical matters have nothing in common, and which his good-natured friends would not be slow to say he would be better employed in attending to than in riding his hobby; and so prudence may become an additional consideration on the same side.

March 22. **Finem Lauda.**

[Quite so; and correspondents need not waste further time in discussing this point, for we shall not print their letters. The English Mechanic has *always* recognised the right of anonymous correspondence.—Ed.]

THE BOEHM FLUTE—LATHE MATTERS.

[28565.]—Allow me to second "E. P.'s" request to our friend "Vulcanite." I have long intended, as soon as spare time could be found, to attempt the construction of a Boehm flute, and thought of the "Rockstro model." It more nearly resembles the original Boehm arrangement than the "Carte 1867," and I should like to have "Vulcanite's" opinion as to which is the better. I intended to use silver, or thin, hard-drawn brass, subsequently electroplated.

A Boehm piccolo which I commenced in brass, some time ago, gives a very clear and bright tone. The method I adopted for finding the exact places for the holes was as follows: Two tubes were prepared exactly equal in diameter, one being for the permanent instrument. The other tube was gradually cut down till it gave the proper fundamental note, and the other then made equal to it. A large hole was then cut in the experimental tube, approximately near the position of the first hole, and a short piece of tube fitted to slide rather tightly over it, provided with a short nozzle of the size of the finished hole. This short tube was then slid up or down until the correct note was obtained, and the hole then cut in the permanent tube to correspond. The remainder of the holes were of course found in the same manner.

Allow me to thank "O. J. L." for the admirable idea of the extracts from that lathe classic "Bergeron." I am sure they will form matter of great permanent interest in a very accessible form, and we know that "Bergeron" will be likely to gain rather than suffer in translation through his hands.

Will some of our lathe correspondents give their opinion as to the value of the method of combining a lead screw and back shaft (or feed-rod) in one, by cutting a flute or key-way along the screw?

A. M.

ON VIOLINS.

[28566.]—There seems to be some mistake in signature of letter 28481—whether the printer's or my own I do not know; however, the letter is mine.

J. H. Schucht (letter 28549) thinks there is some misprint in my description of the ordinary bridge. I said the old form of bridge was never adapted to the requirements of the instrument; it had not been studied as a mechanical medium, for the just intonation of one string with the other.

This is really what I do think. It was this confirmed conviction which led me to experiment with different forms of bridges; but the idea was purely mechanical. I knew that each string represented a series of different numbers of vibrations; hence the idea the E string requiring the most vibrations in a given time. The leverage is the shortest, or nil, because it gets the necessary amount from its position over top of sound-post. Getting nearer fourth string the vibrations become slower and the leverage greater; like the pendulum, by lengthening, the vibration is slower; by shortening, they are quickened—the top of sound-post acting as the fulcrum of both bridge and belly.

If not too impertinent, I should like T. H. Schucht to give his opinion of sound-post and sound-bar—their position, function, or necessity, on the sound-wave theory. I am glad to find, by your experiment, you have got at the principle of the new bridge. It was one of the first experiments I tried some years ago. I found its defects as you describe—not having rigidity enough to support the strings with firmness on the belly. I will be glad if you will try the new one. This is only second week of advertisement, and I have already evidence of their success.

Oasis.

[28567.]—I have read with great interest the letters which have appeared for the last few weeks in your valuable paper under the head of "On Violins." In letter 28481, in your issue of the 9th inst., "Byford" points out to "Orderic Vital" respecting tone of violin back, that it is lower, not higher, than the belly.

I think it is "Byford" who is in error concerning this matter. It is lower, he says, because of greater density, and therefore heavier, having more resisting power. It is true that pine gives a higher tone than maple, owing to its greater elasticity and feeble density; but this, I think, is more than compensated for by the difference in thickness between the back and the belly. His description of the different qualities of tone of the two violins which he mentions in the latter part of the letter is very interesting.

A friend of mine, a violin maker in a large way, made, a few years ago, a number of violas, the breasts being formed of pitch-pine of rather open grain. I remember playing on one of these instruments, the tone of which was remarkably rich, powerful, and brilliant. I have seen it stated that plane-tree, used as material for backs, imparts to the instrument a soft and muffled tone.

23, Kent-street, Rochdale. **F. Watson.**

WHAT POWER DOES IT REQUIRE TO DRIVE A CIRCULAR SAW?

[28568.]—The power a circular saw requires to drive it depends on the condition the saw is in. If the plate is not true, or too thick, or badly sharpened, or the diameter too great for the work it has to do, it will take more power than otherwise. Saws are very often condemned as taking more power than they really do. A circular saw may also be so packed as to require more power to drive it between the packing than if properly packed to drive it through a piece of timber. Again, we may go into a sawmill, and there are a number of saws at work; all seem to be going on well, the timber is sawn clean and true. We leave

l, and go into another; we see the same
of saws at work, and of the same dimen-
e engine of the same class and power; the
rned out is not near so good, and the saws
rely dragged through the timber. Some
the saws are not sharpened as well as at
ner mill, and are not in as good condition;
fault is not at all times in the saws: they
in quite as good order, still there
e power required. We will leave this
nd go back to the former mill, and
the engine-man getting up steam. We
he steam-gauge, and after a while the man
he governor and starts the engine with so
eam, and the shafting is driven its proper
We go back again to the other mill, and
ine-man here is getting up steam. The
rts the engine with 20lb. of steam more
the former mill. The shafting runs at a
w speed, and there is still more power
l to drive the shafting its proper speed.
t is, the power the saws should have to
em is taken to drive the heavy pulleys and
, and the way the shafting and machines
g driven off. We find the main shaft at
l is driven from the extreme end, and the
machines are driven from pulleys that
farthest from the pulley driving the shaft.
to the former mill, and here we find the
aft driven from the centre, and the pulleys
ich the heaviest machines are driven are
he wheel or pulley driving the main shaft,
ach side equalising the load. The pulleys
spindles are much larger, and belts wider
the other mill, consequently less
is required to drive them, and the
nvey more power than at the other mill,
e pulleys are small and belts narrow and
the same time taking more power to drive.
f there is no possible means of getting the
ituated so as to drive from the centre, the
pulley driving the shaft should be as large
le. To get a large wheel or pulley the
hould run a good speed, and to save power
iest machines should be driven from pulleys
the wheel or pulley driving the shaft. All
and shafting should be as tight as possible.
ter to have an extra bearing than to have
afting. Again, counter-shafts should be
as much as possible. In many mills there
shafting than is really required. The same
of machines could be driven with less
, and much power saved. Again, power,
l tear of belts, and fuel may be saved by
clutch where the shaft is coupled at any
uld there be only work for a certain
of machines. By throwing the clutch
shaft from which the machines
en is at once stopped, the belts re-
on the pulleys ready for work at
ment the machines may be required.
here should be easy access to pulleys and
. I believe in many places there is much
asted by bearings not sufficiently lubri-
The reason is, the bearings are not easily
nd are neglected. More reasons might be
w a great deal of power is taken that the
uld have to drive them satisfactorily. I
ve, the power required to drive a circular
nds on the diameter, thickness, and con-
e saw is in.
ar saws to cut soft wood generally should
following dimensions:—

ter...	24in.	30in.	36in.
......	14 tight.	12 easy.	12 tight.
ter...	42in.	48in.	54in.
......	11	9 easy.	9 tight.

he average power required to drive saws
above dimensions is as follows:—24in.,
30in., 4H.P.; 36in., 5H.P.; 42in., 6H.P.;
.P.; 54in. 8H.P. The number of teeth,
, if the saws are driven at their proper
For cutting hard wood generally, saws
e a full gauge stouter, and the number of
-third more; power required, one-fourth

A. R.

FRICTION.

.]—"Ursa Minor" will find his crank-
much easier if he fits it with ball-bearings,
poses in letter No. 28542.
d a crank-shaft thus, but the shaft was
iron, and consequently the surface be-
dented by the balls, giving rise to an
nt tremor. If the shaft was made of
l hardened at the ends, it would probably
ll. The collar which holds the balls should
f hardened steel. Iron well case-hardened
rhaps do as well.

A. Gray.

SPARK COILS.

]—Referring to the subject of spark
to the several queries that have lately
in your columns thereon, will you permit
e particulars of a small coil I have just
l?

Bobbin, 2in. (inside) by 1½in. diameter; core, ⅜in.; primary wire, three layers of No. 22 s.c.; insulation between primary and secondary circuits, two or three layers of guttapercha tissue; secondary wire, No. 36 s.c., as much as the bobbin will take (about 15 layers), each layer being insulated with one layer of guttapercha tissue; condenser, 51 sheets tinfoil, 3½in. by 2in.

The coil has turned out a little marvel, and gives a full ½in. spark in air, with one small bichromate cell.

J. R.

THEORY OF ELECTRICITY.

[28571.]—I consider my note on this subject (28536, p. 80) needs an apology for (to say the least) the careless manner in which it was written. To make it express my meaning correctly, it is necessary to reverse the order of the words "positive and negative." It has often puzzled beginners, and sounds rather an absurdity, to accept the form "that the positive electrode is joined to the negative element, and the negative electrode to the positive element." I can see no other solution of the matter than that "the zinc is the negative element, and the exciting fluid the positive, the carbon collecting the current from the positive fluid, transmits it through circuit, and is then accepted by the negative zinc." Of course the results are the same, but there is no reason why it should not be expressed in a more correct form if it can be agreed upon.

Daddy.

TWISTED TREES.

[28572.]—An inspection of a series of telegraph posts on a country road will show that the majority have left-handed "shakes." Some few the opposite or straight up and down. Joiners know that the grain of a deal board as it lies on the bench meets the plane iron on the near, and goes with it on the off side, as would be the case if cut out of a tree with a left-handed twist. So in sticking sash beads careful men, when not at piece-work, rip the board down and work from the centre edges. The spiral arrangement of leaf buds is mostly left-handed, though sometimes confused by the *number* of threads in the spiral. Haughton says: "It is well known that the turpentines of different pines differ as to their rotation of polarised light, possibly on account of difference in their phyllotaxis and spiral." Perhaps the exciting cause of the spiral is the effect of the sun's apparent motion on the tip of the shoot (but *Enterobryus spiralis*, a fungus in the stomach of the Julus is also left-handed and in the dark). If light-seeking is the cause, would trees and plants differ according to latitude? The grain of Cuba mahogany crops up all ways, both right and left, all over the plank.

Chas. J. B. Findon.

[28573.]—I think it is generally admitted that there are more inexplicable phenomena in the vegetable kingdom than in any other portion of the creation. The twisted stems of certain trees in particular localities, while the same kind of trees somewhere else is unmarked by any such characteristics, will puzzle us as long as the world lasts. Why should the hop-vine invariably grow from left to right, while scarlet-runners, and all other creepers, just as persistently twine in the contrary direction? The twist in the stems of large trees, such as the cedar and the pine and apple tree, so frequently seen in certain localities, is as incomprehensible as any phenomenon can be. It is useless to speculate upon it; they are simply exceptions to the general rule. No one can tell us at what stage of their growth the twist began, since only very old trees are seen to be thus curiously contorted. I have heard it surmised that those trees only are subject to this twist which grow in situations exposed principally to the action of wind currents from one particular quarter. But this seems hardly a plausible conjecture, and I just mention it to show that the subject is not now mooted for the first time. Yet this is only one of many other equally strange phenomena for which science has failed to account. I believe such twisted timber is commercially useless, though it is said to be somewhat harder in the grain than the ordinary growths. Those who have the opportunity in the spring of watching the appearance of the leaves and blossoms of the apple trees thus twisted, might notice if they seem to be as forward as the others. Reason would suggest that they would be some weeks later in their foliage, from the resisting action of the twisted bark on the ascent of the sap. But the almost irresistible force of vegetable growth would surprise those not familiar with the subject. Such a pulpy thing as a mushroom will lift up a flagstone 18in. square and 3in. thick.

John Hampden.

HEATING MODERN BOILERS BY COAL.

[28574.]—Seeing some inquiries in the "E. M." on this subject, I beg to say that two or three years since I made a small boiler of strong tin-plate soft soldered, fitted with water-gauge, cocks, safety-valve, &c. It was set in bricks, which were set narrow side up, three on a side. The grate was simply a thick iron plate bored as full of holes as possible. It was set between the bottom and middle bricks. The door was hinged to a thick iron plate cut to the shape of the bottom of the boiler, and held across the front of the bricks by iron rods fastened into the bricks. The boiler was let half its diameter into the top bricks, resting on the door-plate at the front, and an iron rod at the back.

It was fastened in with common putty. The chimney was two lengths of 2in. cast iron pipe, the same as that used for taking the water off house roofs. The boiler was 8½in. by 6in. I would not recommend anyone to make it of tin, but of strong copper, brazed.

My engine worked very well, and the boiler burnt very little coal.

J. F. L.

RED GRAVEL—FLUVIATITE VERSUS DILUVIUM.

[28575.]—In the very interesting letter (28538) Mr. Godden repeats the often-asked question, "How was this gravel deposited?" and then adds, "I suppose nobody will deny that this is river gravel." If he will go a little further afield he will find that it has been, and is now, stoutly denied; in fact, as hard and tough a battle has been fought over this said gravel as was the case with the much-vexed glacial period, the fluviatite party going in for river and tranquil deposit, as against the diluvium and flood of their opponents. Mr. Godden will find a wonderful deal of information on the subject in the "Antiquités Celtiques" and "De la Création" of M. Boucher de Perthes, and especially so in A. D'Arbigny's "Voyage dans l'Amérique Méridionale," as also in "Palæontological Memoirs and Notes," by Hugh Falconer, A.M., M.D. While on this subject I would take this opportunity of giving an answer to our able correspondent "E. L. G." in regard to his question (letter 27834, p. 63) about the "bones incrusted with salt." He will find all the particulars in the chapters dealing with the "Pampas Deposit—Geologie," p. 83 of D'Arbigny's work as above.

Dens.

YELLOW STAINS IN FINISHED COTTON CLOTH.

[28576.]—Having been connected with one of the largest bleaching firms in Lancashire for a good many years, the letter under the above heading (28538) I read with peculiar interest. It is too true that chemical knowledge amongst bleachers is not of a very high standard. Good results have been obtained by the "rule of thumb," or by the assistance of some specialist with a practical knowledge of chemistry, and there left to remain until some bungler has tried his hand; or deleterious matter deftly worked in by the manufacturers into the yarns; or the *demands* of the shippers for peculiar "finishes," have tried the ability of the bleacher and finisher to their utmost. And the result has been claims for stains and damages; and consequently the state of the trade at the present time compels the finisher to have an acquaintance with chemistry beyond the elementary "texts," if he means to succeed.

Perhaps it may be interesting to your readers to know the position in which a bleacher stands in regard to the manufacturer and shipper. He is placed between the two, he does not purchase grey cloth, nor does he sell to the shipper: he simply receives grey goods direct from the manufacturer or from the shipper's warehouse, but oftener direct from the manufacturer, to be bleached and finished as per order from the shipper, the first process being singeing or firing, and very often during that process the atmosphere surrounding the machinery necessary is charged with the product of combustion which does not belong to vegetable fibre, nor which demands spectroscopic analysis to detect. The second process is the bleaching, pure and simple, to render it clear of the rubbish placed in the cloth by the manufacturer, requires a great amount of boiling or "bowking," and thence passes through the ordinary chlorine process and forwarded into the finishing and stiffening department; and herein comprises the failures complained of by "A Manchester Shipper," and which, in a great many instances, through the endeavours to please and satisfy the said shipper, but very often from the ignorance of the substances used in finishing.

During my experience with the firm where I am employed I have not heard of any stains, or claims for such, as "A Manchester Shipper" names, and something like 500,000 pieces have passed under my supervision during the last six months.

I trust this matter of stains will be still further "explored" and sifted, and lead to a satisfactory remedy.

A Lancashire Stiffener.

POLISHING AND NICKEL-PLATING.

(*Continued from p. 57.*)

[28577.]—CONNECTORS and connections should always be large enough, or if there is a fault let it be that they are too large. I need not enlarge on the matter of cleanliness, as nothing is more wasteful than dirty joints and bad insulation.

I was in a small plating shop recently, and saw the following arrangement: Six Bunsen cells, coupled, in two series, parallel, three cells in each series; each outside cell measured 18in. high by 12in. diameter. The connections were made by twisting a piece of copper wire (20 or 22 gauge) round one carbon, and twisting the other end round the corner of the zinc cylinder in next cell, and so on, to the vat. By shaking the floor and starting a vibration of these wires, sparks could be seen at each joint.

I found the rods on the vat lying in little puddles of solution that had been slopped on to the top edge, and the "nickel-plater" (!) complaining of a want of power. The amount of work he had got in the vat could have been done with one cell, if properly connected and insulated. I should have liked to have given him a bit of advice about the waste of acids, zincs, and time; but I gave it up when he immediately contradicted my first assertion by saying that "there was too much resistance in a thick wire." The ignorance among the platers, who "have been at it since they were lads, and ought to know," is past belief. Science classes and technical education show results among the younger members, but it is Gospel among the old ones that weight means "resistance,"—every foot of work in the vat is so much "resistance." One I know, on having a dynamo started in the shop, appeared very anxious to learn all he could about it. Two terminals were pointed out as being in the shunt or field-magnet circuit, and it was explained that, with suitable "resistance" put in there, the power of the machine could be reduced by lowering the magnetism. A short time after, he was confidently informing his employer that he had "heard of a man being killed with a dynamo, and as he was rather nervous himself about it, he meant to keep the power down for a bit till he got used to it." The "resistance" he had put on was a piece of $\frac{5}{8}$in. copper bolt, securely bound to the two terminals. Another mischievous belief exists in what they call "stops"—i.e., hanging a piece of metal at the end of each rod to stop the current, according to some, and to prevent the work "burning" according to others. Anyhow, it is an invention, and the offspring of laziness. In working with batteries, it is found easier to reduce the current by putting in these "stops," and so spreading it over greater surface, than to disconnect a cell or two. Now, these "stops" mean this—Greater surface in vat, a lower resistance, a larger flow of current, a continuous waste of nickel deposited on them, and a quicker exhaustion of the battery. Against this we have the trouble of disconnecting a cell.

In working with a dynamo, these stops have been the cause of serious mischief. Any dynamo coupled up in simple series gives an output according to the surface exposed in the vat, or, in other words, according to the resistance of the outside part of the one circuit. Now, if the current is too much for the surface in vat, in goes a "stop." This does not cure it, so in goes another, and it gets worse, and as these "stops" increase the surface and lower the resistance, the current increases, the work gets burnt worse, the machine gets hot, and finally there is a full stop.

Now take all the useless "stops" out, insert a yard or more of a smaller gauge wire between the machine and the vat, and the trouble is at an end. Now this brings us to "Resistance Boards" (Fig. 10). The quadrant is divided into 12 or more sections, and connected by the wire running up and down the board. By moving the key on to any particular section, a fourth, fifth, seventh, or more of the wire is switched into the circuit. As the wire is of a fine gauge it offers resistance to the passage of the current. These boards are generally 3ft. 6in. long by 10 to 12in. wide. The copper wire would start at A (Fig. 10) with No. 16 gauge. After three or four turns up and down, connect to a 20-gauge wire, then to a 24-gauge, and finish with a German-silver wire of 24 gauge.

Have all connections in a resistance board on the front, as they are generally fixed to a wall, and if any connections are at the back, it is either that they never are cleaned, or that the board is knocked to pieces taking it down and fixing up again, every me the cleaning is done.

Now, first seeing that all our connections are clean and right, that is, from the positive pole of the dynamo or battery, to and through the resistance board, to the rods on vat carrying the anodes, through the solution to the cathodes (or work), and the rod they are attached to, direct back to negative pole, we will proceed with our plating. Say we have some gross of book rims and clasps; they arrive nicely polished, but greasy and dirty. First, "wire them," that is, twist the end of a fine wire (22 gauge) round one, then, an inch or so further on, twist it round another, and so on till you have a string of them like a kite tail, limited in length by the depth of the vat. Then start another wire, and another, till the lot are "wired up," of course leaving enough free wire to connect to the vat rod.

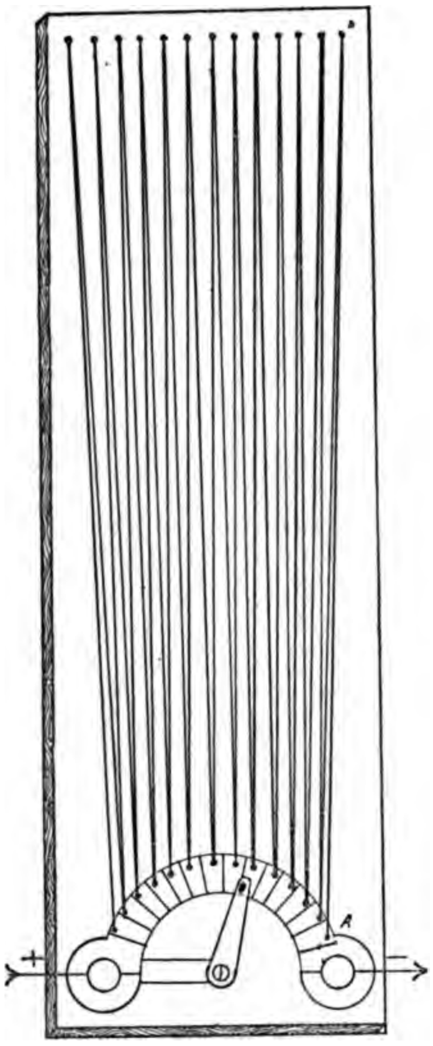


Fig. 10

Now take the whole bundle of wires and hang them in the boiling potash tank, this will soon fetch the grease off; but carefully examine them to see that no dirt is left in corners before passing them to the next process. The hot potash has tarnished them, if they have been in any time, to a cold brown tint; if left in longer they will go a deep blue black shade. Rinse them in cold water to get all the potash off, then a dip in the cyanide solution takes all the tarnish off. Rinse again in clean, cold water, and then hang them in the vat. Don't get them exposed to the air more than possible, keep under the clean water till you actually want them, and then nip them out quickly and into the vat. Let it be understood that the dynamo must be running before any work is put in, so that a deposit may take place immediately. If work is put in before the machine is started, or before the batteries are connected, we have all the elements of a galvanic cell; a film of thickness enough to spoil any amalgamation of the two metals spreads over the surface at once, and it must come out and be recleaned.

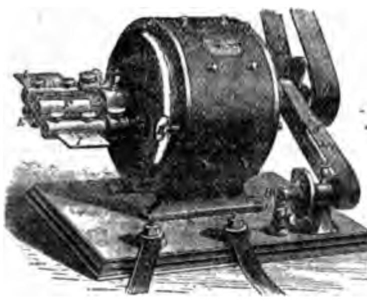


Fig 11.

Again, in no case must work be touched with th hand after it has left the potash tank; keep hol of it by the wires only. Give it a full curren when first in, so that the gas may be distinctl seen rising. Three or four minutes of this, an then, by the aid of the resistance board, shut th power down till there is only a suspicion of ga about, and if a good coat is required, keep it in 4 minutes.

Large articles, such as tea and coffee urns, wil need the potash mop in the cleaning process, an articles of iron and steel will require hard brushin with a suitable scouring brush and powdere pumice stone. This will fetch all tarnish off, th cyanide solution having no effect on a tarnish o iron and steel.

Now, while our plating is going on, we will touch on a few practical considerations of plating dynamos. They vary from electric-light machines in the output of current—for instance, an electric-light machine may give 10 ampères at 2,000 volts E.M.F.; but a plating machine would require these figures reversed, that is 2,000 ampères at 10 volts. But, still, 10 volts is too much for nickelling. Three volts is the E.M.F. for a nickel solution, and I should prefer it a bit below sooner than above. This E.M.F. will strike it on and send up gas freely, and without care will burn the deposit too. The resistance board will be brought into play to check this.

The current in ampères is, of course, governed by the size of the machine, small ones giving 15 to 20 ampères, and some of the larger machines 500 o more.

I suppose of all plating machines the Weston ha had the greatest sale; it was the first practical plating dynamo used in this country on anything like a factory scale (Fig. 11), and is a really goo and efficient machine; but it has two fatal faults The first is its liability to "reverse" current—tha is, to suddenly reverse its poles and start strippin the deposit off. The other one is its boxed-u design, with no circulation of air in it, and conse quently nothing to prevent undue heating excep that awful arrangement of circulating wate through the field-magnets. It seems to me a grea risk having water in a dynamo, any leakage bein ruination to insulation; but with these two excep tions it is a machine that is thought well of b platers who have used it.

Another machine that "has had its little day" i still more risky on the water arrangement; wherea in the Weston the water is circulated through fixe parts, in the Elmore machine it circulates *throug the armature*—a moving part! Of course, th union at each end of the spindle leaks, and more o less water is about; this machine is also liable to reverse.

The original Wilde machine was of a different type, having a separate exciter. In this machine, of course, it is impossible to get a reversal of polarity, as the field-magnets are in no way connected with the vat; consequently any counter E.M.F. or "back current" cannot get round them.

In the modern machine the field-magnets are excited by one or more sections only of the armature, the remaining sections supplying the outside circuit. This arrangement necessitates two commutators, which some platers consider an objection; but it entirely prevents "reversals." A good machine is Wilde's.

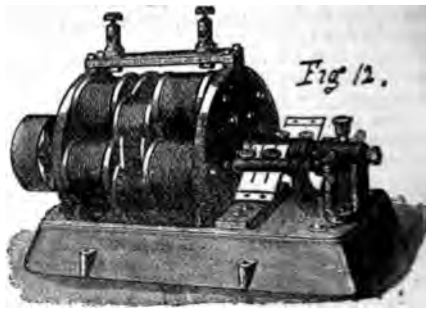


Fig 12.

Another type of machine that is not liable to reverse or to run dangerously hot, is the machine of the Gramme type, shunt-wound; but this type of machine introduces other objections. Being shunt-wound, the E.M.F. is highest when the outside resistance is highest; and as the outside resistance falls the current increases in the outside circuit, but the E.M.F. rapidly falls. Consequently, we should expect a small quantity of work to get burnt black, and a large quantity to be of a bad colour through having a too low E.M.F. If you short-circuit one of these machines by either a large surface of work in the vat, or by a stout wire across the terminals, you get no current round the field-magnets; it all runs on the path of lowest resistance, and in flowing through the vat only meets with a fractional part of the resistance encounter in the wire on magnets. Con- ', E.M.F. is nowhere on a large surface. ll surface the E.M.F. is always too high, ribute this to the armature being wound tically one length of wire only, and this not heavier than 16 gauge. When wound of these wires in parallel, the weight of barely equal to one No. 10.

er type of machine is, at first glance, like e; but in the Chutter machine (Fig. 12) nly one commmutator, but the current t the brush-holders. There are twelve ix on each side of armature; some of d-magnets are coupled as a shunt circuit, inder are in parallel series with armature. ingement gives good results. The mag- he shunt always having a current flowing are not reversed by any counter-current s, and as it is hardly possible to have two flowing in opposite directions at the same s compound shunt arrangement prevents sals. Another thing: the majority of the being in series with armature, get an in- urrent round them as the surface of work sed in vat. This raises the E.M.F. in the io as the surface is increased. Heavy e used in this machine—six No. 10's in n the armature in the small machines; 's and eight No. 6's on the larger ones. No d runs cool; gives a large current at about

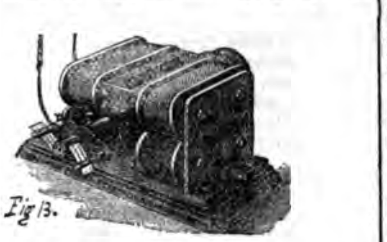


Fig 13.

er dynamo of the Wallace-Farmer type, fied, is giving good results (Fig. 13). The nent of the field-magnets is practically the t the armature, instead of being a circular th the bobbins on either side, is a cylinder bobbins attached to the outside. This runs between the four poles of F.M.'s in plane, but at right angles to the line of as in the Wallace-Farmer machine.

bye, this arrangement of F.M.'s was first Varley, 30 years ago. **Bijli.**

(*To be continued.*)

HANDY WORKSHOP STOOL.

.]—MANY amateurs and professionals do, do, a great deal of their bench work sitting id to such the description of a most con- adjustable stool, with which I have lately d my workshop, may prove acceptable.

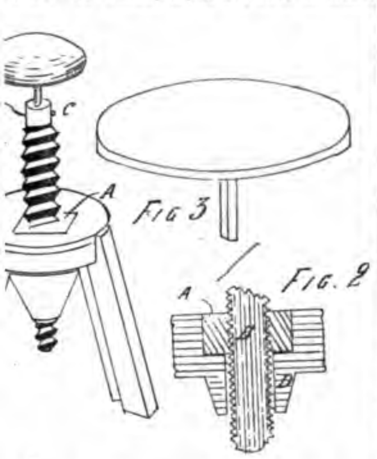


FIG 3
FIG. 2

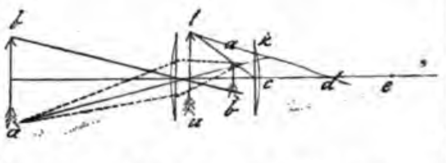
sists of a stout four-legged stool about h, having a top —in. thick, with a hole it admitting an ordinary wooden bench- e nut of which, A, is let into it flush. e head of the screw itself is cut off, and ap shrunk on instead, B. There is a ¾in. ole through this cap, and extending some in. down the centre of the screw. Into this uare iron stem attached to the seat—a iece of wood covered with leather and vith horse-hair. A small thumb-screw, C, he stem tight.

crew, of course, enables the seat to be lowered, just like a music-stool; and the f can be instantly removed, when desired, ble-top —in. in diameter substituted for it, thus turning the stool into a table, adjustable in height, and frequently useful.

Fig. 2 shows a section of the stool top. A is the nut, B the screw. The part D should fit the screw pretty closely, or the whole may prove unpleasantly rickety in use. **Ursa Minor.**

EYEPIECES—SPHERICAL ABERRATION.

[28579.]—THE object of the present letter is to show that when we speak of the "spherical aberration" of an eyepiece there are two distinct aberrations which come under the genus "spherical." The first is as follows:—



1. Let A B be an object placed before the o.g. of a telescope, whose centre is at O. Then an inverted image *b a* is formed, having its extremities in the lines A O *a*, B O *b* drawn through O. Let now an eye-lens be placed at C, and let E be the conjugate focus of O, when rays passing through O are reflected through it. Then any ray, O *a k*, is not accurately refracted to E, but, by reason of spherical aberration, meets the axis in a point D, lying nearer to C than E does. This is the first of the aberrations above spoken of. The rest is thus:—

2. When the image *b a* is placed before the eyelens, a magnified image of it, L M, is formed, having L for the conjugate focus of *a*. Now, the rays which pass through *a*, and are represented by the dotted lines in the figure, do not come accurately to a focus in L, but aberrate from it, and this is the other spoken of.

We have thus two aberrations — the first that of the pencil, O *a*, O *b*, whose origin is at O; and the next of the pencil whose origin is at *a*; and as it is advisable to give each of these a name, we might call them after the focus from which they aberrate. Thus, E is the real focus of O, and so we might call E D the *real* aberration, and for a like reason the other the *virtual* aberration, since L is a virtual focus. Also, since O is very distant from C, the aberration of O *a*, that is the *real*, may be taken as sensibly the same as that for parallel rays.

A practical question now arises—Which of the two kinds had we better try to minimise? The comparative advantage of reducing the one or the other of these two must be put off to another letter. In the meanwhile, we may point out some of the arrangements in use, and show which of the two it is which they actually *do* minimise.

1. *A Single Plano-convex.*—If we place it with the flat side towards the eye, we find that the *real* aberration, which, as we have seen, may be taken for that of parallel rays, is $1\frac{1}{8}$th the thickness of the lens, while if we reverse it, it becomes $4\frac{1}{2}$ times. Thus the former position is much the best for this purpose. But for the virtual these proportions are reversed, so that to reduce this aberration we had better have the curved side towards the eye. In this position the definition is better, and so when a single lens is used for astronomical purposes it is usual (see "Webb's Objects for Common Telescopes") to place the curved side towards the eye. The general view of an object, however, is not so good as for the other position.

2. *A Huyghenian Eyepiece.*—To estimate the effects in this case, we ought to compare the aberrations of a ray falling upon it with those of a single plano-concave of the same focal length. We find then that the real aberration of the pair is to that of single lens as 41 : 252 or 1 : 6, nearly, while the proportion for the virtual is 43 : 12, or $3\frac{1}{2}$: 1, nearly; so that there is great advantage in using two lenses to minimise the real, but for the virtual a single one does better.

3. *A Coddington E.P., which is sometimes used instead of the former.*—This consists of a meniscus for the field-lens, with radii as 4 : 11, and a crossed lens, radii as 6 : 1, the flatter sides being turned to the image which lies between them (see "Carpenter on the Microscope"). If we compare the aberration of this with those of the equivalent Huyghenian, we shall find that the real is *greater* in the proportion of 4·54 : 1, while the virtual is less in the proportion of 1 : 4·14. It is a great deal better, therefore, than the Huyghenian for the virtual, but a great deal worse for the real. If, however, we reverse the position of the eye-lens, as it is sometimes represented in books, the performance much more nearly resembles that of a Huyghenian, the real ab., however, being always greater, and the virtual less than it is in Huyghen's plan. In each of these cases the advantage of using two lenses, rather than one only, consists wholly in our being able therely to reduce the *real* ab.; the other is always increased.

What has been said above of course applies to the *colour* aberrations as well as to the spherical. In both cases we have to reckon with the pencils whose origins are at O and at *a* respectively, and in both cases it is the former of these which is corrected, while the other is exaggerated. Thus, in a Huyghenian, the dispersion of the former is corrected, while that of the other is double that of a single lens. In fact we cannot possibly arrange so that they shall both be corrected at the same time, the condition for the one correction being $F + f - 2d = o$, and that for the other $Ff + (f - d)^2 = o$. That these may be satisfied simultaneously, we must have $F t f = o$, and $d = o$, which cannot be. **W. G. Penny.**

PARAFFIN-OIL LAMPS.

[28580.]—IT is not quite clear whether "F. A. M." (p. 61) does mean that he supports the statements in the "interesting pamphlet," but it is certain now that one lamp exploded, how or why "F. A. M." strangely omits to explain. When I am told that I shall see instances if I look out for them in the newspapers, I must rejoin that it is just because I know the reports in newspapers are often incorrect that I took the liberty of asking "F. A. M." the questions I put to him. The "evidence given at the inquests" will certainly be more convincing than anything that can be written here; but having already said that one case was not an explosion, I have now to say that another case reported in the "interesting pamphlet" was, according to the local paper which reported the inquest fully, a simple case of a lamp being knocked over. I am quite aware that it appeared in the "newspapers" as an "explosion," but I am much too old to believe everything I see in them. Now, let me hit the nail fairly on the head. A paraffin-oil lamp properly constructed and treated cannot explode; but I put it to your readers that surely amongst them there must be some who can devise a lamp which under no possible conditions can explode, and yet cost no more than sixpence to make. Don't be alarmed at the sixpence—that is factory cost. It should sell for about two shillings. **Saml. Ray.**

The Mekarski Compressed Air Engine.—After various delays, several tramcars driven by compressed air on the Mékarski system have recently been placed on the tram lines in the Caledonian-road, where they are regularly taking their turn in working the traffic with the ordinary horse-drawn cars. The Mékarski system has been fully described in our columns, and it is therefore sufficient to state that it consists of a station where the air is compressed and stored for delivery into reservoirs placed under the cars. The air in its passage from the reservoirs to the driving engines, which are also under the cars, passes through hot water and steam, which are charged into a receiver on the car at the compressing station. The heat further expands the air, and also prevents the formation of ice in the cylinders due to the expansion of the compressed air. The Mékarski cars, which resemble the ordinary horse-drawn cars, take their turn regularly with the other cars on the line, keeping time and observing all the other conditions of traffic. The introduction of the air-driven cars by the tramways company on their line has been decided on in consequence of the economy of the system over horse traction, and this notwithstanding that both horses and forage are at a comparatively low price.

AN ancient Japanese coat of mail has recently been unearthed in the vicinity of Victoria, British Columbia. Some workmen engaged in digging a well came upon this interest relic 4ft. below the surface. It is a complete piece of chain armour, consisting of thousands of links of diminutive iron rings the diameter of a common pencil. When worn, the coat covered the breast, back and right side, leaving the left side, where it was fastened, to be protected by the shield. The right sleeve extended to the elbow. From the neck to the end of the shirt the length is 20in. In the side of the coat below the arm is a gash 2in. long, resembling a cut from a heavy weapon, which has been repaired by what appears to be a piece of native silver. Such armour was made by the Japanese two or three hundred years ago. A few years ago a large number of ancient Japanese coins were found in cairns, or stone graves, in the neighbourhood of Victoria.

Thermo-Electric Couples.—Some foreign papers state that a new thermo-electric couple having an E.M.F. as high as 0·18 volt, and a resistance as low as 0 009 ohm, has been constructed by M. Heimel. The importance of these figures becomes evident when it is pointed out that the thermo-electric couple best known in this country, that of Clamond, has an E.M.F. of only 0·02 volt with a resistance of 0 02 ohm.

REPLIES TO QUERIES.

⁂ *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[64157.]—**Electric Tramway (U.Q.)** — If "Boy Reader" refers to p. 38 of present volume, he will see replies by Mr. Bottone and "Chronos" to a similar query.—W. PERREN-MAYCOCK.

[64157.]—**Electrical Tramway.**—It is not clear from this query whether the querist merely requires a model of a tramcar using the rails as the conductors, or whether he intends making a model of an electric tramway fulfilling all the conditions that would be required of an electric tramway were it laid down in a street. If the former is required, the necessary information has been given in some recent answers to a similar query; but if the latter, the accompanying sketch will show how a small model track may be constructed. Similar letters denote similar parts. A channel *a* having a continuous slot in the top is laid down the entire length of the track between the two rails *b b*. In this channel are placed two copper bars *c c′* fixed to the sides of the channel and insulated therefrom by the ebonite blocks *d d*, placed at suitable distances apart. Fixed to the car is a collecting-arm *g*, which passes through the slot and runs in the channel, the springs *s s′* making contact with the copper bars *c c′*. When one pole of the battery is fastened to the copper bar *c*, and the other to *c′*, the current flows from bar *c* to spring *s* up into the car to the motor, through the motor to spring *s′* and copper bar *c′*. Fig. 1 is a perspective view of the track, showing the channel and rails in their places. The girder type tram-rail is shown, but any other form can, of course, be substituted. The rails should be made of brass, and the granite sets of mahogany, either cut out and placed separately, or a piece of wood may be placed between the channel and the rails, and the surface cut to resemble granite sets. Fig. 2 is a section of the channel, which should be made out of sheet-brass, bent and riveted together in the manner shown. The conductors (*c c′*) are shown fixed in their places, and the method of fixing the ebonite blocks to the bar is shown in Fig. 3. Fig. 4 shows the method of insulating the collecting arm (*g*), so that it shall not touch the sides of the channel. The springs (*s s′*) are pieces of watch-spring, insulated from one another by varnished paper. (*n n*) are wider pieces of spring, insulated from (*s s′*) by another layer of paper (*m m*), and the whole is bolted together by the bolts (*v v*), the bolts being placed at the edge of the plates (*n n*) so as to clear the springs (*s s′*).—F. C. ALLSOP.

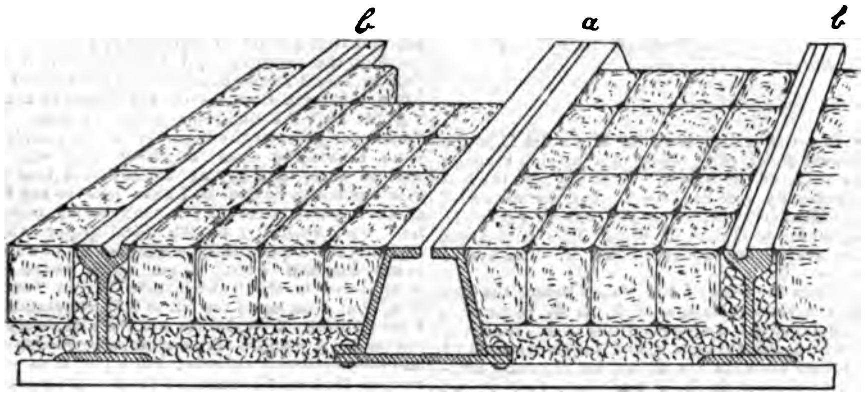


Fig 1

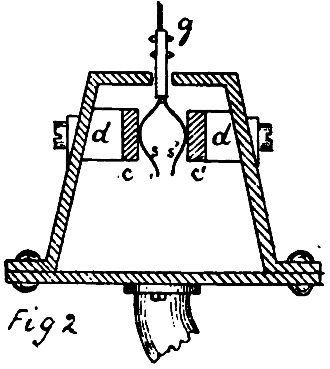


Fig 2

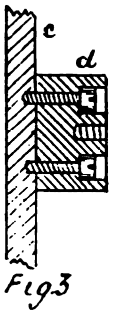


Fig 3

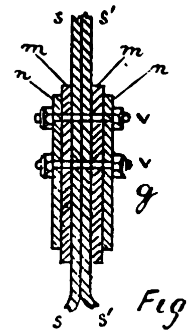


Fig 4

[64255.]—**Vertical Coil (U.Q.)**—Your coil appears to be an altogether antiquated affair, and it is somewhat difficult to grasp your description. *Are you sure that the* knob (marked 6) is of brass? *I should say that it was iron; if so, the* wire should be bent round so that end just dips in brass cup, which is filled with mercury, the ball being just over the top of the iron core of coil. This acts as a "make and break." The regulator is filled with water, and the strength of shock is altered by pulling wire in and out. The two terminals connected with the thick wire go to battery. Proportion of acid to water about 1 to 12. Bichromate cells would certainly be stronger.—W. PERREN-MAYCOCK.

[64263.]—**Bearing Springs.**—I never knew or heard of any formula concerning spring-making. I know nothing of mathematics, which may account for that. Formerly, there used to be on omnibuses, &c., dumb springs, which consisted of one piece of iron, while the under spring was of steel, made as common. If a comparison was made of the deflection of both, there will be a great difference, and the substance of the plates will show a great difference in the deflection of the spring. This being so, it does not appear clear to me that any formula can be given on the subject to rely upon. I never had any difficulty in finding of what strength a spring should be when the load and other dimensions were given. My system was what I term "theo-practical." Take, for instance, "Sydney's" query. I should go to work on a model spring, on a 2in. scale, and this will require a piece of hooping ⅜ wide and about No. 14 gauge thick; but as regards so great a difference as ⅛ of the back and other plates, in my opinion, it is too much, for I have found in actual practice it tends to fracture in the stout plates. Now, the plates all cut off to length, fitted, and put together, it is to be tested with a weight of 61lb. quite, which on a 2in. scale is in proportion to six tons. We will suppose the spring is put together, and the compass measures 8in. Now put on the weight, and that will prove whether the compass is too much, too little, or that it requires the plates to be more numerous, or of stouter material, or otherwise. I mention hooping for the model, which will be found quite stubborn enough for the occasion, as it is easier obtained for width and substance than steel; but, of course, too much pressure would make it set. An opinion is prevalent with many, that steel when hardened will deflect less than when left soft. Anyone can easily satisfy themselves on that point by experiment.—G. B.

[64359.]—**Wheatmeal Bread.**—We appear, after a long correspondence, to have arrived at "how to do it." Now, we are told by chemists that although the husk of wheat—i.e., the bran—does contain nitrogen and certain nutritious substances, yet that these substances pass through the human body practically unchanged; that the digestive organs of man cannot assimilate them. I beg to ask "Hygienist," who is well to the fore in the matter, if this is true or not. I have asked the question upon more than one occasion, when this "craze" has been under discussion, and have invariably received evasive replies—not one advocate of wheatmeal bread has plainly said that it is untrue. It is desirable that the truth should be known, for it is needless to put indigestible husk into bread, and I expect the digestive organs would not quietly submit to the indignity: they have quite enough to do under ordinary circumstances without being troubled with rubbish. In corroboration of this suggestion, I can state as a fact that whenever I invest in wholemeal bread the result is symptoms of diarrhœa in the family in about three days.—R. G.

[64382.]—**Turbine or Waterwheel.**—Many years ago I was sent to a Lancashire cotton-mill to test the respective merits of a turbine and a waterwheel. The latter was a splendid machine. Fall was about 16ft. (I am writing from memory.) The wheel had ventilating buckets; water was laid on shoulder, over a rising hatch, in a thin stream without shock, so that not a drop of water was wasted. The turbine was by a Lancashire firm no longer existing. The result of the trials was slightly in favour of the turbine; but the conclusion I came to was, that in actual everyday work there would be no difference so long as the turbine was working at full power. If the water was short, I have no doubt the advantage was with the waterwheel. I have known several cases of turbines being replaced by waterwheels, probably because the useful effect rapidly diminishes when the water falls below the amount for which the turbine is constructed. I am surprised no mention has been made in this correspondence of the Girard. It is a capital wheel, will give 7 per cent. useful effect at full power, and 70 at half power. It is exceedingly simple, and not likely to get out of order; has no bearing under water, and is easily adjusted or cleared out. Its defect is, that the useful effect diminishes when working in tail water. Some years ago I was anxious to put in a waterwheel, the place being peculiarly suitable for one; so we applied to a noted waterwheel maker in the South of England for an estimate, and, in reply, received one for a turbine, as they no longer made waterwheels. We then got an estimate from a Scotch firm on the Continent. The price asked was 12,000f., whilst a foreign firm offered to make a Girard for 3,000f. In both cases the necessary gearing was included. The latter offer was accepted, and we are quite satisfied with it, and our stream is the receptacle of every imaginable filth—a disadvantage which every turbine user will appreciate. I fancy, as a general rule, the turbine has the advantage of falls under 12ft.; on higher falls there is little difference between a good wheel and a good turbine. By the bye, might I ask "Millwright" if 8ft. of head to deliver water on to an overshot is not rather a wasteful proceeding? Does anybody know anything of that hydraulic motor illustrated in the "E. M." about two years ago? It was a sort of reversed chain pump, and, I think, was made at Salford. It had one good quality—a cart-load of bricks shot in would hardly have injured it.—A. J.

[64387.]—**Watch Repairs.**—The pivot holes of any description of watch should be oiled, both through and those with end stones. The ruby pin of a lever watch should not be oiled, but the wheel-teeth of lever or horizontal should. Plugs [illegible] cylinders can be bought, but require pivoting after fixing in cylinders. Pivots can only be [illegible] in a lever balance staff by drilling it up, putting [illegible] plug in, and pivoting it; a feat few amateurs [illegible] likely to perform, and one rarely practised by workmen, as it is easier to make a new staff [illegible] once.—PEGANDREDSTUFF.

[64424.]—**Telescope.**—To "F.R.A.S."—Since your first reply to my query, I have taken o.g. [illegible] of cell; there is but one glass. I put straight-edge across o.g., and I find it to be highest in middle, showing a very gentle curve on both sides. The focus is 30in., not 40in. The plano-convex [illegible] is 2¼in. diameter, placed 4in. from eyepiece, [illegible] in same tube.—FITTER.

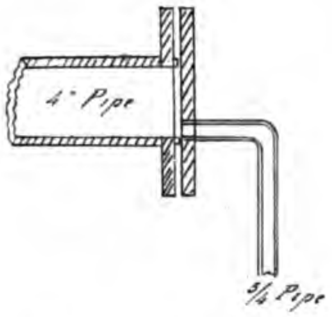
[64492.]—**Petroleum Engine.**—Is not this [illegible] rather funny query? Why does "Colchester" want to explode a piston-rod by petroleum [illegible] benzoline about "one man power"?—SILEX.

[64495.]—**Gramophone.**—Surely the particulars given of this instrument in No. 1,19[illegible] [illegible] sufficient to enable any one to make. If not, [illegible] suspect the patent will be invalid.—NUX. DOM.

[64498.]—**Forge Coal.**—Any fairly good [illegible] will do for a forge—the small from any [illegible] tolerably free from sulphur.—T. B.

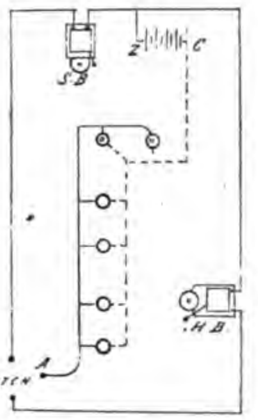
[64527.]—**Cupola.**—As several illustrations [illegible] foundry cupolas have been given recently, the querist will probably get an idea of what he requires. If the bellows has a large reservoir [illegible] that the blast will be steady, it will probably do. —B.

[64452.]—**Steam Heating.**—If "Jonathan" will do away with the 2in. return, and bring down from each room a separate return pipe of [illegible] wrought iron, and fix a trap on each one separately —a ½in. trap would be large enough—he will then be able to get rid of his waste water without risk room holding up the water in the other as es now. He had better make quite sure each room the 4in. pipes have sufficient fall, at the ¾in. wrought-iron pipe is inserted into ank end in such a way as to thoroughly drain pe, thus—



annot have a better trap than Royle's; you nd it answer your purpose exceedingly well. can arrange to collect the waste water, so use it again in your boiler or in the wash- it will well repay you for doing so. With to the relative merits of 2in. or 4in. pipe, it a question of which pipe heats soonest, but offers the largest surface for radiating the f the steam it contains.—WEBER.

61.]—**Altering Bell Circuit.**—Misfortune to attend the diagrams of this query, as the ver has made two blunders in the diagram ast week. It should be thus—



ake it clearer to the engraver, I have slightly d the positions of the two lower press buttons. d line represents battery wire connected to pole of battery, A centre on which switch B the terminal for shop bell, D terminal for bell.—WEBER.

28.]—**Weather.**—Has our friend at San ompared observations with his neighbours— a wide term there—at, say, Crescent City os Angeles? I can't think the moon can nything to do with the facts he mentions.—

89.]—**Solder for Aluminium.**—There is d for the querist to trouble Mr. Reader Lack, particulars of the specification of Sellon given, with other interesting notes, in No. . 423, Vol. XLIV. If the number is still t, that will cost only 2½d., and there is sure something else, if not half a dozen things the money. It is always advisable to look indices when information is wanted.— C.

47.]—**Problem.**—I suspect that this problem be put into an equation quite so readily as " has attempted to do it. My impression is e answer to the question is a number con- ly smaller than 190,902,411. Indeed, I do lieve that 12 soldiers could march in more different ways, so that no man is followed by the same individual. Let us take four s an example (a, b, c, and d), and let us e them according to their 24 possible permu- . We have the following:—

a b c d	b a c d	c a b d	d a b c
a b d c	b a d c	c a d b	d a c b
a c b d	b c a d	c b a d	d b a c
a c d b	b c d a	c b d a	d b c a
a d b c	b d a c	c d a b	d c a b
a d c b	b d c a	c d b a	d c b a

g at a b c d, the first in the list, we observe contains the three combinations of a b, b c and c d. Now, according to the question, these must not occur again. We will therefore append all those of the remaining 23 arrangements that contain such combinations. They are five in number—

a b d c, c a b d, c d a b, d a b c, and d c a b.

This reduces our 23 to 18. From the remaining 18 let us eliminate all containing b c. They will be four in number—

a d b c, b c a d, b c d a, and d b c a.

This reduces our 18 to 14. Now, from the remaining 14 eliminate those with c d. They are three only—

a c d b, b a c d, and c d b a,

which leaves us 11 from which to select another arrangement of the soldiers. These 11 are—

a c b a		
a d c b	b d a c	c b d a
	b d c a	d a c b
	c a d b	d b a c
b a d c	c b a d	d c b a

none of which contain a b, b c. or c d. Let us select one at haphazard—say, c a d b. We have now to eliminate from the remaining 10 all those containing c a, a d, d b. Let us take those with c a first. There is only one—viz., b d c a. From the nine remaining we must take those containing a d. There are three, a d c b, b a d c, c b a d. Now, from the six remaining let us eliminate those with d b, of which there is one only—viz., d b a c. We are now left with the following five—

a c b d, b d a c, c b d a, d a c b, and d c b a.

Let us now select a third arrangement at haphazard—say, d a c b. Then from the remaining four let us eliminate those containing d a, a c, or c b, and we find that they now all disappear. We have by this means cleared off all the arrangements excepting the three selected—a b c d, c a d b, d a c b; consequently it would seem that four soldiers can only march three times in different order, so that none shall be followed by the same man. If a similar experiment be made with five letters, it will be found that four is the greatest number of such possible combinations. Now, according to the formula given by "J. C.," five soldiers ought to be able to form 53 different arrangements. Thus—

$$
\begin{array}{lr}
\text{Permutations of 5............} = & 120 \\
\text{Deduct } 4 \times 4 \times 3 \times 2 \text{ ...} = & \underline{96} \\
 & 24 \\
\text{Add } \tfrac{1}{2} (4 \times 3 \times 3 \times 2) \text{ ...} = & \underline{36} \\
 & 60 \\
\text{Deduct } \tfrac{1}{6} (4 \times 3 \times 2 \times 2) = & \underline{8} \\
 & 52 \\
\text{Add } \tfrac{1}{24} (4 \times 3 \times 2)\text{.........} = & \underline{1} \\
 & 53
\end{array}
$$

So I think there must be something wrong in "J. C.'s" reasonings; for I do not think he can get more than four on trying.—Since writing the above I have made careful trials up to 6, and probably have found the law by which the results with higher numbers may be obtained. 6 men can march in 6 ways and no more; 5 men in 4 ways; 4 men in 4 ways; 3 men in 2 ways; 2 men in 2 ways. For example, the greatest possible number of arrangements of 6 letters so that no pair shall appear a second time is 6—viz.:—

a b c d e f
f e d c b a
c f b e a d
d a e b f c
e c a f d b
b d f a c e

5 letters can be arranged in no more than 4 ways—viz.:—

a b c d e
e d c b a
a c e b d
d b e c a

With regard to the other part of the question—What is the effect on the problem when the arrangement is made in a circle?—it would appear that there is no effect when the number of men is odd; but when it is even, the result is less by 2. This can be seen by repeating the first letter at the end and noticing the result. In the arrangement of 5 letters above we can have equally—

a b c d e (a)
e d c b a (e)
a c e b d (a)
d b e c a (d)

But in the arrangement of 6 letters we find we shall have to strike 2 out. Thus, in—

a b c d e f (a)
f e d c b a (f)
c f b e a d (c)
d a e b f c (d)
e c a f d b (e)
b d f a c e (b)

We must eliminate the 3rd and 4th, because d (c) and c (d) are already appropriated by the 1st and 2nd, the 1st containing *c d* and the 2nd *d c*. We may put the results in a table, and so see what the law probably is.

No. of objects.	No. of combinations in a line.	No. of combinations in a circle.
2	2	1
3	2	2
4	4	2
5	4	4
6	6	4

So far by actual experiment. Probably the figures would be continued as follows:—

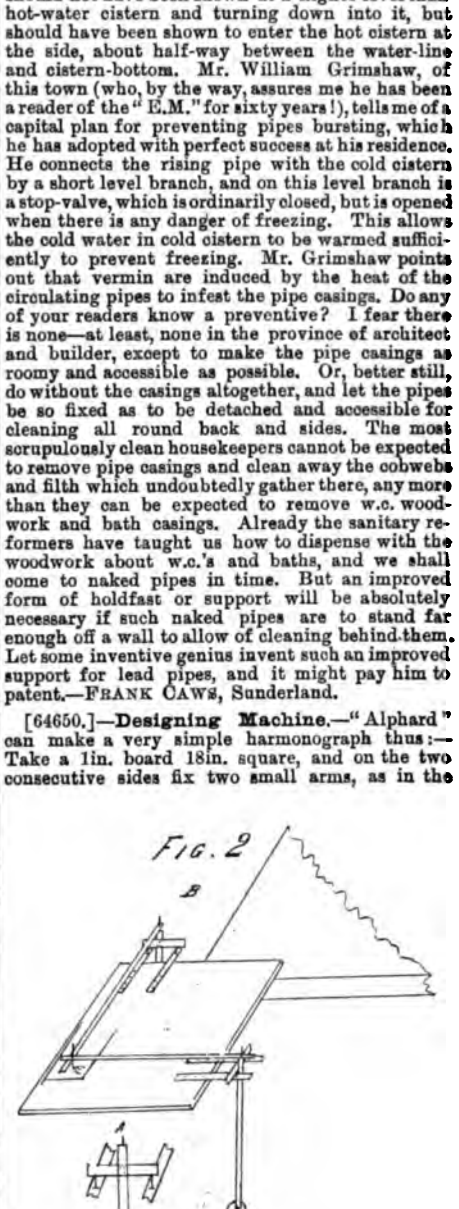
7	6	6
8	8	6
9	8	8
10	10	8
11	10	10
12	12	10

In which case the answer to the problem with respect to the 12 men would be 12 and 10 respectively.—F. S. S.

[64633.]—**Cement.**—In reply to "Ferro," Purimachos cement is a patent—makers, Purimachos Works, Redland, Bristol. Vulcan cement is supplied by J. Matthews and Co., Hatton Garden Works, Liverpool.—T. W. B.

[64642.]—**Hot-water Fittings.**—Pipe-branch *l* in the diagram accompanying my reply last week should not have been shown at a higher level than hot-water cistern and turning down into it, but should have been shown to enter the hot cistern at the side, about half-way between the water-line and cistern-bottom. Mr. William Grimshaw, of this town (who, by the way, assures me he has been a reader of the "E.M." for sixty years!), tells me of a capital plan for preventing pipes bursting, which he has adopted with perfect success at his residence. He connects the rising pipe with the cold cistern by a short level branch, and on this level branch is a stop-valve, which is ordinarily closed, but is opened when there is any danger of freezing. This allows the cold water in cold cistern to be warmed sufficiently to prevent freezing. Mr. Grimshaw points out that vermin are induced by the heat of the circulating pipes to infest the pipe casings. Do any of your readers know a preventive? I fear there is none—at least, none in the province of architect and builder, except to make the pipe casings as roomy and accessible as possible. Or, better still, do without the casings altogether, and let the pipes be so fixed as to be detached and accessible for cleaning all round back and sides. The most scrupulously clean housekeepers cannot be expected to remove pipe casings and clean away the cobwebs and filth which undoubtedly gather there, any more than they can be expected to remove w.c. woodwork and bath casings. Already the sanitary reformers have taught us how to dispense with the woodwork about w.c.'s and baths, and we shall come to naked pipes in time. But an improved form of holdfast or support will be absolutely necessary if such naked pipes are to stand far enough off a wall to allow of cleaning behind them. Let some inventive genius invent such an improved support for lead pipes, and it might pay him to patent.—FRANK CAWS, Sunderland.

[64650.]—**Designing Machine.**—"Alphard" can make a very simple harmonograph thus:—Take a 1in. board 18in. square, and on the two consecutive sides fix two small arms, as in the



drawing; then take two pieces of wood for pendulums 2ft. long by about ½in. thick, and fasten to them about 3in. from the top a small piece at right angles, as in A, Fig. 1; at the extremities of this fix two stout needles. At the end of the pendulum fix another needle; then take two light laths, and at one end of each bore a hole large enough to admit of a cedar pencil, and at the other end a hole large enough to admit the needle. Put the cedar pencil through the two, so as to form a right angle, and the needles through the other holes; then, if weights of about 2lb. each be put on the pendulums, and a piece of paper pinned under the pencil, and the pendulums started, beautiful diagrams will be described. The pencil should be finely pointed.—H. T.

[64666.] — **Jointing Thick Wood.**—To "H. A. G.," Kingstown.—The joints you speak of I have made for many years, and have worked with joiners who have made them. I have shown it to many myself, although it was shown to me a secret. I think the best way is to take a centre-bit the proper size, and bore holes for screw heads first, and then cut slots into centre-bit holes.—J. B., Langley.

[64673.]—**Closed Circuit Bell-Ringing.**—In my account of this system last week the keys in the sketch should have been shown as "closed circuit keys"—i.e., keys which are always "on," which break contact on being depressed.—W. PERREN-MAYCOCK.

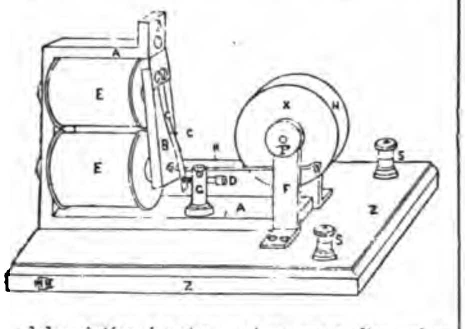
[64679.]—**Knife Boards.**—I am obliged to "Sheffield" for his attempt to instruct me; but what I recommended is really the same thing that he does—viz., an absorbent surface (cork) in which the abrading material may imbed itself. If he prefers the mess of a paste, I do not; and certainly the knife boards I recommended are by no means "useless."—T. C., Bristol.

[64682.]—**Battery.**—TO MR. BOTTONE.—Many thanks for your answer. My query was certainly rather vague, but I will try to be more explicit this time. I want to drive a motor, R. of which = ¼ ohm, and which is meant to take 20 amps. at 4 to 10 volts. How many square inches of carbon surface should there be in each cell? I intend to use corrugated rods. Does adding an extra cell, in series, increase the current through an external R. greater than the internal?—PHOTOMANIAC.

[64683.]—**Brewing.**—1. An ounce. 2. A cool place. The temperature of March and October is the most favourable for brewers. 3. The liquor may be put in the cask same day of brewing, and use be commenced ten days or so afterwards. Remember that as the temperature of the air rises as the year advances, then fermentation is so much the more energetic, and acetous fermentation follows close behind vinous ditto. Refer to back numbers for fermentation.—THE LYDNEY DISPENSER.

[64686.]—**Horse-power of Motors.**—Theoretically, 746 watts = 1H.P.—that is, for a perfect motor of 100 per cent. efficiency. If E = efficiency of motor, $\frac{100 \times 746}{E}$ = watts required per horse-power. No reciprocating armature motor is a success at present, the efficiency being far behind the rotary type. The number of cells required depends on the size of cells employed. The E.M.F. of battery squared, divided by the resistance of battery and motor, must equal the number of watts found by the above formula.—ELAG.

[64686.]—**Horse-Power of Motors—Bayley's Motor.**—To produce 1H.P., a current of 746 ampères at 1 volt pressure, or of 1 ampère at 746 volts, must be employed. In other words, 1H.P. equals 746 watts, and 1 watt is equal to 1 volt multiplied by 1 ampère. With regard to the number of cells of any battery required to give 1H.P., it will greatly depend on the resistance of the wire with which the motor is wound. Some motors are wound to give 1H.P. with a pressure of 100 volts, and in these the wire is comparatively fine and in many coils, while others, wound to work with a larger current at lower pressure, have fewer coils of coarser wire. Messrs. Dale inform me that Bayley's clutch motor, of which I append sketch and description, is not a great success, as it requires a good deal of power to work it. It is, however, useful in certain cases. The motor consists in an electro-magnet E, in front of the poles of which is an armature B. This armature is provided with a contact spring C, and a contact breaker G, so that as the battery current passes the magnet may be alternately magnetised and demagnetised. A *second electro-magnet H is mounted* on an axis, to which is attached the driving pulley P. The electro-magnet H is free to revolve. Facing the poles of this magnet is a loose disc armature X. By means of the rod K this loose disc armature is attached to the vibrating armature B of the electro-magnet E. The battery current passes entirely through both magnets, when immediately the armature B is attracted to the poles of E, the loose disc X being also drawn forward by reason of its attachment to B. As the electro-magnet is simultaneously magnetised, it clutches or grips on to the disc X, and is carried round a short distance along with it. When the pull of the magnet E causes the contact at C to be broken, both magnets become demagnetised, the disc X falls back to its former position, but the magnet H does not. The same series of operations is again repeated.—S. BOTTONE.



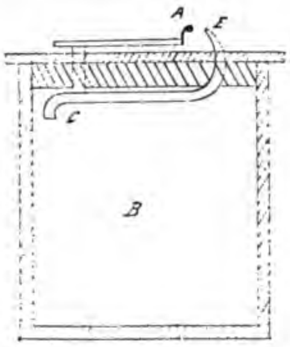
[64705.]—**Turkish Bath.**—I should be very glad if "T. H. W." would describe and give a sketch of his bath and furnace. What is the size of his bath, and what fuel is used? I am sorry he has not received an answer to his query yet.—J. R.

[64715.]—**American Organ.**—As a little additional information to my previous reply to this query, let me say, that if the querist intends to adopt the use of a four-row cavity board for his lower manual, one containing two 8ft. sets, one 16ft., and a 4ft. set of reeds, will be suitable; but he can have it made to suit any special specification to order. I previously recommended the treble sets to be of three octaves, for convenience in playing solos: a lesser compass than three octaves is often found to be insufficient for this purpose. Providing that the treble sets are voiced properly, a nice variety of effect will thus be obtained. It is also advisable to consider well, and settle upon every matter of importance, before commencing the work. Specifications are numerous and varied, each being adopted according to the exact purpose for which the instrument is required. When specifications are adopted to suit personal tastes, it is exceedingly difficult to advise, unless the taste of the individual for which a certain instrument is intended is understood. The querist is welcome to any information I can give that is of general interest to the readers of the "E. M."—G. FRYER.

[64728.]—**L. and S.W.R. Single Expresses.**—As "C. F. G. M." may have some doubt as to my answers to this, I should like to inform him that my first is the correct one, and that there was also one more single engine I omitted to mention —viz., the Victoria (scrapped a few years ago). The Havelock is used as a portable boiler at Southampton.—S. S.

[64730.]—**Photometry.**—An arrangement by a Mr. Jolly is said to possess distinct advantages over the ordinary greased spot. Two small rectangular slabs of paraffin wax, about ⅜in. thick, are placed side by side in a suitable metal frame. This is placed between the two sources of light in the usual manner, with its faces opposite them. The light shining on either slab renders it translucent, and of course if one light differs from the other in intensity, so will the translucency of the respective paraffin slabs. All light is screened off from the experimenter except the edges of the slabs. His object is to adjust the stand at such point that the translucency of one edge equals that of the other. I believe this has been found more easily adjustable and exact than the usual arrangement.—W. PERREN-MAYCOCK.

[64741.]—**Spongy Platinum.**—Spongy platinum is made by gently igniting the double chloride of platinum and ammonia. In order to prepare it in a suitable form for a lamp, soak a small piece of asbestos in a strong solution of platinum, and then dip the asbestos, thus impregnated with platinic chloride, in a concentrated solution of ammonium chloride. It is now gently ignited in a Bunsen flame. In this state the asbestos easily ignites a Bunsen burner when held in the stream of coal-gas. I inclose a sketch of a self-igniting lamp. B is a reservoir in which hydrogen is generated; E is a pipe having a cock at C, and ending in a nozzle. The o attached to the arm A, and is arrange allow the gas to escape when the end o is opposite the nozzle. By this means th of hydrogen flowing out of E impinges of platinised asbestos placed at the e which ignites the hydrogen. I do not t such an apparatus will ever come into ge It is, to use very mild language, dar CHEMIST.



[64743.]—**Paint for Bicycles.**—I al the best black japan laid on very thin soft brush. One coat should be allow thoroughly hard before another is appli will not, I expect, get anyone to give y cipe for a good black enamel, such as t facturers use.—CHAS. PROVIS.

[64745.]—**Separation of Tin.**—If "' treats his alloy in the following manne probably arrive at what he wants—viz., s of the tin:—Treat the finely-divided al flask with dilute nitric acid (say 25cc. H 15cc. H_2O). The Sn and Sb present oxidised, and remain as white ppt., which filtered off from the solution containing Cu, and Zn. It remains now to carefully the oxides of Sn and Sb from the filter p a beaker, adding 5cc. HNO_3, and evapo perfect dryness. This dried mass is th detached from beaker, and washed into basin, again evaporated to dryness, and fu an excess of NaHO. After fusing, tak small quantity of H_2O, and add about volume of strong alcohol. The Sn wh exists as stannate of soda (in solution separated from the insoluble sodium ant Allow to stand for a few hours, filter, ppt. with dilute alcohol. The antimonia dried, and fused with KCn, metallic being obtained. The filtrate containing boiled to expel the alcohol, acidulated wi c.c. of dilute H_2SO_4, and pptd. by H_2S. filtered off, washed, dried, and burnt weighed, and estimated in usual way.—W

[64746.]—**Spirit Varnish for Glue.**- dissolved in methylated spirit is about substitute for glue. Rough the surface united, and see there is no grease on them. PROVIS.

[64749.]—**Gold Lettering on Clot Books.**—It affords me extreme pleasure t to give "A New Subscriber" the inform desires. To letter cloth books begin by gi back or side a coat of glair (i.e., the whit which has been thinned by churning, o drops of vinegar), and allow it to become dry. To make sure that it is dry give the has been glaired a rub with an oily rag, or hand previously passed over the hair of t This will prevent the gold leaf from stickir it is not wanted. Now blow out a leaf of the cushion, and cut it to the required siz the part of the book where the lettering with a piece of cotton containing olive o use too much oil or you will stain the clot another piece of cotton lift the gold leaf cushion and lay it on the book. It will place by the oil until the lettering is co You will require brass letters in wooden and they must be heated by gas or some co means. Guide lines may be drawn across upon the gold with a thread. The letters up one by one and pressed quickly and eve the back; when all have been pressed on title completed, the gold is rubbed off with rag mentioned above, and the remaining of gold carefully rubbed off with a piece rubber. This is all the information I can now remains with our friend to try. I will, and let me know how he succeeds. help at any time.—PRACTICAL BOOKBIN

[64750.]—**Diaphragm of Telephone** thanks to the gentlemen who kindly answ query of telephone. Since I have obta discs of ferrotype iron, also some s.c. wire, round bar magnets. Will they kindly tell many layers of wire ought to be wound about 1in. long, and how far such a t ought to work satisfactorily?—H. T.

[64754.]—**Percentage of Oxygen.**— addressed to Mr. Gray, I take upon m answer this query. When barium di treated with sulphuric acid, hydrogen pe formed, according to the following equatio

$$BaO_2 + H_2SO_4 = BaSO_4 + H_2O$$

Hydrogen peroxide and potassium permang thus—

$$5H_2O_2 + K_2M_2O_8 + 3H_2SO_4 = K_2SO_4 + 2M_2SO_4 + 8H_2$$

From these equations we see that 314·2 permanganate are equivalent to 845·5 barium dioxide, or 80 parts of oxygen. H may easily see that 100 parts of oxyger obtained from 1056·9 parts of the dioxide, equivalent to 3,931 parts of permanganat of permanganate were dissolved in ter, then 1cc. would be equivalent to $_2$, or ·001gm. oxygen. If we desire a determination, weigh out 1·05gm. e in sulphuric acid, and run in the until the pink colour is permanent. was pure, we should expect to use , since 1·05gm. BaO_2 = ·1gm. O, and nate = ·001gm. O. Hence, we have a letermining directly the available rium dioxide, expressed in percent- tassium permanganate is not a stable solution of exact strength cannot be this reason. The usual way to make is to dissolve about 5 grams of the sed solid in a litre of water. The his solution is then determined by or oxalic acid (112 parts of iron being 169·1 parts BaO_2, or 16 parts oxygen). ctual value of the permanganate solu- e was found to be 1cc. = ·0012gm. O, to make a determination, weigh out tance and titrate as before. The bic centimètres used × 1·2 will give e of available oxygen.—CHEMIST.

ron Cistern.—The width makes no the strain on the tie rods; it depends th. The best position for the rods is lepth from the bottom. The strain rods in pounds = $\frac{\text{depth in feet}}{4} \times \frac{\text{e in inches}}{\text{ie rods}}$. Thickness of plates and ldom calculated, except for large the strains become considerable.—

ron Cistern.—The centre of pres- is one third of the height from the ter. In your case it would be $4\frac{1}{2} \times \frac{1}{3}$ bottom of tank. The amount of ng side of tank is—

$$\times 4{\cdot}5 - 1{\cdot}5 \times 62{\cdot}4 = 8{,}424\text{lb.},$$

d of tank—

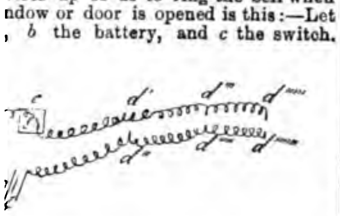
$$\times 4{\cdot}5 - 1{\cdot}5 \times 62\,4 = 6{,}739\text{lb.}$$

particular formulæ for the bolts, a ght be stiff enough to resist the pres- cross-ties. But if the stiffness of the lected, the ties must be sufficiently d this pressure. It would be better nber of thin ties distributed than a s, as the plates might then be made qual strength.—ELAG.

lectric Bell.—Run a wire from tery to each contact (this wire must ted). From each contact run another ndicator and bell. Read the recent F. C. A.," but you will find it best the diagrams in every respect. It is wire from push to carbon, than from —CHAS. PROVIS.

lectric Bell.—The reason your bell is because your wires are not run make each contact work independ- st run two wires parallel wherever ut your contacts; join one wire to of your bell, one pole of your battery erminal, and the other pole of battery ; then, by joining your contact be- o wires—that is, one side of contact and the other side to the other wire, ke each work independent of each s.

lectric Bells.—A simple plan of vires up so as to ring the bell when ndow or door is opened is this:—Let , *b* the battery, and *c* the switch.



e switch is on, and the contact pieces put in contact, it will complete the the bell will ring. The same will e case of d''. d''', d'''', and d''''' show em may be extended to any number -H. CATTERALL.

team Launch.—You are on the ntirely. You want your machinery ssible, and to give out the maximum o this you must have a compound sur- ing engine, and the boiler pressure . per square inch. In the *Field* news- h 3, page 286, you will see a descrip- sey steam canoe, which will give you ts. Why do you say your boiler must thick and have no tubes? I should r of a boiler that would do what you want without tubes. You would want a smaller size engine than that referred to. It should weigh, boiler and all complete, about 4½cwt.—R. N.

[64762.]—**Mounting Microscopic Objects for Use with High Powers.**—It is necessary to press the cover-glass gently down on the object for use with any power. In Waldeyer's laboratory—where I worked for some years—the common Minie bullets were used as weights; but for my own use I prefer the piano-wire clip used in Prof. Rothrock's botanical laboratory, Philadelphia, which any one can make for himself. With this clip you can slope the object in the sun or anywhere to get quit of the air-bubbles. For a $\frac{1}{12}$th immersion of Hartnack, the ordinary German square cover glasses were used; but I understand specially made thin glasses can be obtained. The secret is: learn to make your sections thin and cut with the hand. If you need a freezing microtome, the one made on the principle of a joiner's plane and used by Klein I find to be the best.—B.SC., Plymouth.

[64764.]—**Mathematical.**—Consider n points in space, a_1, a_2, a_3, &c., a_n; and if we take a_1, we may join it to any one of the remaining $n - 1$ points. We thus have $n - 1$ lines running from a_1 to each of the other points. Similarly, we should have $n - 1$ lines joining a_2 to each of the remaining points; similarly, we should have $n - 1$ lines joining a_3 to each of the remaining points, and so on; and as there are n of them, we should have

$$n\,(n - 1) \text{ lines.}$$

But this reckons as two lines, the line a_1, a_2, and the line a_2, a_1, &c.—i.e., each line is counted twice. Hence, we must divide the above result by 2, and we get $\frac{n\,(n-1)}{2}$ as the total number of lines which can be formed by joining n points in space. It should, of course, be stated that no three of the points are to lie on a right line. This gives us—

$$\begin{aligned} (x^2 - 2{,}000)^2 &= 6{,}400\,x^2 - (x^2 - 3{,}300)^2. \\ \therefore\ x^4 - 4{,}000x^2 + 4{,}000{,}000 &= 6{,}400x^2 - x^4 \\ &\quad + 6{,}600\,x^2 - 10{,}890{,}000 \\ \therefore\ 2x^4 - 17{,}000x^2 &= -\,14{,}890{,}000 \\ \therefore\ x^4 - 8{,}500x^2 &= -\,7{,}445{,}000 \\ \therefore\ x^4 - 8{,}500x^2 + (4{,}250)^2 &= -\,7{,}445{,}000 \\ &\quad + 18{,}062{,}500 \\ &= 10{,}617{,}500 \\ \therefore\ x^2 - 4{,}250 &= \pm\, 3{,}258{\cdot}4 \text{ nearly.} \end{aligned}$$

This gives us—

$$\begin{aligned} x^2 &= 4{,}250 \pm 3{,}258{\cdot}4 \\ &= 7{,}508{\cdot}4, \text{ or } 991{\cdot}6 \text{ yards, nearly.} \end{aligned}$$

Since x^2 must be less than 60^2, the latter is the only admissible value.

$$\therefore\ x = \sqrt{991{\cdot}6} = 31{\cdot}5, \text{ or } 31\tfrac{1}{2} \text{ yards nearly.}$$

—S. REPTON.

[64767.]—**Leclanche Cells.**—You have evidently a contact somewhere. The "E.M." went in for this rather fully on Feb. 3, entitled "Electric Bell-Fitting," and you would do well to look this up.—LEWIS.

[64767.]—**Leclanche Cells.**—The zincs in these cells always become covered with the black scum when the solution of sal-amm. is weak. The probability is, that in setting up your cells, you omitted to dry and grease the edges, thus affording good opportunity for the "creeping" action, which, taking place, weakened the solution.—W. PERREN-MAYCOCK.

[64768]—**Amateur Manufacture of Tobacco, Perfumery, &c.**—I do not understand your objection to my wording of the instructions for dyeing *couleur de rose* from "Carthamus." The recipe is almost the same, I find, in the large Bengal "Materia Medica," and is exactly the one I always used myself, and saw in frequent use by my native servants. Did you use clean, cold, soft water, and was your home-grown product from very rich land, and the flowerets prepared *cum arte?* I am not to blame for your failures. I have not time, and our "E. M." has not space, to give you minute details on the subject. Surely lemon trees will grow rapidly in a climate sufficiently warm for safflower. *Crocus sativus*, or "true saffron," is a native of Britain and other temperate climes. It is largely cultivated in Kashmeer, and though considerably adulterated by the time it reaches Hindostan, brings over £2 per pound weight. My books and printed memoranda on "Tobacco Culture" I have given away long ago; but advise you to get American or Indian seed, with instructions, &c. Rose-water: The best is made by distilling 1,000 flowers of *Rosa centifolia* in an imperial quart of water, and then redistilling with more roses; but the operations are too lengthy for insertion here. As I know nothing of your soil and climate, I can only suggest the following scent-yielding shrubs: *Pandanus odoratissimus* (Keora of Bengal), also the *Jasminum* tribe of India, very numerous. For the oil preparations, the roots of *Andropogon muricatus* (Khus-khus grass of India). There are almost innumerable vegetable sources of fragrant oils and essences; but it will require local experience to raise the plantations and make them floriferous. That popular perfume, Ihlang-Ihlang (Flower of flowers), is the product of the strongly-scented flower of *Artabotrys odoratissimus*—a trailing shrub introduced very long ago from Cochin China or Malacca into Lower Bengal, where it has been naturalised. One blossom will make a large room sickly as an apple loft. I have raised it from seed, but cuttings or layers grow quicker—that is, in tropical climates. Chiretta is 1s. per pound wholesale price in London, and requires an Alpine climate; it is a wild shrub.—EOS.

[64772.]—**Steel Castings.**—You can cast these from a crucible; but they will require annealing—you cannot run them from a cupola.—T. W. B.

[64775.]—**Defective Electro-Magnet.**—In the first place, cast iron is not a proper material for electro-magnets, unless it is very soft, and then good wrought iron is better. Secondly, you seem to have only used one bobbin; therefore, you only have the pull of one pole (the other pole being at the opposite end). Thirdly, there is no occasion to use paraffined paper between every layer on a magnet, this keeping the wire away from the core. You should take wire off, and throw the cast iron away, and make a horseshoe magnet, two bars united at top by crosspiece, of as large section, put boxwood ends on; then you would have a good magnet.—A. J. DEW.

[64775.] — **Defective Electro - Magnet.**—I gather from your query that this consists of a cast-iron bobbin, with cast-iron cheeks, bolted upright on to an iron base. A magnet could hardly have been devised on worse principles. To begin with, you are only utilising one pole; the use of cast iron still further reduces available effect, and the ponderous base is useless. Use two bobbins with cores of Swedish or Norwegian iron, well annealed, having brass or zinc cheeks (not iron by any means), and mount these on a good thick base of soft wrought iron (Swedish, if possible). According to Prof. Ewing, pieces of Norwegian and ordinary hard iron wire of same dimensions, subjected to the same magnetising power, showed values of magnetisation in the proportion of 439 to 36, which means to say that a magnet of Norwegian iron would be about twelve times stronger than one of ordinary wrought iron, subjected to same strength of magnetising current. A similar magnet of cast iron would be nowhere. It would be interesting to know, if your friend follows this advice, what the result is.—W. PERREN-MAYCOCK.

[64777.]—**Screw.**—The kind of screw you require is such as you will find on the point of American twist bits for wood, or on the ordinary screw-nose wood chuck. Some corkscrews are made with a tapered flat thread-screw of similar form.—T. W. B.

[64779.]—**Condensing Exhaust Steam.**—If you have a good supply of cold water, you can use either the ordinary air-pump condenser (either injection or surface condensing), or one of the patent exhaust condensers, such as Morton's. These latter require no air-pump. You can then feed from the hot well of condenser. But a considerable quantity of cold water is required, and, if limited, a cooling reservoir or pond is the only alternative.—T. W. B.

[64781.]—**Cut-off in L.P. Cylinder.**—A graphic method of finding this is given by Prof. Smith in the *Engineer*, 27th Nov. 1885.—ELAG.

[64782.]—**Engine.**—You had better take the bearings to pieces and file up smooth, and put together again, and be careful to keep well oiled; nothing else will make a good job.—A. J. DEW.

[64782.]—**Engine.**—"Black antimony" mixed with the oil is a good "separating" or anti-frictional mixture. Sulphur is also used for the same purpose, but does not skin a bearing so well as the antimony.—W. M. J., Dublin.

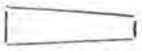
[64782.] — **Engine.**— If "Perplexed" would take common blacklead (used for polishing fireplaces) and mix it with oil to the consistency of paste, and apply it to the bearings, he will find it to answer his purpose.—FIFE.

[64782.]—**Engine.**—I believe the best plan would be to clean the bushes and rubbing surfaces of the crank-shaft thoroughly. I have noticed that if brass bushes get dry, the brass gets ground into small grains, which, if not immediately cleaned out, cut up the bearings like emery.—ENGINEER, Langholm.

[64783.]—**To Weld Steel.**—In looking up an old number of a paper called the *Practical Mechanics' Journal*, I came across two recipes for welding steel and iron, which I inclose. To weld steel to iron.—Boracic acid, 35·6 parts; common salt, 30·1 parts; ferrocyanide of potassium, 26·7 parts; rosin, 7·6 parts. To weld steel to steel.—Boracic acid, 41·5 parts; calcined salt, 35 parts; ferrocyanide of potassium, 15·5 parts; dried carbonate of soda, 6 parts. The articles to be welded have to be brought to a proper welding heat, and the mixture applied to the surfaces to be joined. The compositions are said to clean the surfaces most effectively, thereby securing a perfect weld.—ENGINEER, Langholm.

[64783.]—**To Weld Steel.**—With a good sample of mild steel there ought not to be any difficulty; but I have met with some very troublesome to work, and have had to use some composition to master it. Perhaps some of the following may assist "Blacksmith." Many years since a man called where I was at work and sold the governor a recipe for welding iron and steel; but it was kept a secret from me, so in the evening I went to a chemist and got a small crucible and twopennyworth of borax, and the same amount of spirits of salammoniac; crushed the borax and melted it in the crucible; then, while on the fire, poured the spirit into it, and then poured it on to an iron plate. When cold, it was pulverised. With such I did many troublesome jobs of both iron and steel. It was a perfect success. Made as above, it looks like amber. I have made it in an iron ladle with borax alone; but when turned out it is very black-looking. The other is the best. Another way: Take a piece of salammoniac as big as a filbert, crush it and dissolve it; take about 2oz. of borax and crush it, and add the liquid, and put all in a good-sized iron ladle, and at a low heat; keep stirring it about till all comes to a powder. Put it in a bottle to keep the air from it, and use it like sand, or dip the article in some put out for the purpose. I have found this very useful. Another I never tried: Two gallons of water; put in ¼lb. saltpetre, ¼lb. oil of vitriol; heat ends of steel and quench in mixture. Make rather long scarfs, and use plenty of glassy sand. Again: 1 of common soda with 4 of silver-sand, and 1 of blue pigment. I don't know what good the pigment is. Work, as with sand alone.—Not proven. Again: Same kind of filings as metal to be worked, 60 parts; borax, 25 parts. Good.—G. B.

[64783.]—**To Weld Steel.**—If "Blacksmith" uses best shear steel for his tools, he will have no difficulty in getting a sound weld. Proceed in the following manner. Work up a piece of iron (good material) much thicker than the tool is required to be when finished. Be careful to clean off all dirt by dipping the hammer in water, and hammering well on anvil till quite clean, always leaving narrowest at the end which is to receive the steel, thus—



and also convex the side which is to receive the steel. Fig. 1 represents a perfectly prepared surface of two pieces of iron and steel about to be welded, providing an opening for the dirt to escape. This is most important, as, if prepared as in Fig. 2, the dirt will be shut up in the hollow part, which no amount of hammering will ever dislodge, and the result will be an imperfect weld, as in Fig. 3. Prepare the steel by hammering it to a bevelled edge, so as to cover the width of the iron, and as far up as desired. Heat iron to a red heat, lay on steel, and nip together with a pair of tongs, and tack together at the middle, leaving the sides free for the dirt to escape. Now comes the most important part in tool-making—that is, getting a good heat, which is difficult to explain here, but I will do so to the best of my ability. First see that your fire is quite clean; then commence by blowing easily at first. Always mind to keep the steel uppermost in the fire, so as not to get scalded, as this is another important point. (Note: Once you have burnt your steel, no amount of tempering will ever make it stand for a cutting edge.) As soon as the steel begins to fuse, cover it with good silver sand, so as to act as a flux and to protect it from the fire. When the sand runs it is hot enough. Bring out on to anvil, and have a blow from a sledge-hammer, taking care to have the blows delivered light and quick, as this is essential, so as not to fracture the steel. Beat out to the required thickness, and cut out to shape, taking care (if tool is thin) not to hammer on edge. If "Blacksmith" wishes to know more about welding cast steel, I have recipes, and will give him all the information he requires if he will advertise his address.—LOWESTOFT SMITH.

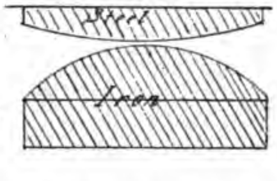


Fig. 1

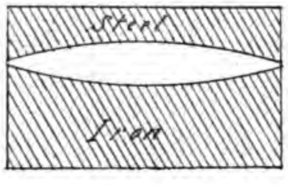


Fig. 2

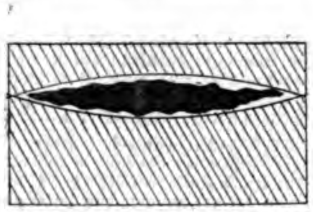


Fig. 3

[64788.]—**Violins.**—Savart published a description of his trapezoidal violin, together with an account of his experiments on violin acoustics, in a "Mémoire sur la Construction des Instruments à Cordes et à Cachet," Paris, 1819. If "Pan" cannot procure this work, he will find copious extracts from it in "Old Violins," by James M. Fleming, and "Otto on the Violin," either of which contains all that he probably requires. With regard to "Fiddler's" violin, it was described, illustrated, and freely discussed in "E.M." 1882-83.—WAR.

[64789.]—**Domestic.**—Speaking tubes are the very best means of communicating at short distances, if surroundings permit of their use.—CHAS. PROVIS.

[64789.]—**Domestic.**—Telephones possess many advantages over speaking-tubes. They are more easily fitted; floors, &c., do not require cutting away, speaking is interchangeable between any number of rooms, and the system can be added to at any time. During the past three years I have fitted a number of instruments of New Telephone Co., 4, Great Winchester-street, E.C., which have given very little trouble. I learn that this company is now selling a cheap telephone which answers well for short distances.—E. J. T.

[64802.]—**Angle Plummer Blocks.**—These are used where there is horizontal thrust (as in a horizontal engine), as well as vertical pressure due to weight of shaft and connections.—T. W. B.

[64805.]—**Electric Bell.**—Herewith sketch of an electric bell with the movement under the gong. Fig. 1 is a plan with the gong removed, and Fig. 2 is a section along the rod R. The letters denoting the different parts are the same as used in Fig. 17, page 425, so that all I have said about trembling bells there will refer to this one. Compare it with Fig. 17, and you will see that the rod R carrying the hammer H, instead of being rigidly fixed to the armature, as in Fig. 17, is pivoted at Y, and passes through the support X, being supported again at the bend by the pin N. T T are the two terminals. The gong must be filed away a little by the screw D, so as to allow the screwdriver being inserted for adjustment. The bell will ring in any position, though it may require fresh adjustment for each position. If you are not able to construct one from this, write again, and I will send sketch of the separate parts. T
ing is half-size.—F. C. ALLSOP.

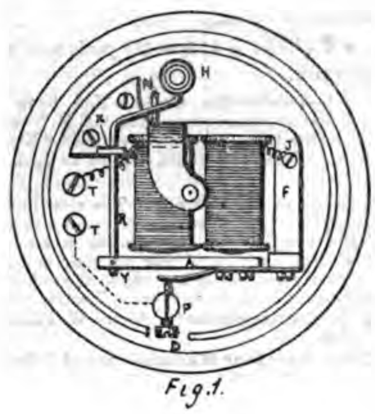


Fig. 1.

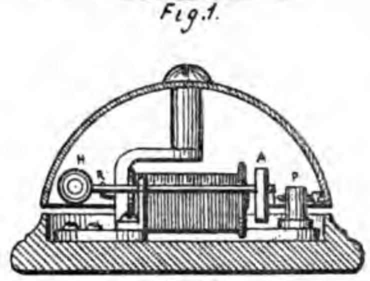


Fig. 2.

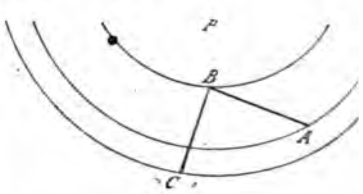
[64807.]—**Photography.—View**
Neither photo-journals nor almanacs are a
If the description of a meter is too elabor
reply, will "B.Sc., Plymouth," kindly tel
back number of a photo. journal where
scribed? I have looked through the i
nearly thirty vols. of the MECHANIC, bu
find it therein.—D. G.

[64813.]—**Drying Wood.**—Your boar
be stacked one above another, with 1in.
cross-strips between, taking care to put
directly over one another, and lay a he
or weights on the top.—T. W. B.

[64818.]—**Steel.**—As you have only as
tip I give you one; but please note th
of manipulation and the chemical rea
volved can be ascertained in almost every
on analytical chemistry, which please c
complete particulars. Take a small qu
your steel (say one-fifth of a gramme) an
in nitric acid of 1·5 specific gravity, o
fluid ounce will be quite sufficient. Now
the resulting colour of the solution with
of colour obtained by dissolving the sam
of steel of known carbon contents in the
of acid. The quantity of carbon contain
sample is exactly proportional to the
colour resulting.—METALLURGIST.

[64820.]—**Thermometers.**—The bulb
blown on to the end of the tubes, the o
being left open. Heat bulb in flame
lamp—the air inside expands; invert ove
of mercury—as the air cools down some m
forced up into the bulb. The bulb is aga
until it and the whole tube becomes fi
the fumes of red oxide of mercury, whi
off. Again invert over basin, and as the t
the red oxide will give up its oxygen, a
mercury will be forced in. And so
PERREN-MAYCOCK.

[64821.]—**Measuring Buildings.**—I
blem" really wishes to ascertain the dime
an actual building, and is not merely givi
blem to work, I would recommend him t
figure to scale and measure off the answe
will be a fairly correct approximation,
about a twentieth of the time of a cal
There is more than one way of doing it.
proceed as follows:—Take off 40 divisions
scale, the larger the better, with a pair
passes, and from P as centre of the abov



describe a semicircle. With same centre
of 60 and 70 on same scale describe two oth
circles. Take any point B on inner ci
apply to it the right angle of a wooden
moving the square about till it comes in a
such that A B = B C. Then measure off
B C on your original scale, and this wil
answer. If the figure be drawn on a la
the answer should be very near. I should
the very rough figure which I have draw
would be somewhere close on 32 yards. I
patience with people who solve such prob
this, or problems of mechanical stra
stresses, by the laborious process of cal
The method of graphic construction wil
always apply, and be quite accurate en
all practical purposes. In this example t
of measurement of the streets and the i
bility of three angles of the building being
in the centres of the three streets would
to cause more error than the constructio
tion, if done to any reasonable scale. O
my diagram is not intended as a solution,
as a sketch of how the problem may be
T. PRESTON BATTERSBY, Capt. R.A.

[64822.]—**Bucket Speed of Water-W**
Overshot wheel 3ft. per second at
buckets. I have known large wheels d
double this speed; but it is done chiefly
wheel-work in getting up the necessary
the machinery to be driven, because the l
wheel (at a certain speed per second) the
the number of revolutions; but for m
prefer that a speed of 3ft. should never
exceeded for either small or large wheels.
WRIGHT.

[64824.]—**Telescopic Photograph**
photographing celestial bodies by the a
telescope it is not necessary to use a cam

te-holder may be carried by a rod (or rods) ed to the telescope, and extraneous light ex- ded by a black velvet cloth. The eyepiece may used or not, according to the size of picture quired. With a refractor, some trouble is ex- rienced in finding the chemical focus, which does t coincide with the visual focus. It is necessary expose plates at various distances, and after- rds develop them until the exact spot is found. course, if this work is done in daylight, a nera is essential, and should be fixed on the eye- ce of the telescope, the end of which projects ide the camera. I have successfully photo- phed the moon by the above method.—SM.

64826.]—**Steel for Scissors.**—Double shear el is the only reliable article to make scissors m, providing the proper temper is procured. semer steel is, I believe, largely sold for the rpose, but is worthless to those requiring sors to keep a good edge. Shear steel would ve to be purchased, it not being in the province anyone ignorant of the process to make. Will e "Cutter" further information if required.—F. RNER, Sheffield.

64827.]—**Brass Castings.**—See Nos. 1135, 7 for details of moulding the articles you ntion.—J. H.

64827.]—**Brass Castings.**—In this case printed ections would be of no use whatever, as "X." s got nothing in the shape of sand-box, sand, or mps, and, seemingly, has no idea what casting lly is. He would do well to put himself in the nds of a professional, who, for a small fee, would e him a few practical lessons on the *modus erandi*, including what to get for the purpose. At e same time "X." will understand that cylinder sting is rather a difficult matter, and he might d it better to buy castings from some of the firms o advertise in "Ours."—DENS.

[64828.] — **Silvering Reflectors.** — Copper icles may be silvered by immersing them in a lution of silver cyanide (or silver chloride dis- lved in potassium cyanide), whilst an electric rent is passed through. The copper to be vered is connected by a wire to the zinc of the ttery, and a silver plate which dips in the solu- n is similarly connected with the carbon of the ttery. The article to be plated should be oroughly cleansed and polished before im- rsion, and then the silver coating is easily ightened with the usual polishing powders. In ur case, I should proceed thus: Connect a pper wire to the back of the reflector (bright ntact), which support in a horizontal position. ll quite full of silver solution, and suspend the ver plate (an old thimble will do), just touching e solution in the middle. Connect as before ith the battery. One Daniell or Grove cell, arged with old acids, is all that is required.— M.

[64829.]—**Case-Hardening Bessemer Steel.** Use either prussiate of potash or hoof-parings, nes, and horns, as so frequently described in urs" for iron.—T. C., Bristol.

[64832.] — **Hydraulic Ram Leathers.**— pecially tanned hydraulic leather can be got from y good maker (not a machinery agent) of what known in the trade as hydraulic butts. You uld get a mould from the makers of the press. not make your leather too soft, keep the leather the mould or press until quite set and firm, e them with a knife, and be sure and pack them h rope yarn when in the cylinder grooves.— M. J., Dublin.

[64833.] — **Brass Furnace.** — Consult the mbers referred to in 64827 for instructions for king such a furnace.—J. H.

[64834.]—**Tricycle.**—A Road-sculler would no ubt suit our friend "W. P." exactly; but as I ve not seen one tried on the road, I cannot say w it would answer. Most of the up-and-down tion tricycles are entirely out of date, and are t made now. Messrs. Singer, I believe, some e ago made a "Help Myself" tricycle, on which rider is in a sitting position, and uses his hands y. The "Omnicycle," "Merlin," or "Facile" cycle) might also suit him, as they have the tion he desires.—S. S.

64835.]—**E.M.F. of Cell.**—Chromic acid and bichrom. give precisely the same E.M.F. en employed under the same conditions.—SM.

64835.]—**E.M.F. of Cell.**—The electromotive ce of a copper-zinc couple in the usual chromic d and sulphuric acid exciter is, as nearly as can one volt. A zinc carbon element, plunged in e same solution, gives two volts.—S. BOTTONE.

64836.]—**Dynamo.**—Wind armature with 2oz. d.c.c. B.W.G. in shunt F.M.'s. Put about 12oz. 22 d.c.c. B.W.G. on field magnets. Will light a p lamp very easily.—T. G. SLATER.

64836.] — **Converting Electromotor into ynamo.**—If my memory serves me aright, this a series motor, in which it is only needful to ve it the contrary way to what it runs as a motor —i.e., against the brushes—to make it work as a dynamo. If a motor be shunt-wound, it will give current if driven in the same direction as it rotates as a motor. For so small a machine the speed should be not less than 3,000 per minute.—S. BOTTONE.

[64837.]—**Watch Repairs.**—"Beginner" must oil all jewel-holes, whether with endstones or not; also the cylinder of horizontals, and the ruby pin of a lever should be greased, or, rather, touched with oil, the two sides of the cut in the lever. I know some people dispute this, and do not oil the ruby pin; but I have had some forty years' experience as a watch-jobber, and have found it best to oil it.—J. A.

[64837.]—**Watch Repairs.**—All jewel-holes and cylinders should be oiled. Cylinder plugs can be obtained from material dealers. The way to replace a broken pivot is by means of centring and drilling tool: they have a small brass frame, shaped something like ordinary turns, the best have movable disc containing countersunk holes of various sizes. Take rough off with fine pivot-file where pivot is broken off; select countersunk in disc that will cover stump, fix it opposite centres, and tighten set screw; take one of the small drills, suitable size, and grind round, which is the best cutting shape for hard steel. Oil work, and place it in tool, revolve with hair bow, push the drill through the hole in disc, and keep a gentle pressure on, using slow speed with bow, until you have drilled hole over three times the diameter of pivot. Clean hole out with pegwood, file and polish a piece of steel wire to fit half-way down hole, cut off short, and drive in with two or three blows of small hammer; turn down to required size. If you get bottom of hole polished with working too fast, or using soft drill, start again with one more chisel-shaped.—G. H. QUORNDON.

[64838.]—**Bunsen Battery.**—TO MR. BOTTONE OR MR. AUSTIN.—E.M.F. of Bunsen charged with sulphuric and chromic acids, instead of nitric, about two volts. Internal resistance varies according to size. Constancy quite equal to the nitric acid form; rather better. A well-made No. 2 Leclanché has an internal resistance of from ·8 to 1 ohm, according to porosity of pot.—S. BOTTONE.

[64839.]—**Salt in Marine Boiler.**—The salt must be chipped off; in some places it is difficult to get at, requiring bent tools and "elbow-grease." Employ the nearest boiler-maker at a contract rate. He can command the men and necessary tools, and supply you with a blow-off cock and salinometer for future use.—W. M. J., Dublin.

[64839.]—**Salt in Marine Boiler.**—W. J. Smith's boiler must have been very carelessly treated if it is in the state he mentions. I should advise him to fill it with a strong boiling solution of quicklime or pearlash, which may perhaps dissolve the salt, as it very likely contains a great quantity of muriate of magnesia. He ought to get a friend in the engineering line to give it a good look over before using again, as it is quite possible that the iron may be very much corroded.—S. S.

[64841.]—**Ruhmkorff Coil.**—If you have a pretty powerful current—say, about 3 or 4 ampères, use two layers of No. 18 s.c. For a less powerful current, use four layers of No. 20 s.c. There is no reason why three layers should not be used.—T. G. SLATER.

[64841.] — **Ruhmkorff Coil.** — "Coiltonian" is right in noting that much has been said about this coil in the "E.M." I am of opinion that much more will be said, as most persons pay so little attention to what they read, unless the replies are to their own queries. The question as to the amount of primary, the number of layers, &c., was thoroughly threshed out some twelve or fifteen years ago. It is a matter entirely of what battery power it is intended to use with the coil. If a large current of low E.M.F., then not to oppose much resistance, two layers of a coarse wire are used; if the E.M.F. is higher, but the current smaller, then a finer gauge may be used, and the effect enhanced by having a greater number of ampère turns, so that four layers may be put on. It would not spoil a coil to have 1, 3, 5, or 7 layers on the primary. The only reason why even numbers are generally used is because this brings both ends of the wire out at the same end of the coil, and this is convenient for connection to contact breaker. For further information see "Electric Instrument-Making for Amateurs," advertised in Sale Column. —S. BOTTONE.

[64842.]—**Water Tap.**—I am sorry if my "copy" for the above query was so illegible as to read "tough," instead of "rough," as in the fifth line, and "either," instead of "leather," in the sixth line, as you have printed it; neither was I aware that "Bath bricks," in the last line but one, was plural. The main question may be understood, notwithstanding these errors, which don't help to make it any more clear.—J. W.

[64843.]—**Small Boiler.**—Your boiler would easily stand 50lb.; but I cannot give directions *re* safety-valve, as you omit to give position of fulcrum—i.e., swivel or hinge on which bar moves.—COPPER.

[64843.]—**Small Boiler.**—You can hang a 4lb. weight on the valve: the boiler will stand that, and will give you a pressure of 36lb.; but I should not work it above 30lb., which will require a weight of 3½lb.—T. C., Bristol.

[64845.]—**Battery.**—On page 65 I gave a full description of this cell. The zinc should be suspended in dil. sulphuric acid (about 1—10), not in water. The zinc is the – not the + pole. The lead cone eventually becomes coppered, which copper is the – element and + pole of the cell.—W. PERREN-MAYCOCK.

[64846.] — **Dynamo.** — TO MR. BOTTONE.—I cannot, without examining the machine, say what is wrong with any degree of precision; but at a guess should imagine the brushes were not in the right position, or that you were running the dynamo the reverse way to what you should to get current. Try to reverse the direction of rotation. If you cannot get it right, send it to me, carriage paid, to Wallington, and I will examine it, and report what is wrong.—S. BOTTONE.

[64847.] — **Fuller's Battery.**—If you have spare Leclanchés, and they work your bell splendidly, then I should decidedly say, Use them. It is practically impossible to use a Fuller's battery for any period of more than one day economically. For intermittent work it is almost useless.—T. G. SLATER.

[64847.]—**Fuller's Battery.**—Your trouble is due to the mixture of your two liquids, the bichromate finding its way quickly into the porous cell. The pot should be thick so as to prevent such rapid diffusion, and should be paraffined top and bottom for about 1½in. I am afraid that you short-circuited the battery for longer than was necessary. With moderate work they should last three or four months.—W. PERREN-MAYCOCK.

[64848.]—**Magneto-Machine.**—If you rewind with as much No. 36 d.s.c. wire, you should get a powerful shock.—T. G. SLATER.

[64848.]—**Magneto-Machine.**—I gave a very full description of the mode of constructing one of the machines in the "E. M.," Vol. XLIV. No. 1,133, p. 318. This article also appears in my book, "Electrical Instrument-Making for Amateurs." Your magnets may be weak. The contact spring may not press properly, or the contact breaker itself is not rightly timed to break contact. The wire, too, is rather coarse to get high tension.—S. BOTTONE.

[64849.] — **Centre - Seconds Watch.** — Your quadrant-shaped regulator is evidently composed of two metals, and intended for compensated regulator.—G. H.

[64849.]—**Centre - Seconds Watch.**—Surely, "Gwent" has never asked a practical watchmaker as to the part on the regulator of his watch, as every watchmaker knows a "compensation curb." If "Gwent" looks, he will see that the arms are made part brass and part steel, the same as a compensation balance; and the idea is, that, as one metal expands or contracts more than the other, the curb pins will open or close, and so compensate for heat or cold.—J. A.

[64849.] — **Centre - Seconds Watch.** — The appendage described is sometimes found in Geneva watches. The object of it is to correct any errors caused by change of temperature. One end of the metal arm is fixed to the regulator, leaving the other end free. The free end carries one of the curb pins. The outer coil of the hair-spring passes between this pin and a fixed pin in the regulator. The idea is that the metal arm corrects the hair-spring by allowing it more or less play between the pin at the end and the fixed pin. The arm expanding or contracting in extreme temperature, making the distance between the curb pin wide or narrow. In fact, the object of all this is to accomplish what the compensation-balance does much better, some watchmakers asserting that it causes more errors than it corrects.—G. R. BALDOCK.

[64849.]—**Centre-Seconds Watch.**—"Quent" should know that a watch with a plain balance—that is, not a compensated one—will gain in cold weather and lose in hot. The curved device at the end of index, or regulator, is called a compensating curb, and is a contrivance to correct the error in timekeeping produced by the expansion and contraction of pendulum spring, caused by change of temperature, but in practice it is found to be a failure, and has long been superseded by the compensation balance. The compensating curb is composed of laminæ, outside of brass and inside of steel, the unequal expansion of the two metals causing the curb in cold weather to open and in hot to close, thus allowing the pendulum spring more or less play, as the case may be; but there is no means of adjusting to the error of the spring as in a compensation balance, and it often creates a larger error in a watch than would exist without it.—PEGANDREDSTUFF.

[64850.]—**Steam Pressure.**—Does "Engineer's Apprentice" suppose the water in the boiler to have no weight? Surely "Apprentice" has looked at the wrong side of the stop on the steam gauge, or at its zero. Verily something else at zero!—W. M. J., Dublin.

[64850.]—**Steam Pressure.**—Yes; the same pressure exists on bottom of boiler below the water, and in addition to the weight of water, say, 1½lb. extra. In the second case the safety-valve has evidently stuck, and is, of course, very wrong indeed, in spite of all the driver can say. You exercised good judgment in "clearing out" if you had no authority to alter the existing rules.—T. C., Bristol.

[64853.]—**Induction Coil.**—Your paper tube inclosing primary coil is too thick; ⅛in. is quite sufficient. For condenser, use 100 sheets 8in. by 6in.; 2lb. of 38 s.c. will give 2in. spark.—T. G. SLATER.

[64854.]—**Forging Lathe-Chuck Dogs.**—How can any "English Mechanic" be in a fix about so simple a forging? He should not jump on the tail, it should be all worked into a bore out of the solid; if worked freely on the anvil, say, out of mild steel, he will require to use the chisel. But if he has a lot to make, it will pay to make them in a pair of dies, under the steam hammer.—W. M. J., Dublin.

[64855.]—**Dirty Water in Steam Boilers.**—Your water is either not filtered or unclean, or else the boiler or some part of it must be corroded.—COPPER.

[64855.]—**Dirty Water in Steam Boilers.**—A copper boiler with iron rivets is something new. Although not yet apparent, there must be corrosion going on. Clean the filter and put a little plaster of Paris in the boiler, to get a thin scale over the rivets; open and repeat if not at first successful.—W. M. J., Dublin.

[64855.]—**Water in Steam Boiler.**—Use a little soda in this; the redness evidently comes from the boiler itself, and not from the water.—T. C., Bristol.

[64856.]—**Egg-ended Boiler.**—The correspondent will find something to suit him in a recent work by William Anderson, M.I.C.E., "On the Conversion of Heat into Work." There is certainly a great advantage in "powdered fuel," if burned under air pressure.—W. M. J., Dublin.

[64857.]—**Cheap Red Sealing-Wax and Crayons.**—To make common, or what is generally termed parcel, wax, take 1¼lb. of common rosin, ¼lb. of shellac, and ⅛lb. of turpentine; melt these together (do not let it catch light, whatever you do), and then add 1½lb. of red lead, stirring the whole till it is thoroughly mixed; then pour out into a lid of a strong tin or iron box, so as to fill it about ½in. deep. When nearly cool, cut down with a sharp knife into strips and take out. I never heard of casting chalk pencils, but often used to cut them out of a dry block of chalk when at school, and they did just as well as the crayons used by the masters. W. Jackson might try this if he is near any place where chalk is procurable.—S. S.

[64858.]—**Copper Boiler.**—Not safe beyond 10lb. or 12lb. per square inch.—T. C., Bristol.

[64858.]—**Copper Boiler.**—I should advise you to get a book by Robert Wilson, published by Crosby Lockwood and Co.—COPPER.

[64858.]—**Copper Boiler.**—If the ends are domed to hemispheres, and the joints well brazed (not burnt in the brazing), the vessel should carry about 8lb. working pressure—

Thickness. Tensile strength of sheet-copper.

$$= \frac{(\frac{1}{8} \times 2) \times 10 \text{ tons} \times 2240 \times {\cdot}8 \text{ (per cent. of joint)}}{46\text{in.} \times 10 \text{ (factor of safety)}}$$

= 8lb. Attach a safety-valve.—W. M. J., Dublin.

[64859.]—**Dynamo.**—To MR. BOTTONE.—Put about 3oz. No. 22 on the armature and about 2lb. No. 24 on the field-magnet (both silk-covered copper wire). Drive at from 3,000 to 3,500 revs. per minute, to get from 12 to 15 volts, and one to two ampères.—S. BOTTONE.

[64860.]—**Accumulators.**—For lighting, accumulators are certainly preferable. It would need three cells to replace the bichromates. For such rapid discharge as would take place through the low R. of the primary of a coil, it would be necessary to increase the size or number of plates in each cell, if the same are required to last long.—W. PERREN-MAYCOCK.

[64860.]—**Accumulator.**—If the experiments are only to be performed occasionally, three chromic-acid cells, with lifting arrangement, will be best. If the cells are wanted frequently in use, accumulators charged from dynamo would be cheaper and better. Three cells of the size named would be ample. A 10c.p. dynamo would hardly do to charge them with, as the E.M.F. is rather high, but the current very small—not more than one or one and a half ampère.—S. BOTTONE.

[64862.]—**Malt Extract.**—I do not see how you can make this at home. The process is as follows: Crushed malt is placed with cold water in a mashing tub, which is heated by a steam coil to a temperature of about 120°F.; an agitator is used from time to time. After sufficient digestion the liquid is run off into a copper vacuum pan similar to that used in the refining of sugar, where it is evaporated at a temp. of 40° F. by means of steam coil, the air being exhausted as thoroughly as possible. The pan is provided with glass windows, through which the contents can be viewed, and when of sufficient consistency, known by its appearance, the extract is run off and bottled. Great care and cleanliness is necessary, otherwise the product will soon become mouldy.—SM.

[64863.]—**To Mr. Bottone.**—Very powerful, indeed. The primary current, taken from the two pillars of the contact breaker, and led by means of conductors to the affected part of the face and the inside of the mouth, near the affected nerve, will sometimes give relief.—S. BOTTONE.

[64864.]—**Small Boiler.**—Why do you want it ½in. thick in a boiler 11in. diam.? It is simply a waste of metal, unless you intend going into the hundreds, and even then you will require rolls to bend the metal, unless you get the "Delta" people to do it for you.—T. C., Bristol.

[64866.]—**Compound Winding.**—TO MR. BOTTONE.—No. 20 is rather large for the shunt coils of so small a machine. I presume you have got about 4lb. No. 18 on your armature. Now to balance this on the fields in No. 20 you would need about 150lb., which, of course, you have no room for. Still, you may get fairly good results, only with a considerable expenditure of power, by putting on about 20lb. No. 20 and 4lb. No. 16.—S. BOTTONE.

[64870.]—**Glycerine in Leclanche Cells.**—This is merely to form a coating on the surface of solution, which has the effect of retarding the creeping action of the salammoniac. It is not in any way detrimental to the working of the cell. The Principal of Finsbury Tech. Col. recommends an ointment made up of equal parts of paraffin-wax and vaseline, with which the edges of jars are smeared. It is known to act admirably.—W. PERREN-MAYCOCK.

[64873.]—**Cement for Glass and Brass.**—Whiting, or plaster of Paris, made into a paste with Le Page's liquid glue.—SM.

[64873.]—**Cement.**—Melt together 5oz. of resin, 1oz. of beeswax, 1oz. of red ochre, ⅛oz. of plaster of Paris. Temperature must not rise above melting point.—T. G. SLATER.

[64873.]—**Cement for Brass and Glass.**—Make a thin cream of good, fresh plaster of Paris with water. Pour it in the inside of the brass collar. Squeeze the neck of the bottle in. When quite set, and perfectly dry, varnish carefully with "white hard varnish."—S. BOTTONE.

[64876.]—**Boring Hard Steel.**—I think if you were to try turpentine instead of oil to lubricate a good hard steel drill, you would get over the difficulty. If not, you might try a diamond drill, as that would drill through anything.—F. WOODS.

[64876.]—**Boring Hard Steel.**—Take a good triangular file of best steel, and carefully grind the required size at the small end, using plenty of soap and water to avoid heating it. "Bort," or "Black Diamond," if you have to bore many holes, might do better.—EOS.

[64877.]—**Cleaning Cretonne Curtains.**—"R. F. A." must bear in mind that it is the boiling water and hard scrubbing that take the colour out. The following is a very good method. Take some soap (as much as you think fit), cut up into small pieces, put it into a basin, and pour boiling water upon it. Do this overnight, and the next morning you will find it a jelly. Mix this with more boiling water in the tub you are going to use, and let it cool down till a little more than lukewarm. Wash the curtains in this mixture, and rinse through in another tub containing a little blue and a small handful of salt. Then squeeze the curtains in a large blanket till the wet is pressed out, and hang up to dry. If this does not suit "R. F. A.," he ought to send them to the cleaners, several of whom use a dry process in cleaning this sort of goods.—S. S.

[64880.]—**Mounting Insects.**—Try mounting in a cell just deep enough to protect the insect by taking the pressure off cover glass.—E. G. M.

[64880.]—**Mounting Insects.**—Mount without pressure by allowing the covering glass to rest upon three or four tiny beads, or upon some fragments of glass, or upon the edge of a cell formed of a material suitable for the media used in mounting.—J. H.

[64882.]—**Electro-Depositing.**—The followi recipes for baths I have taken from "Jamies and Munro." Copper: Saturated sol. cop. sulp and dilute sulphuric (1—10) are mixed in prop tion of 1 to 4. Silver: Silver nitrate (3½oz. p gal.) is dissolved in water; the silver is thro down as cyanide by adding a solution of potassi cyanide in water, stirring the while, and taki care not to add excess of cyanide sol., else silv will be redissolved. Wash precipitate, and dissol in about as much fresh sol. of potass. cyde. as w required in first instance to give precipitate. A to this fresh crystals of potass. cyde., in proporti of 2oz. per gal. of sol. If, in working, the silv anodes darken or turn pink, it is an indication th fresh free cyanide is required. Gold: The b sol. is the cyanide of gold in potass. cyanide. prepared chemically, the process is identical wi that of the preparation of silver bath, using ch ride of gold in place of silver nitrate. By th method, however, the risk of losing metal in p cipitate is considerable, though the result is t best. Otherwise, the bath may be prepared simply hanging the gold anode into the sol. potass cyde.; on passing current the gold cyani is formed as required. The bath is worked b temperature 150° F. = 65·5° C. Green gold is o tained by adding silver cyanide to sol., or by wor ing with silver anode for the requisite time. R gold, by the addition of copper.—W. PERRE MAYCOCK.

UNANSWERED QUERIES.

The numbers and titles of queries which remain un swered for five weeks are inserted in this list, and if st unanswered are repeated four weeks afterwards. We tr our readers will look over the list, and send what informati they can for the benefit of their fellow contributors.

Since our last, W. Perren-Maycock has replied to 642 64255; F. C. Allsop, 64157.

64233. Paper Bottles, p. 492.
64246. Boring Longitudinal Holes through Wood, 492.
64255. Vertical Coil, 493.
64263. Bearing Springs, 493.
64265. Silver and Nickel Specula, 493.
64266. Reflecting Telescope, 493.
64267. Drum Armature, 493.
64281. Elevators, 493.
64286. Spongy Aluminium Castings, 493.
64288. Nitrous Acid, 494.
64289. Oval Chuck, 494.
64292. Xylophone, 494.
64293. Electric Lighting, 494.

64503. Thermopile. To S. Bottone, p. 583.
64507. Hooter, 588.
64509. Waterproof, 588.
64513. Coppering Rifle Projectiles, 583.
64519. Coach Painting, 588.
64524. Hemp Scutching, 588.
64529. Rust in Water Pipes, 583.
64530. To Mr. Wimshurst, 588.
64542. C. and C. Battery, 589.

QUERIES.

[64885.]—**Piccolo Lip Plate.**—Can any reader te me the reason of a piccolo lip plate not being pleasant the taste of the player after only having played about minutes?—S. R. Y.

[64886.]—**Orange Stain for Leather.**—I wou feel obliged for a recipe how to stain leather an colour, suitable for harness and portmanteaus? Also title of a book of instructions how to stain and leather.—JOURNEYMAN.

[64887.]—**Small Turbine.**—What size turbine w be required to give 1 man-power with 12ft. head? A sketch and directions for making such a turbine w oblige (or reference to back numbers).—SAWYER.

[64888.]—**Cork Composition.**—Could any of you kind readers give me a recipe how to get cork chips dust stuck together, almost to a solid, and what the c might be coated with to keep it water-tight?—R. G.

[64889.]—**Bassoon Reeds.**—Could any reader kin tell me how to make bassoon reeds, and what tools I sh want, and what is the best way of selecting cane—BASSOON PLAYER.

[64890.]—**North Point on Maps.**—How is a pedestrian to set his map truly north by the compass w the points are not marked upon the maps?—J. R.

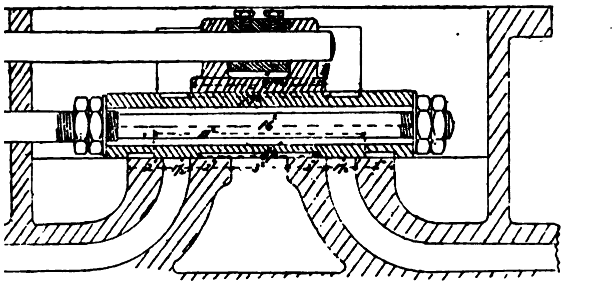
[64891.]—**Hospital Floors.**—Can any of yo readers give the benefit of their experience in tre pitch-pine flooring in hospital wards, so as to secure maximum of economy, appearance, healthiness, an durability, with a minimum of scrubbing?—BERTHA.

[64892.]—**Mechanics.**—In a shaping machine having a quick return motion by means of a slotted bar or lever and crank pin, how can I obtain a comparison of the angular velocities of the crank and lever in any position whatever, assuming any length of crank, and distance of centres of crank, and fulcrum of lever?—ONE IN A FIX.

[64893.]—**Micro Slides.**—I have several mounted slides of blood of different kinds. In some the gold si has run in and spoiled them. Can I remove and dis the gold size without disturbing the mount?—M.

[64894.]—**White Enamel for Iron.**—Will so reader kindly inform me how I can enamel some sm pieces of sheet iron, and what the enamel is composed o

A



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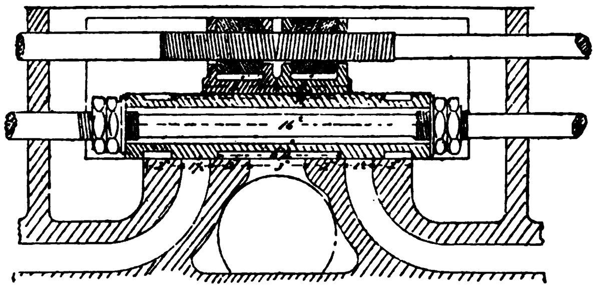
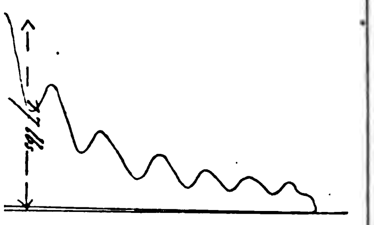


ıffle furnace, I should like to do my own burn-

Manufacture of Indiarubber Sub- ntioned on p. 50 as capable of vulcanisation of sulphur. Would some one oblige by w of such substitutes and their composition : refer to books which may be consulted in ies ?—HAMMER.

Micro-Polariscope.—I am anxious to fit ppliance to my microscope. I have read of . covers answering the purpose. Are they 'ial ? Would round ones do, as elliptical ones to obtain here ? Please tell me the size the d polariser should be and how to make and .—M.

Indicator Diagram.—Would any corre- ı kind enough to say what is the matter with iving the inclosed diagram ? Make : Ruston,



ł Co., 8½ by 16 cylinder, expansion valves con- overnor by rocking link, very short steam ports, o lead, but opens just as crank is coming over. d has been tried, but diagram just as bad aken by Richards, indicator made by Elliot ends alike.—A. J. DEW.

-Strength of Cast Iron-Pipe.—A short I. pipe in the form of a T is on top of a boiler ı 2in. and the sides are 5-16 full thick. Is this ıgh for 60lb. pressure ?—A. J. DEW.

-Blast Furnace Gases.—Can any of our ve me the quantity of air required to consume of gases of the following analysis ?—

	By volume.		By weight.
CO_2	12·0	...	18·35
CO	23·0	...	22·24
H	6·0	...	0·41
N	59·0	...	57·30
	100·0		98·30

'e about 800° Fahr. And say what will be temp. on. Also what quantity of cold air must be ıe resulting gases to reduce their temperature r. ?—T. W. B.

-Fan Blast.—I want to supply eight smiths' blast by a fan instead of ordinary smith's he forges are 80yd. from engine. Can any m the size and best fan for the purpose ? Also pipe required to convey the blast from engine ad is iron or wood best for the same.—J. E. J.

- Transit of Aries. — Will "F.R.A.S." ain the following in the *Nautical Almanack* ? of

Aries on the 20th is	0h. 6′ 11″
21	0 2 15
and ,,	23 58 19
22	23 54 23

e difference between the 20th and 22nd, two 48″.—INQUIRER.

-Fire Lighters.—Will some of "ours" rm me of a suitable article to steep blocks of itable for lighting fires ?—FIRE LIGHTER.

-Bursting Pressure of Tank. — A tank, 8ft. diam. and 12ft. deep, is filled with ıd the bursting pressure round the base of the v does the diameter affect the pressure ?—

-Llandudno Pebbles. — While visiting I have noticed on the beach many pebbles ıneycombed with holes in all directions. They freely when acid is applied. Many of them ıd on one side. Are they the limy remains of als that lived in the holes ? If so, what Or are they pebbles formed in the ordinary o, 'what is the cause of the holes, and from ıtion are they derived ?—G. H. C.

-Great Orme's Head.—Could any Welsh me the meaning and orign of the above . H. C.

-Electric Clocks.—Referring to description ı's electric c ock in *Industries*, of 14th October 'Acolyte," Mr. Bottone, or other reader kindly give me the following information ? 1. Size of bobbin, number of coils of wire on same, and size of wire. 2. How is the dry zinc-iron pile with E.M.F. of 1 volt made ? —X. Y. Z.

[64907.] — **Cleaning Valuable Japanese Lacquers.**—I shall be extremely obliged for advice as to the best way of cleaning valuable gold and general Japanese lacquer ware.—X, X. X.

[64908.]—**Quadrant.**—I have a quadrant which is divided into degrees and ½ degrees on the arc or limb. On the movable arm or index bar there is an ivory vernier divided into 20 parts, which just corresponds to 13°, or 39 divisions on the quadrant. I am at a loss by not knowing how to read it, and shall feel thankful for instructions from some of our qualified and obliging friends who so often assist the—IGNORANT.

[64909.]—**Cutters for Wood Planing Machine.** —Will some reader kindly inform me how to temper the above mentioned articles ? Having made some new ones, 14in. long, we tempered them in the following manner. First heating them to a bright red, they were dipped edgeways in oil for about 1in., then plunged into water. Then, as they seemed too hard, they were covered with oil and flamed off, and again plunged into water. By this process they were bent about 1-16in. out of the straight, and were straightened by hammering. They do not seem to cut very well. They are made of spring steel —ATHENIAN.

[64910.]– **Huge Aerolites.**—How sad it is that the China sea has engulfed the big gooseberry of Cochin China. Whence came it, and what was its temperature after that fearful fall from somewhere ? What a hissing and boiling it must have caused as it took its suicidal dive ! intended, no doubt, as a refreshing bath after its leap of 400 miles. If "Eos" had seen it I would believe it ; but that *North China Daily News* must have a Yankee editor as full of fun and romance as Mark Twain.—JUDÆUS APELLES.

[64911.]—**Electric Lighting.**—Being desirous of utilising the force of a small mountain stream (which runs close to my house) for the purpose of driving a small dynamo and lighting up the house, I should be obliged if any brother amateur who has gone through the same experience would furnish me with a few hints, so that I may avoid any pitfalls there may be in the way. The water at my disposal would fill a 2in. pipe, with a 25ft. head of pressure. Would this be sufficient to drive a 150 to 200c.p. dynamo, and if so, what form of water motor would be most suitable, and should a shunt or series-wound dynamo be employed ? It has occurred to me that a high-speed motor coupled direct on to the spindle of the armature would meet the case ; but before taking any steps towards setting up this installation, I should be glad to avail myself of the advice so freely given in these columns.—D'ELGO.

[64912.]—**The Power with which a Piece of Iron is Sucked into a Bobbin through the Coils which a Current is Passing.**—If a piece of iron is brought into the vicinity of a bobbin of wire through which a current is passing, the centre of the bobbin being vacant, the iron is attracted and sucked into the bobbin. For instance, let the bobbin be a small electro-magnet with the iron core taken out and held at the mouth of the bobbin. With what force will the iron be pulled in with a given current C, and will the force vary as the core approaches the centre of the coil ?—TYNESIDE.

[64913.]—**A Simple Way of Striking Arcs of Large Radius, and Finding the Proper Amount of Spherical Aberration in a Speculum.**—The answers sent in reply to Mr. G. Calvers's query in the early part of 1884 are really too difficult for me to understand. Will some kindly disposed correspondent give a plain English way of doing it ? Please to leave out on this occasion all algebraical formulæ. Give sketch of some instrument easily made for doing same. How can I find out the amount of spherical aberration in a speculum, no matter what focus ? Please work it out, for I cannot understand the former answers, though having wasted several days in trying to solve the above mysteries.—SPHERICAL.

[64914.]—**Electro-Typing.**—I have two very fine old medallions about the size of an ordinary war medal. I want to reproduce a copy of each, perhaps more, for my friends who are interested in them. Will any practical hand give me the best way to take the mould, and in what substance to show both sides and get the edge perfect ? I am willing to expend both time and patience and do not mind a small outlay. I have worked hard at them, but have not yet been successful. Is there any book on the subject that would give really useful and practical information on the subject ? I am a good hand at jewellery jobbing and can use my tools and hands, and have a small knowledge of electrical matters. But my work in the above direction if not a failure is not good enough to please.—LIMELIGHT.

[64915.]—**Designing Valve Gearing.**—I have Mr Welch's book on "Designing Valve Gearing," but find no scale mentioned for drawing the diagrams. It would seem, in fact, as though no scale or any proportion between the crank or stroke of valve were intended. I observe the same omission in diagrams given in back volumes of the "E. M.," and should be glad of an explanation how otherwise the different parts of a valve can be drawn from such diagrams. I have repeatedly tried to work out a slide valve from methods (Zeuner's and others) given by Mr. Welch and the "E. M.," but somehow have never yet succeeded. A short time since reference was made in "Ours" to a diagram in "The Practical Engineer," of 17th June, 1887. I procured the number, but failed again, not being able to make out how the centre O of the circle, representing the travel of the valve, is found. Would "Glatton," or "T. S.," perhaps, kindly explain how obtained, and also work out a diagram answering the above sketches of slide valves with single or double slides on back of main valve for a cut-off of one-quarter of stroke ? I don't happen to know the stroke of the valves. They were designed for engine of 36in. stroke—the single slide being variable by shifting of eccentric, and the double slides by hand wheel.—M.

[64916.]—**Cementing Bicycle Rubbers.**—Will anyone give a good recipe for cement to fasten rubber tires on bicycles, as any cement that I can get, even the best, seems too brittle, and though I have tried several ways, I cannot succeed in causing sufficient adherence between the steel and rubber. The cement seems little better than pitch, although a good round price is charged for it. Would it be best dissolved in any spirit and applied with a brush, or how ? I have made the cement into ribbon or tape and heated tire underneath with spirit lamp. "T. C., Bristol" once helped me to put washers on tricycle cranks ; perhaps he would tell me. In riding about a busy town it is a *sine qua non* that tires should be safe, and I cannot afford to throw tires away in order to fit any new idea.—C. CALVERT.

[64917.]—**Photo-Litho. Transfer.**—In trying to make a photo-litho. transfer I expose a piece of sensitized gelatine paper under a negative, then soak it in water for half an hour. I then attempt to roll it up in litho. transfer ink, using a velvet roller ; but the paper, instead of inking properly—that is only those parts taking ink which have been exposed—takes ink all over, even when I use an opaque mask round the negative. Would some correspondent oblige by telling me the cause of this ? Should a special gelatine be used ? That which I employ is very hard. I get better results from starch paper, but am not able to get a good transfer even with that. I have tried all sorts of negatives and exposures. I should be glad of any instruction in photo-litho. work, and any hints as to the proper condition of the roller and the sort of ink to be used.—J. S. B.

[64918.]—**Closed - Circuit Bell Ringing.**—Referring to Reply No. 64673, p. 65, on the above, I should like to ask if the writer has had personal experience with the battery he proposes to keep always at work, as it seems to me that it would be an endless source of trouble. Would not the zinc ring in a comparatively short time be eaten up by the acid, or rendered useless by being coated with copper deposit, when the action ceasing would cause the bells to ring. If this should happen in the night a needless alarm is given ; and then the necessity of feeding with sulphate of copper from time to time is a nuisance, which, if forgotten, would cause the battery to fail. These are difficulties I should much like explained in an otherwise excellent system.—CHRONOS.

[64919.]—**Breech-Loader.**—I should be extremely obliged if any of your readers would advise me as to the most serviceable gun for an emigrant to take out with him to America. Whether central, pin, or other fire. What is best size in bore ? Should one barrel be choke bore, and what are the advantages of the latter ? Can the complete apparatus be bought so that the emigrant may make his own cartridges, or must he purchase the primed empty cases from a maker and then charge them himself with powder, &c. ? I should like to know name of cartridge machine and approximate price. Also price of empty primed cartridge cases, and whether the last named article can be easily obtained in U.S.A. Are guns as cheap in America as here, quality being equal ? —PIONEER.

[64920.]—**Mining.** — Will any reader answer the following ? Certain persons worked a mine of coal till it got near the outcrop, when it began to fall through to the surface in several places. The man who farmed the land began to find fault to the agent of the estate. The same stopped them from getting that portion of the mine. A certain amount of water is drained through the bed working, so that the party that was stopped from getting the coal has to deal with it. Several years have elapsed, the agent of the estate is dead, and another party (in a small way) wants to get this coal that was left, but would like to know whether any compensation could be claimed by the old party, as they have this water to deal with whether the coal is worked or not.—MINER.

[64921.]—**Propeller.**—I have a propeller to make, the diameter is 4ft. 2in., the pitch on point is 7ft. 8in., diam. of boss 11¾, to have four blades. I want to find the angle of the blade at the point and at the root by formula or by a diagram. Is it at the widest part of the blade they take the angle of the blade when a screw is in a dry dock to have the pitch ? One of my fellow-readers has replied to a query something similar in No. 1,190, but I don't understand how he gets the pitch at root, and with what radius he described the arc which he divides into equal parts. Perhaps he will oblige by enlightening me a little on these points in detail.—J. W. J.

[64922.]—**Engine.**—I have a horizontal engine running 100 revs. per min., 20in. stroke, 10in. bore, which I wish to cut steam off earlier, as near a ½ stroke as possible. The throw of present eccentric is 2⅞in., the valve is 6⅞in. long, with hollow for exhaust 3¼in. The steam chest is [illegible] long, from outside to outside of port holes is 5⅞in. The port holes are 15-16in. wide. The exhaust is 1⅜ wide. I may say that we work up to 80lb. pressure. The engine is only about half loaded. Any information that will lead to economy will oblige.—A. [illegible]

[64923.]—**Electric Bells.**—I have some electric bells with relays. Sometimes the tongue of the relay sticks and puts the battery in short circuit until it is exhausted (which occurs after being in short circuit about 20 minutes); but it takes two or three days before it will act proper again. Recharging the glass cells does not put it right. Is there any method that I could put the cells right again in half an hour, or in the same time that it takes to get polarised, for I believe that is the name given when the battery fails from causes mentioned above? How should I go about looking for an earth failure—that is, bad earth or disconnection? How should I know which end of circuit the failure was, and is it possible to get as good earth for return current as what a return wire would be?—NERO.

[64924.]—**Chiretta.**—Will "Eos" kindly tell me how much water should be put to ½oz. of the herb? I did not understand his directions to make it some time back in the "E. M." May I make it in a teapot like tea and pour off from the root as wanted? For how long may I continue to take it? I wish to persevere. I suffer dreadfully from black spots before the eyes, congested liver, and constipation. If it does not relieve the bowels, what medicine may I safely take with it?—MARION.

[64925.]—**Chromic Acid in Batteries.**—In using the above (Sullivan's) I have observed that brass work and connections get much acted on (although none of the liquid can possibly have touched them), as though some volatile corrosive substance was given off. No such effect is noticed in the same battery when bichromate of potash (with the same sulphuric acid) is used. Have any others observed this, and how is it to be explained?—E. R. F.

[64926.]—**Band Saw Machine at New York.**—I believe about two or three years ago a band saw machine was erected at New York, the diam. of wheels 8ft., length of saw [illegible]ft., width of saw 6in. I should feel obliged if any of our readers would inform me whether the machine has given satisfaction or not, and if any saw broke how long did it work before breaking, and how much was it reduced when it did break?—A. R.

[64927.]—**Leclanche Cells.**—In the fifth article on "Practical Electric Bell Fitting," "F. C. A.," speaking of Leclanche cells, says:—"It is a pity that some standard method of numbering (the sizes) is not adopted. . . . . . No. 2 size is the most generally used." Why not name them by their capacity, as the Silvertown people do—viz., pint, 2-pint, and 3-pint—then there can be no mistake? With regard to the 2 pints being most used, Preece and Sivewright, in their book, state that the pint size is most common. Is this so? The S.E.B. Co. use 6-pint cells in each van for their passenger communication apparatus, and also in some of their boxes.—METEOR.

[64928.]—**Weight of the Porter Governor.**—How is this weight calculated? I have the formula for ordinary form of governor.—F. A. M.

[64929.]—**Sight Feed Lubricator.**—Will some one give a description and illustration of this? I think it has been asked for before, and I do not find it in back vols. What is the best kind of lubricator for slide-valve and piston of a small power engine of 6in. diam., and should one use oil, tallow, or suet?—F. A. M.

[64930.]—**To "Moonstarer."**—From a recent letter of yours to this paper I gather that you are able to reply to my hitherto unanswered query (64266, Jan. 20) respecting figuring of specula for telescopes. If it would not be troubling you too much I should be glad of a few directions. Shall I advertise my address?—ESNE CABALLITA.

[64931.]—**Preservation of Slate Roof.**—The slate roof of my house is getting shaky owing to age. I wish to coat it with a wash of Portland cement. Could any reader inform me what I can mix with the cement to give it a bluish or slaty hue when dry? I find soot kills the cement. Of course I require something which will not destroy the value of this.—CELT.

[64932.]—**Phosphates of Bran.**—Will some intelligent reader inform the writer which is the best way to keep the phosphates extracted from bran by boiling in water and [illegible] the liquid will keep pure, so that a little may be taken every day as medicine?—ENQUIRER.

[64933.]—**Spectacle Lenses.**—Will any practical reader favour us with a description of the manufacturers' method of grinding, edging, and fitting the above in frames and also state the handiest way for a retail optician to do so?—[illegible]

[64934.]—**Electrical Machine.**—I am going to make a plate machine [illegible]. What will be the best form of rubbers and collectors? Will wash leather do for rubbers?—[illegible]

[64935.]—**Musette.**—Will some one kindly describe the musette [illegible]? Is it fingered [illegible]? Is it ever used in the [illegible]?—WAR.

[illegible]—**Brains.**—[illegible] prepare and collect [illegible] animals, for the study of [illegible] give a few hints.—CEREBELLUM.

[illegible]—**Earth's Speed.**—[illegible] is the velocity of [illegible] at perihelion [illegible]

[illegible]—**Tempering Turning Chisels.**—Will [illegible] temper turning chisels [illegible] of cast steel?—JNO. [illegible]

[illegible]—**Enamelling Cycles.**—Can any reader [illegible] enamelling cycles, with particulars [illegible]

[illegible]—**Chloride of Silver Battery.**—I should [illegible] reader will kindly help me in a [illegible] I want a portable battery that will light a small incandescent lamp of about 4 volts. In the "E. M." of February 12th, 1886, I saw a chloride of silver battery described by Mr. J. A. Barrett, of New York (p. 487). It seemed to be just the thing for my purpose. I have made one exactly as set forth in the article, but the result (in my hands) is dreadfully disappointing. It lights a 4-volt lamp well for about five minutes, then the current gradually falls to a mere nothing, the filament hardly showing redness. I may mention I used 6 cells. The silver plates are 4⅜in. by ⅜in., and zincs same size. Solution of chloride of zinc in glass cell. The above battery, however, rings a bell very vigorously after ceasing to light the lamp. I am sure there is no short circuit, as everything is most carefully put together. Perhaps some of "ours" will tell me if a sulphate of mercury battery, or one of Lalande and Chaperon's, might be more suitable for the purpose. Bichromate of potash batteries will not answer my purpose; they become exhausted in such a short time, and consume on open circuit. A rather peculiar feature in connection with the silver battery above is that it did not recover its power after hours of rest, as Leclanché cells do. All I could get it to do was just a momentary redness of the filament of the lamp. I forgot to mention that the zincs are amalgamated.—FREDK. W. MUNCEY.

[64941.]—**Bubbles and Films.**—I have heard of a mixture with which bubbles and films can be formed, which sets firm, and can be preserved in shape after drying. Can anyone give the recipe, and how to use it?—T. F. S. T.

[64942.]—**Model Loco.**—Would "T. C., Bristol," or others kindly say if, in making a model locomotive, it is necessary that it should be fitted with springs? The engine to be 18in. long, boiler 14in. including smoke-box, body 7in., firebox 7in. wide and 5in. long. Would this supply steam for two cylinders, 1in. bore and 1½in. stroke? The boiler to have one 2in. tube running through. Wheel base 12in. Could you tell me what sized circle this engine would run in?—MODEL LOCO.

[64943.]—**Battery.**—Will any of your kind readers assist me? I have made a battery of 6 cells. The cells are 3½ by 3⅞, outside measurements. The zincs are 1½ by 6, quite flat; but the coppers are in the form of a cylinder, 6in. by 2½. I used bichromate solution and connected in usual way; but could not get a current worth a mention. I will be glad if any fellow-reader would kindly send a sketch and explain any error in construction. 1. Do you think the solution is right? 2. Don't you think the elements ought to be bigger? 3. Do you think, when properly done up, it would light a small arc lamp of very low resistance? Please explain best way of connecting.—A. HUTTON.

[64944.]—**Chemical.**—1. Is there any simple test for pure nickel to distinguish it from an alloy, as German silver? Nitric acid seems to give greenish colour with both nickel and alloy. 2. Are there any of the commoner metals that will bear being in constant contact with bichloride of mercury in either a dry state or in solution, without a change occurring? 3. Is there any salt, such as potassium chlorate or nitrate, that can be readily fused and run into moulds and there remain unchanged, exposed to the air? The chlorate seems very difficult to fuse and soon takes fire.—CHEMICUS.

[64945.]—**Continuous Ringing Bell.**—Will some of our electrical friends kindly help me? I have made a bell to be continuous ringing, as described by "F. C. A.," and on trying it it acts capitally when connected up as shown by him. But on looking at Gent's book, and also King, Mendham, and Co.'s, I find they connect them differently—viz., the push is connected to the carbon and not the zinc as shown by "F. C. A." Now if I connect mine like that it will not ring. Is the bell made up differently on the baseboard, or what? I have puzzled over it for some time, and at last seek information from our willing electrical friends. Also I should be glad to know how switches are connected, so that burglar alarms are off and other contacts on, and both off and both on. Sketch showing connection would oblige.—ONE WHO TRIES.

Fruit Growing for Profit.—The times are propitious for the employment of capital and enterprise in the production of good fruit: excellent agricultural land, adapted by means of previously good cultivation for the production of high-class apples, can be obtained at moderate cost; but no time should be lost in acquiring it, for we think land has touched its lowest level of value. To grow fruit profitably, and in order to be unfettered by deterring clauses in leases, the cultivating occupier should also be the owner. Let a lesson be taken from our Transatlantic brethren; let similar enterprise, intelligence, persistence, and capital, be employed here, and a formidable rivalry will be established that must also, we believe, prove a gratifying success.—*Gardner's Chronicle.*

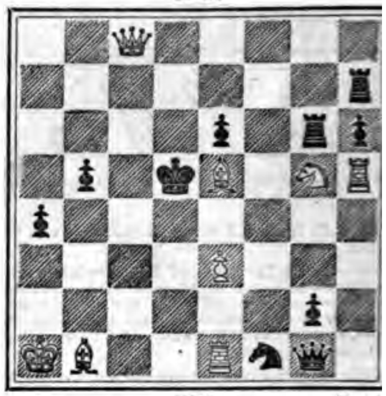
New Type of Torpedo Boat.—Messrs. Yarrow have completed another boat of the new type of "second class" torpedo boats, but of slightly different design. The first vessel was 60ft. in length by 8ft. 6in. beam, with a displacement of 11¼ tons light and 15 tons when loaded, and on her official trial she averaged 17 knots in speed. The new boat is 56ft. long by 8ft. 3in. beam, with a displacement of 10 tons light and 14 tons when loaded, and a speed of 16 knots. Her armament is the same as in the first boat—namely, the swivel torpedo tube and a couple of small Nordenfelt guns, all on deck. The object of the Government in ordering this boat was that they might compare her performances and efficiency with those of the larger craft, in order to determine which of the two should be the pattern for future boats of the class. A successful run was made with the new boat on Monday on the Thames, the naval representatives of several foreign Governments being on board.

CHESS.

ALL communications for this department mu addressed to J. PIERCE, Langley House, Dorking.

PROBLEM MXC.

Black.



White. [8 + 1

White to play and mate in three moves.

SOLUTION TO 1,088.

White.	*Black.*
1. B-K Kt 2.	1. Anything.
2. Kt or B mates.	

(Three variations.)

NOTICES TO CORRESPONDENTS.

CORRECT solutions to 1,088 by H. A. Lindfield, C nock, James Kistruck, A. Hausler, G. T. Stringfe Hensing, A. Dean, H. Fellows, and Nelson, Kent; to by Link, H. A. Lindfield (Kt 6 put for Kt 3).

A. DEAN.—It began with problem 1,089.

J. DUDLEY.—You have numbered the problems correctly, as to 1,088 if 1. $\frac{\text{R-Q B sq}}{\text{P-Q B 5}}$. We are unabl follow the moves altogether in "1,532," also "1, In 1,084, how do you proceed if 1. $\frac{\text{———}}{\text{Kt takes Q Kt P}}$.

C. READER.—You have not given the defence 1. $\frac{\text{——}}{\text{P-Q}}$ in 1,088. It cannot be done your way.

SOLUTIONS to 1,099 acknowledged next week.

A MATCH played between Bradford and Halifax Halifax on the 18th inst., resulted in a victory for Br ford by five games to three.

A MATCH between Bradfield and Wakefield played Bradfield on the 17th March was won by the home tea four games to two.

A PRIVATE match between Mr. A. Burn and Rev. Owen for the final possession of the Rutherford Challe Cup has been won by Mr. Owen.

IN the Liverpool Cup Handicap Tourney the first pri has been won by Mr. A. Burn, class 1; second prize, Clayton, class 5; third prize, O. Lucovich, class 5. Thirt six candidates.

THE first prize in the Manchester Athenaeum Handic Tourney—forty-eight competitors—has been won by Mr. A. Dust, Chess editor of the *Machester Evening News.*

A CHESS column has been recently started in the *Bel Weekly News.*

A SUBSCRIPTION fund is being raised for the wid and eight children of the late Sergeant Major McArth who was an earnest worker in the cause of Sussex che Subscribers should address Mr. H. W. Butler, 43, Gardne street, Brighton.

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Subscribers receiving their copies direct from the office are quested to observe that the last number of the term for w their subscription is paid will be forwarded to them in a Wrapper, as an intimation that a fresh remittance is necessa it is desired to continue the Subscription.

The English Mechanic
ND WORLD OF SCIENCE AND ART.
FRIDAY, APRIL 6, 1888.

XTRACTS FROM BERGERON.—III.

THE cord suitable for a lathe ought to have sufficient twist without being ard. It is sold in all large towns under the ame of "Filagore." It is a cord of three rands, or simply triple. As regards thickess, it should be neither too small nor too rge. If too thick, it has a good deal of gidity; and, as it makes two turns about e work, if it is of medium or small size, it eakens and ravels out rapidly. If it is too nall, it lasts no time. In a word, it should about two lines in diameter. There are me people who provide themselves with a rd of six or seven ply—a kind of cord of ven or nine strands very tightly twisted, d hard; but its very hardness should cause to be rejected, because when applied to a art of the work which is smooth and nished it impresses the marks of its strands n the part upon which it rested.

Gut is the best cord of all; but as it is ery costly, and as, when turning between entres, it is often necessary to reduce a bit f stuff that has been roughly trimmed with he hatchet, which leaves sharp angles, this ind of cord is soon worn out, and would volve considerable expense. It is thereore kept for the lathe with a mandrel, and or others which require an endless cord. Nothing is more quickly used up than a lathe ord. To retard its destruction somewhat it as been proposed, when it commences to hiten, to rub it with a sponge slightly etted. The sponge, which envelops the ord, is held below the work, and the treadle s set in motion; but the time is not chosen hen the cord is on a smooth and finished art of the work, lest it impress its mark upon t. In Fig. 1 (p. 45) is represented a piece of wood roughly trimmed and placed between he two centre points, and the workman is upposed to face the reader in such a way as hat he can be seen at work.*

The workman supported by his left leg laces his right foot upon the treadle, and, o enable him to give to the work as many urns as possible without raising his foot ery considerably, he can place it nearer *h* han *c*, especially if the piece is not large, nd offers no great resistance to the process f roughing it down. Nothing is eaiser than o use the gouge; there are, nevertheless, ertain difficulties in cutting wood neatly. We have not considered it possible to render early the position of the tools by reprenting the workman holding them in his two nds and turning; we have preferred to reesent the tool and work in profile.

Fig. 3 represents the position of the gouge, d generally of every kind of cutting tool order to cut wood in a proper manner. any people present the tool at right angles the axis of the work, without reflecting at it can but scrape and tear it. It is cessary, on the other hand, that the tting edge shall almost make a tangent th the circumference, and that the surplus ood shall seem to come upon the tool in der to be carried away. We say almost a ngent, for a tangent being a right line perndicular to the extremity of a diameter, n only touch the circumference, and conquently a tool agreeing with the line could t cut the wood. To speak accurately, it ust be said that the tool must make the allest possible chord; for if we present e tool on a line approaching the diameter is as if we forced the edge to enter ghtly into the material, and by the power of the foot we attempted to tear away that which resists the tool. It is easy to perceive that we can only produce by this means a series of chatters, and it is by inspection of a piece of wood roughed out by the gouge that we can judge whether the tool has cut or scraped. A is the piece of wood that is being turned, *a b* is the gouge, supported by the rest *c*. Generally the handle is held in the right hand, and the left hand grasps the upper part, the four fingers above and the thumb below, just in front of, and always close to, the rest, so that the left hand, supported by the rest, serves to control the tool, that it may not cut away more wood than is desired. We say that this is the usual way of holding the tool, but at the same time it is well to accustom oneself to change hands. There are many cases in which this is convenient.

It is not, however, necessary that the left hand hold the tool so firmly, and that it be applied to the rest so forcibly that the edge cannot reach the wood as it turns to and fro. On the contrary, it is necessary to hold the tool so lightly with the left hand that it shall lend itself almost insensibly to a certain degree of movement which carries it towards the wood as the treadle descends, and draws it back as it rises. One can understand to what a small extent the tool is to be drawn towards oneself, if it is considered that after having removed all the wood that the last revolution of the piece offers, on retiring the tool but a hair's breadth, it no longer touches the wood. Fig. 4 shows the manner of holding the tool. A is the left hand, which, as can be seen, embraces the tool, the fingers above and the thumb below. B is the right hand, which holds the handle C. The left hand does nothing but secure the direction of the tool, and the right sustains the strain against the cut that is being made. Furthermore, it need not be thought, from the way in which the left hand is holding the tool, that it fails to hold it rigidly. A little practice will soon give more skill than we can supply by lengthy description.

The form of the gouge makes it sufficiently evident that at each cut it makes a circular groove in the wood. Similar ones are made along the entire length of the cylinder at equal distances from each other; and, so far as may be, of equal depth, so that the bottom of each groove shall have an equal diameter; and to make sure of this, a pair of calipers, *i* (Fig. 1), or a figure-of-8 calipers, *l* of the same Fig., is taken, and a measurement made from point to point. Care must, however, be taken to give the calipers an opening of at least one line more than the diameter it is desired to give the cylinder, and to fix them to that gauge. When the cylinder has been thus roughed out in its entire length, all the ridges which separate the several grooves are taken off by light cuts, and it is brought almost to a level, only leaving those slight unavoidable ridges, due to the form of the tool; and it is then the chisel (the most difficult tool to manage) comes into use.

Many turners make use of chisels ground square, such as that shown in Fig. 5. But as when turning it is impossible to take the wood directly in front—that is, parallel to its length, and since one is obliged to present the chisel obliquely to the axis of the piece that is being turned (Fig. 6), which compels one to carry the body towards the right and left, out of the equilibrium position, according as one leans to either side—many prefer, and it is the better plan, to have the chisel ground slanting, like that in Fig. 7, and it then suffices to present it perpendicularly to the wood, that the bevel may stand obliquely, as can be seen in Fig. 8.

There are many reasons for thus attacking the wood obliquely to its grain, and not merely in front or parallel to the grain. The first is that the wood cut thus offers less resistance, and that the pores divided in this way are laid down upon the wood itself. In the second place, it is by this plan that only the middle of the cutting edge need be employed to cut the wood, and, supposing the wood to have been already roughed out accurately round, that part of the chisel which does not cut rests upon a perfect circle, and does not permit the tool to cut otherwise than following the direction given to it by that part on which the chisel lies.

It is necessary, moreover, to place this tool almost in the direction of a tangent to the cylinder; the less wood it is desired to cut away, the nearer must it approach a tangent. If it is desired to cut away rather more, the tool will be placed in the direction of a chord to the circle, and the way to judge whether the tool is well placed and if it cuts the wood well, is to observe whether the shavings which come away are large, curled, and of equal thickness.

Care must be taken in carrying out what we have prescribed, in reference to the inclination of the tool upon the wood, not to carry it to excess. Beginners are apt to deceive themselves upon this point. They notice that the more they incline the tool the neater it cuts, and the more the shaving is curled; but then, as the too great obliquity of the tool causes it to approach perpendicularity to the axis of the cylinder, there are then but about two or three lines of the width of the edge which cuts the wood, and in place of levelling the cylinder, as ought to be done, the surface presents but a series of furrows composed of portions of circles of large diameter, and the imperceptible ridges which this defect leaves behind it cannot be altogether effaced. It is therefore necessary, when a cylinder is to be surfaced, that the chisel shall glide along parallel to the length of the piece, and this movement should be as regular as possible, without jar or cessation; otherwise each check or thrust of the tool may be counted upon the cylinder. This operation is a very difficult one, and on that account we recommend its repetition as often as possible so that manual accuracy may be gained.

We have mentioned one quality which the shaving ought to possess—namely, that it should be wide and neat. In order, then, to obtain such, the inclination of the chisel must be as slight as possible, but, nevertheless, sufficient to make a neat cut—that is to say, it should make an angle of about twenty degrees with the axis of the cylinder. Nothing need be feared during this operation from the lower angle of the chisel; but such is not the case with the upper angle, which, as has been already said, must always be raised clear of the wood, and never so as to cut it. When it is desired to lay the chisel too flat in order to turn very truly and equally, it is a common thing for the upper angle to catch in and to penetrate deeply, and as this happens at the very moment when least expected, the entire circumference of the cylinder is cut into, and it is seldom that the surface at that spot is not damaged beyond remedy. (This accident goes by the name of "the master stroke.")

It is specially in using the chisel that it is difficult to turn accurately round. We may be certain that it is physically impossible. In order to convince oneself, it suffices to turn partly from left and partly from right, and it will be seen that the surfaces never meet accurately, for this reason: when it is desired to turn a piece to fit another a scraper is made choice of, as we shall explain in the proper place.

We have seen some people, Germans especially, hold the chisel in a very peculiar manner, and in a way to cut the wood very neatly. It consists in passing the left hand behind the cord, in order to grasp the cylinder with four fingers, and to place the thumb upon the bevel of the tool. In this way the

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The rest is accidentally omitted. It is only a bow of d which rests in the notched part of the puppets.

ol is secured in a very sure manner upon e part already turned and cylindrical, and the rying position of the hand is much less nspicuous upon the work. We have seen is method employed very satisfactorily by maker of wood instruments, who turned ery well, and with special neatness, the odies of flutes out of boxwood, and of assoons out of maple. This twofold experience upon one hard wood and the other ery soft, proves that this method is applicable in many cases, but principally when e work is weak and very slight compared ith its length. For then the action of the ol, combined with that of the foot, tends make it bend, and, consequently, it cannot be turned cylindrical, because the wood only cut by jerks and not uniformly.

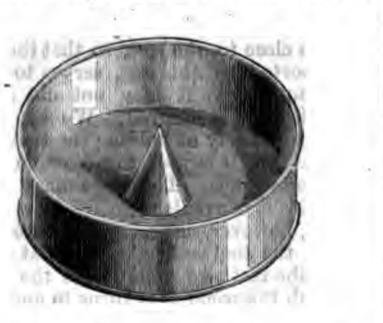
As soon as success has been attained in urning a cylinder fairly well, let the hand be assed along it, compassing it from one end to he other, and the inequalities invisible to the ye will be felt. In this way the perfection f the work may be judged. Whatever the kill acquired, a cylinder is never absolutely ound. Many causes prevent it: the unequal density especially of quartered wood, and the unskilfulness of the turner. To convince oneself, it is only necessary to take a well-sharpened point tool, and to present it to the surface of the revolving wood so as slightly to graze it. The point of the tool will be seen to cut the wood at all the salient parts, and not to reach the others, proving incontestably what we say. When one is assured of such imperfection, courage must be had to begin again. In default of having a well-practised and sure hand, it will be impossible to correct with the chisel the imperfection alluded to.

The best way is to take up again the gouge, and only to cut off the excess beyond what is perfectly cylindrical, leaving the surplus altogether untouched. Then let the chisel be taken again, and try to make better work than before, and in this way, after a few attempts, perfection will be attained. It is very evident that in working thus the diameter of the wood will be continually diminished, and that, if a fixed diameter has been given for the cylinder, it will have been already passed. For this reason, nothing of value should be taken in hand until the hand has become sure. Besides the difficulty of turning accurately cylindrical, and surfacing the piece correctly, there is another very considerable one, and that is keeping the piece to the same size from end to end; and, although one has the resource of calipers, if mathematical perfection is aimed at, as in the bearings of a machine, which ought to be perfectly cylindrical, or in the rebate of a box, it is possible to deceive oneself very considerably, owing to the calipers having more or less gripped the place at which they were applied.

There is in regard to this an instance in which one may fall into an error without perceiving it, unless the cause of it is understood. Suppose it is desired to turn a perfect cylinder, it will be "gauged" (which is the term used to express the act of taking its thickness with calipers) with a certain amount of care at one spot of its length—for example, at one of its ends. It is desired to ascertain whether at a distance of six lines further on it has the same size. It is found to be at this spot just imperceptibly larger. The calipers will pass but a little more tightly: nevertheless, it is considered satisfactory. A trial is made six lines further on; they pass it again rather more tightly, but again it is allowed to stand as correct, and having measured from place to place, the calipers always passing, although a little tightly, the journal is believed to be perfectly cylindrical: nevertheless, it is nothing of the kind, for, if the calipers are a second time applied near the end at which a commencement was made, one is surprised to find half a line more or less of difference.

ANOTHER BOON FOR COOKS.

STANLEY'S patent heat-conducting cake tins will prove a boon to all housewives. They are an extension of Mr. Stanley's patents for heat conductors for cooking all kinds of meat, &c., which have proved such a success, and will save at least 25 per cent. of time and firing, and insure the centre being thoroughly cooked without the outside being in the slightest degree burnt or overdone. These tins guarantee light and wholesome cakes, and they will be found of great use and a great economy. The hole which is left in the centre of the cake is not seen from the top, and prevents all crumbling and waste in cutting the cake up. The conductor is made of pure copper, plated to render it perfectly wholesome. H. T. Tallack, of 28, Hatton-garden, is the manufacturer, and they are now made in three sizes—viz., 6in., 2s. 6d.; 8in., 3s.; and 10in., 4s.



BALANCED TELEPHONE APPARATUS.

THE improvements in and relating to telephonic apparatus, patented by the Stanhope Co., in conjunction with G. L. Anders, of Bucklersbury, E.C., consist in a method of balancing the instruments in a telephonic circuit, so that the balance is disturbed by any external currents. The invention relates to electric telephones operated by the vibration of an armature or armatures in front of an electro-magnet or electro-magnets wound with and excited by coils of wire placed in the main circuit or line; and it consists in the method of connecting such coils with the exciting or line battery, in such a manner that the coils form what may be termed a balanced bridge, so that the electro-magnets will be highly charged and sensitive, while the balance will be disturbed by currents entering from a source outside the balance or by currents generated by vibration of an armature or armatures in front of one or more coils forming part of such balance. The manner of obtaining such balance is as follows:—The main line or wire is joined to one end of each of two coils of equal, or approximately equal, resistance; the other end of one coil is then joined to the positive pole of the exciting battery and the other end of the second coil is joined to the negative pole of the same battery: the earth, or return wire, is joined in a similar manner to one end of each of two more coils whose resistances are equal or approximately so, the other ends of such coils being joined to opposite poles of the exciting battery in the same way as the first-mentioned pair of coils. Fig. 1 illustrates this arrangement—X being the battery and L the line. A and B are equal coils, C and D are equal coils, and M is the return or earth wire. It is not necessary that all the coils shall be of equal resistance, but the pair joined to earth should be equal to each other, and the pair joined to line should be equal to each other. It is evident that two or more coils in series or in parallel may be used instead of any single coil, provided that the resistance of such substituted coils so arranged is equal to the resistance of the corresponding balancing coil or coils. It is also evident that one or more of the coils may be used or be substituted by balancing resistances doing no electro-magnetic work. This method of connection may be extended without departing from the principle explained. For the sake of illustration, a case is shown in Fig. 2, there being three pairs of balancing coils and two batteries. The invention is applicable not only to instruments used as transmitters by means of currents generated by the vibration of armatures in front of electro-magnets, but also in cases where the balancing coils are part of a secondary induction circuit of which the primary is influenced by a microphone and a battery not in the main circuit. In such an arrangement the wire of the secondary circuit is the line wire so far as the telephonic apparatus is concerned. Fig. 3 shows this arrangement, the primary circuit being indicated by thick lines, and the secondary circuit by thin lines.

When using the coils and battery as described, and to effect the necessary connections, an automatic switch is used such that while one or more receivers are hanging on a hook or hooks one terminal of the battery shall be connected directly to earth or return wire and the other terminal to the open point of a calling key or push connected to line (or *vice-versa*), and on taking the receiver off the hook, the latter moves by means of a spring, and connects the coils with the battery as above described. The vibrating arm res used in connection with the magr mployed as described may be of the o ind forming part of or attached to phragm or dia-

Fig. 1

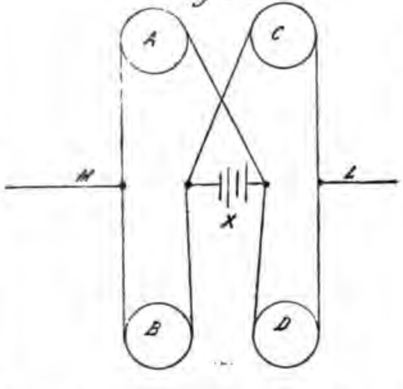


Fig. 2

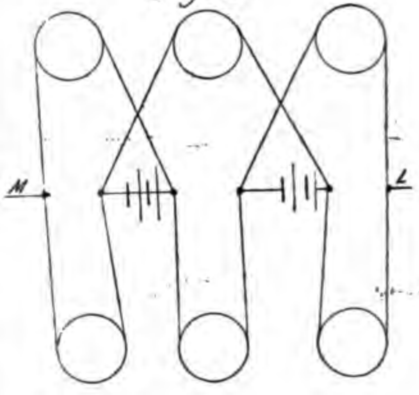
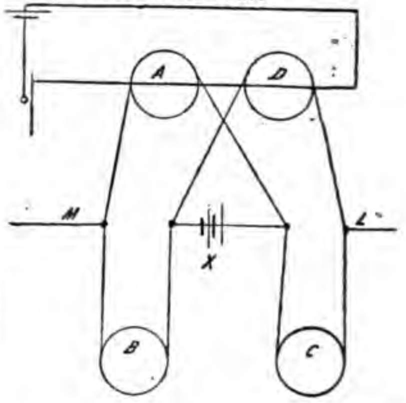


Fig. 3

Primary Circuit



phragms, or they may be supported by or connected to a diaphragm and pivoted in the centre in such a manner that one end moves towards one magnet or pole while the other end moves away from another magnet or pole. Or the armature supported by a diaphragm may be fixed at one end to one magnet or pole, with its other end opposite, but not fixed to a second magnet or pole. Or the diaphragm armature may be placed between two or more poles, so that it will be moved towards or attracted by one pole or set of poles and moved from or repelled or released by the other pole or set of poles.

It will be seen that in all the above-described arrangements the batteries are in the line wires, and there is no independent circuit insulated and separate from the line wire as in many arrangements previously proposed in which electro-magnets are used: that is effected without its being necessary to maintain a considerable current throughout the whole of the line wire, thereby wasting a great amount of electrical energy.

A NEW MECHANICAL STAGE.*

THE stages of all microscopes fall under two heads—Plain and Mechanical. Plain may be divided into 3, and Mechanical into 2, subdivisions. They are as follows:—*Plain:* 1, spring clips (Hartnach model); 2, sliding bar (Powell's iron-stand); 3, where the slide is placed on a carrier which is sprung to, and can be moved about, a fixed stage (Beck's National). *Mechanical:* 1, a clip moved by screw and rackwork holds the slide and pushes it about over a fixed stage (Mayall's); 2, the stage itself on which the slide-rest is moved by screw and rackwork (Powell's No. 1). This new stage is of the form of Mechanical Section I., inasmuch as the slide is pushed about a fixed stage. This is accomplished in a somewhat different manner to that of Mayall's. The defect in this kind of stage is the clipping of the slide. When the slide is clipped it prevents one feeling the working distance when using high powers. This system of feeling one's working distance I regard as a very important point in microscopical manipulation, and one which ought always to be employed, not only in high-power work, but also in low. It is bad form, to say the least of it, to see any one accredited with knowledge in microscopical matters adopting a novice's plan of looking to see how far his objective is from his object. Just as one can recognise the novitiate in horsemanship by the distance he rises from his saddle, in skating by his bending over his toes, or in cycling by his bending over his handle-bar, so the novitiate in microscopy may be detected by the way he handles his tools.

It is very important that the young microscopist who invariably begins with the 1in. and ¼in. objs. should practise the method of focussing by touch, and then when he advances to the highest wide-angled objectives, the focussing of them will be perfectly natural. He will fearlessly focus down his choicest lens on his most cherished object by means of the coarse adjustment.

There is yet another disadvantage in clipping he slide—it is this. The bearings of the piece which clips the slide in this form of mechanical tage are necessarily short, the clip therefore has a endency to rock, which rocking is communicated o the slide.

Of these stages that I have personally tried, in very few was this rocking motion absent. With a view to remedy these defects I have drawn out a plan which has been admirably executed by Mr. C. . Curties in the microscope before you this vening.

The stage, which is of my horseshoe form, has wo narrow vertical slots cut in it, one on either ide of the opening. The usual rack-and-pinion which is placed underneath the stage moves blocks sliding in the vertical slots. These blocks come flush ith the stage, and have a screw in them, the head f which, projecting above the stage and pressing gainst the lower edge of the slide, pushes it up. The position of the microscope is assumed to be an inclined one, then on turning back the pinion the ide drops. In fine, the slide is kept against the rew-heads by gravity, the microscope being inclined.

As the blocks only come up through the slots ush with the stage, the screw-heads alone projectig, a plain stage may be obtained at any time by emoving the screws. Or, if preferred, a bar may e fixed by the screws to the blocks, which will ake a mechanical sliding bar.

This last is the form I have adopted in my own microscope. In addition to the vertical, a horizontal movement may be fitted in the same way by slotting the stage and moving a block by a screw underneath. Such a fitting has been put to the microscope before you. It is obvious that by such a method one can push the slide across the stage; but there is no means but that of the finger to bring it back again. Of course, by keeping the slide pressed against the stud one can regulate the motion backwards by means of the screw. If a horizontal backward motion is required, there are two—and only two—alternatives before you: either you must clip the slide, or you must place the slide in a moving plate. If, on the one hand, the slide is clipped, you fall into the errors mentioned above; and if, on the other, you adopt the moving plate, you must, if it is to stand a crucial test, copy the Powell model. Now, as the scope of the new stage is to improve the student's microscope at a small extra cost, it stands to reason that the second alternative is out of the question.

The advantages I claim for the new movement are as follows:—

1. The vertical and horizontal movements are independent of one another, so you can have a vertical movement fitted to your microscope without the horizontal, or vice versâ.

2nd. By removing the screws in the blocks which are the only things above the stage, the stage is left perfectly plain, just as if there was no mechanical movement at all.

3rd. By merely slotting the sliding-bar, to enable it to pass over the screw-heads, the sliding-bar and the mechanical movement can be used independently of one another.

4th. By screwing a bar to the blocks you have a perfect mechanical vertical movement. This, I think, in practice, will be found the most useful.

5th. By graduating the heads of the pinions, and by marking the stage for each complete revolution, a finder and a rough micrometer sufficiently accurate for low and medium powers is made.

6th. It is inexpensive.

7th. And perhaps the most important. The moving pinions being fastened to a fixed stage, and the blocks sliding in grooves in the stage, renders the movement peculiarly steady.

Edward M. Nelson.

THE PHILOSOPHER'S STONE.

IN the course of a lecture on the "Philosopher's Stone," delivered by Dr. Hürter, at Widnes, the lecturer observed that once upon a time there was a small village situated near the shores of a beautiful large river, in a lovely country. The peaceful inhabitants of that village, most of them tillers of the soil, enjoyed themselves in the simple fashion of those times. To satisfy their wants there had long been built in the midst of shady grounds, close to the riverside, an inviting hostelry, where the inhabitants on holidays assembled to escape for once the drudgery of their everyday occupation, to enjoy a game or dance, but more particularly to taste of a special dainty, for which the hostelry was famous, and which was known by the name of Snig-pie. One day the peaceful inhabitants of that village were alarmed by the appearance of a stranger, who began to cut down their beautiful trees, and to erect structures of curious shape, of which the villagers had as good ideas what they were intended for as the man in the moon. By degrees a rumour went abroad that this stranger had found ways and means to make pure gold from salt. And, indeed, the stranger prospered. Rapidly the green fields and trees disappeared, the ground was covered with more gold factories, all of them turning salt into pure gold. The tillers of the ground lent a willing hand, and became workmen in these factories, receiving as reward part of the gold there made. The village, formerly unknown, increased into a large town of world-wide reputation, churches, schools, and other public buildings were erected, one of the finest being a town hall, the roofs of which sheltered an institution called a free library. Eminent citizens of the town were constantly endeavouring to supplant the old-fashioned enjoyments, such as the public-house offered, by more rational and more intelligent amusements, such as free lectures on various topics, and the people heartily supported their leaders. Such were the wonderful changes which were brought about by the introduction of this process of converting salt into gold. Some grumbling inhabitants said that the change did not prove a blessing altogether, and it could not be denied that little was heard now of the Snig-pie house, that the river was not now famous for its sparkling clear water, and that the town had a peculiar odour at times; but on the whole the people enjoyed their share of the gold in good health, thanks to the cares of their worthy chairman. Be that as it might, the things which the people of Widnes strove to obtain, wealth and health, were held to be indispensable for human happiness all the world over, and at all times men had endeavoured to gather riches and to preserve health and long life to enjoy them. But not at all times were men satisfied to resort to such processes for obtaining gold as the people of this good country were now using, processes known by the names of industry and thrift. About 300 years ago there were many people to whom these processes appeared to be too slow, and to taste too much of the well-known curse, "in the sweat of thy face shalt thou eat bread." These people looked out for a quicker and easier way of becoming rich, and they verily believed that there was such a way for obtaining gold, and not only for obtaining gold, but also for procuring health and life everlasting. And this was how that belief had arisen. Old philosophers had given it as their opinion that all metals were composed of only two or three things, and that the mixture of these things in any one metal might be so altered as to change it into another metal. These philosophers had long searched, and were reputed to have found, a material which should change the commoner metals, iron, copper, tin, lead, and mercury, into the precious metals, silver and gold. This material was named the philosopher's stone, and the operation of changing one metal into another was called the transmutation of metals. But the process by which the philosophers had succeeded in making their wonderful stone remained a profound secret. They would readily perceive that in that theory there was hidden the prospect of an honest and easy way of getting rich quickly. There was nothing to do but to find, by fair or foul means, that secret of the philosopher's stone, and riches without bounds would be the reward. Curiously, history recorded many cases of men who were reported to have found the grand secret, and who had amassed fabulous fortunes, such as they only read of in Oriental stories. The lecturer then proceeded to quote some of the cases alluded to, observing that foremost amongst them all was the story of Nicholas Flamel, a Frenchman. He was born at Pontoise, in 1330, and lived in Paris, gaining his livelihood as a copyist. In 1357 he obtained a manuscript, engraved on a piece of bark, which he tried to decipher. Having spent twenty-one years of his life in a vain attempt to solve the riddle, he travelled to Spain, where he found in St. Iago de Compostella a learned physician, who translated the document and explained its mystery. It proved to be written by a certain Jew, Abraham, and addressed to his fellow Jews; and it yielded no less a secret than the preparation of the philosopher's stone. Flamel returned to France and set to work. In 1382 he was able to change mercury into silver or gold at his pleasure. He became enormously rich, and spent his riches for the benefit of his fellow creatures. He built and endowed fourteen hospitals, seven churches, and three chapels. Even as late as 1742 alms were distributed in Paris from funds which he left for that purpose. The year of his death was uncertain. Various other instances which are reported in history of persons having been possessors of the magic stone were given, and of the immense amount of money which they left when they died, the lecturer observing that it was no wonder, then, that all classes of people were anxious to obtain the great secret. Stories of such wealth so easily acquired were sufficient to interest anyone, and, indeed, they found that in the 17th century the craze of the philosopher's stone had spread amongst all classes of the population of the whole of civilised Europe. What, they would ask, were the grounds for this universal belief in the possible existence of this mysterious substance? There were many reasons. Besides the well-attested stories of which he had just given a few, there were certain experiments easily performed which seemed to prove that one metal could easily be changed into another. Then there was a certain theory propounded by ancient philosophers, as to the composition of matter, which satisfactorily explained these changes. Last, but not least, the belief in the existence of the philosopher's stone was older than Christianity, and had taken deep root in the minds of superstitious people. After various other remarks, Dr. Hürter gave a translation of a prescription for the making of the philosopher's stone, to which he said he was indebted to Mr. Gibson Smith, of Warrington; and concluded his remarks by various interesting experiments, showing by what chemical experiments people could be made to believe that the adepts really had in their possession the magic stone. He also touched upon the many discoveries which had been made by all chemists whilst looking for this phantom.

SIMPLE ELECTRO-MOTOR.*

IT is generally understood that an efficient electro-motor cannot be made without the use of machinery and fine tools. It is also believed that the expense of patterns, castings, and materials of various kinds required in the construction of a good electro-motor is considerable. The little motor

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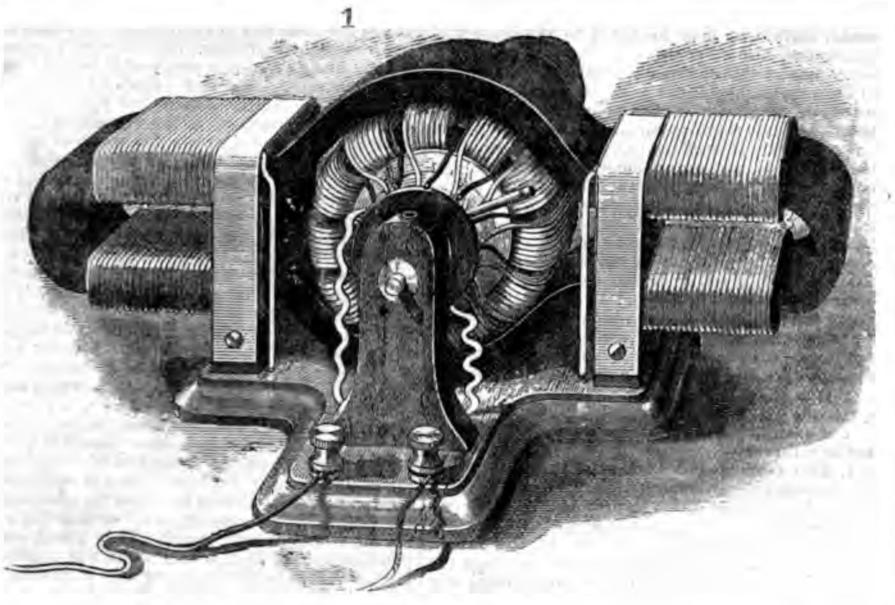
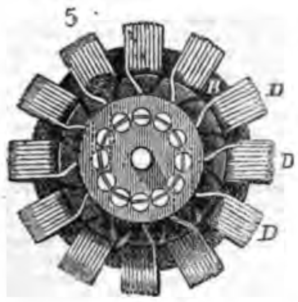
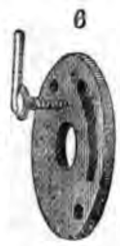
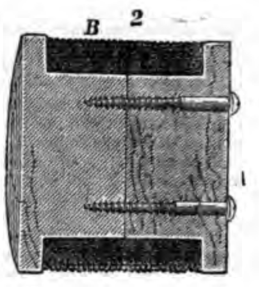
* Read before Quekett Microscopical Club, February th, 1888; and the Royal Microscopical Society, March th, 1888.

* By GEO. M. HOPKINS, in the *Scientific American*.









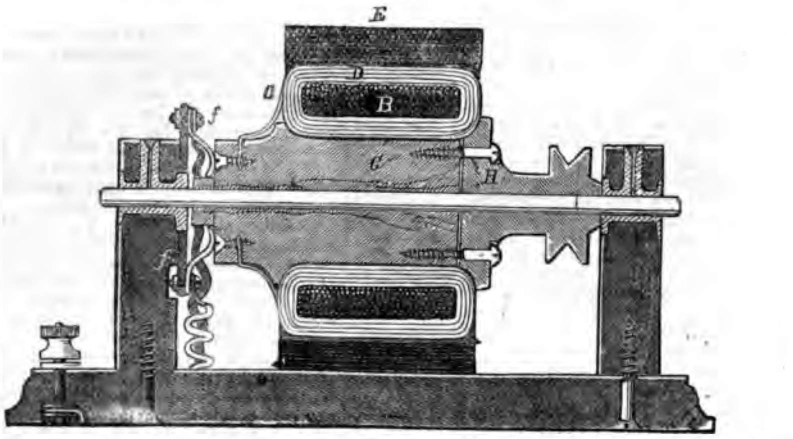


FIG. 2.—Armature Core. FIG. 4.—Transverse Section. FIG. 5.—End View of Armature showing Commutator. FIG. 6.—Brush-Holding Disc.

shown in the engravings was designed and constructed with a view to assisting amateurs and beginners in electricity to make a motor which might be driven to advantage by a current derived from a battery, and which would have sufficient power to operate an ordinary foot lathe or any light machinery requiring not over one man power.

The only machine work required in the construction of the motor illustrated is the turning of the wooden support for the armature ring. The materials cost less than four dollars, and the labour is not great, although some of the operations, such as winding the armature and field magnet, require some time and considerable patience. On the whole, however, it is a very easy machine to make, and if carefully constructed will certainly give satisfaction. Only such materials as may be procured anywhere are required. No patterns or castings are needed.

Beginning with the armature, a wooden spool, A (Fig. 2), should be made of sufficient size to receive the soft iron wire of which the core of the armature is formed. The wire, before winding, should be varnished with shellac and allowed to dry, and the surface of the spool on which the wire is wound should be covered with paper to prevent the sticking of the varnish when the wire is heated, as will presently be described. The size of the iron wire is No. 18 American wire gauge. The spool is $2\frac{3}{16}$in. in diameter in the smaller part, and 2in. in length between the flanges. It is divided at the centre and fastened together by screws. Each part is tapered slightly to facilitate its removal from the wire ring. The wire is wound on the spool to a depth of $\frac{3}{8}$in. It should be wound in even layers, and when the winding is complete the spool and its contents should be placed in a hot oven, and allowed to remain until the shellac melts and the convolutions of wire are cemented together. After cooling, the iron wire ring, B, is withdrawn from the spool, and covered with a single thickness of adhesive tape, to insure insulation.

The ring is now spaced off into twelve equal divisions, and lines are drawn around the ring transversely, dividing it into twelve equal segments, as shown in Fig. 3. Two wedge-shaped pieces, C, of hard wood are notched and fitted to the ring so as to inclose a space in which to wind the coil. This coil consists of No. 16 cotton-covered copper magnet wire, four layers deep, each layer having eight convolutions. The end, *a*, and the beginning, *b*, of the winding terminate on the same side of the coil. The last layer of wire should be wound over two or three strands of shoe thread, which should be tied after the coil is complete, thus binding the wires together. When the first section of the winding is finished, the wire is cut off and the ends (about 2in. in length) are twisted together to cause the coil to retain its shape. After the completion of the first section,
one of the pieces C is moved to a new p
the second section is proceeded with,
until the twelve sections are wound. T
the ring are then varnished with thin s
nish, the varnish being allowed to soa
interior of the coils. Finally, the ring
to remain in a warm place until the
thoroughly dry and hard.

Care should be taken to wind all of t
the same direction, and to have the sa
of convolutions in each coil. A conveni
carrying the wire through and around t
to wind upon a small ordinary spool e
for a single section, using the spool as a

The ring is mounted upon a wood
hub G, and is held in place by the wo

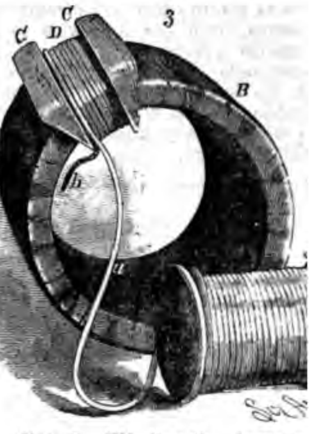


FIG. 3.—Winding the Armatu

H, both hub and collar being provided
cave flange for receiving the inner ed
ring. The coller H is fastened to the
ordinary brass wood screws. Both hub
are mounted on a $\frac{3}{32}$ steel shaft formed
wire, which needs no turning. A pulley
integrally with the collar H. The end
G, which is provided with a flange, is pr
form the commutator, and the termin
the ring coils are arranged along the sur
hub and inserted in radial holes drilled i
in pairs. The wires are arranged so that
of each pair receives the outer end of on
the other hole receives the inner end of
coil, the extremities of the wire bein
before insertion in the holes. The dis
tween the holes of each pair is sufficien
a brass wood screw to enter the end of t
and form on electrical contact with bot
the pair, as shown in Fig. 4.

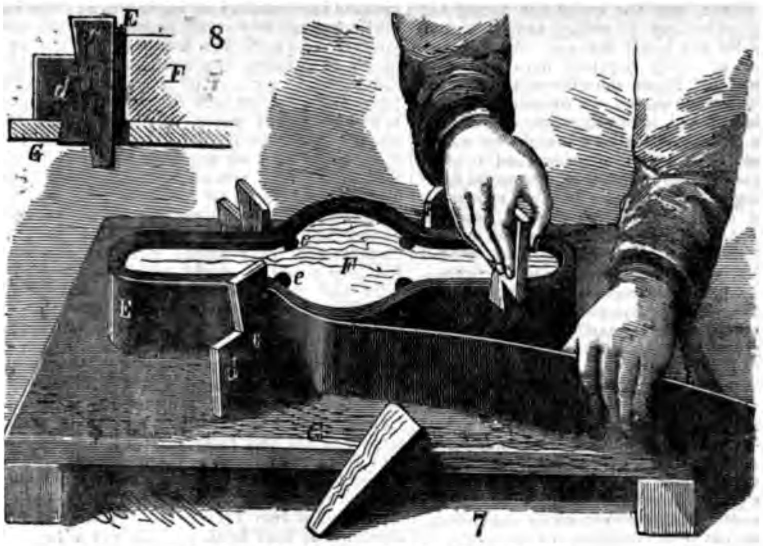
There being twelve armature sections a
pairs of terminals, there will of course be
a corresponding number of brass screw
screws are inserted in the end of the hu
to come exactly even with the end of
This completes the armature and the
tator.

Before proceeding to mount the armat
in journal boxes, it will be necessary to
the field-magnet, as the machine must,
extent at least, be made by "rule of thum

The body E, of the field-magnet consists
of Russia iron, such as is used in the man
of stoves and stove pipe. The strips are $2\frac{1}{2}$
their combined length being sufficient to
a magnet core $\frac{7}{16}$in. thick, of the form sho
motor illustrated has 15 layers of iron in
net, each requiring about 26in. of iron,
mately 33ft. altogether.

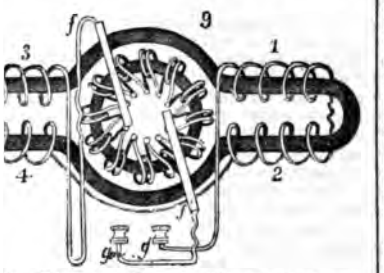
The wooden block, F, on which the m
formed, is secured to a base board, G, as
Fig. 7, and grooves are made in the edg
block, and corresponding holes are forme
base to receive wires for temporarily bin
iron strips together. Opposite each angl
block F mortises are made in the base bo
receive the keys, *d*, and wedges, *c*. Each
retained in its mortise by a dovetail, as
Fig. 8. By this arrangement each laye
strip of iron may be held in position as th
tion of the magnet proceeds, the several
and wedges, *c*, being removed and replace
cession as the iron strip is carried around t
F. When the magnet has reached the
thickness, the wedges *c* are forced down
hold the iron firmly; then the layers of
closely bound together by iron binding wi
around the magnet through the grooves *e*
in the base board G.

The next step in the construction of the
is the winding of the field magnet. To i
insulation of the magnet wire from the iro
the magnet, the latter is covered upon the
be wound by adhesive tape or by cotton
tached by means of shellac varnish.



FIGS. 7 AND 8.—Forming the Field Magnet.

irection of winding is clearly shown in Five layers of No. 16 magnet wire are pon each section of the magnet, the wind- tions 1 and 2 being oppositely arranged ect to each other. In like manner the sections 3 and 4 are oppositely arranged.



9.—Circuit of Simple Electric Motor.

ling of section 1 is also opposite to that of hat of 2 is opposite to that of 4. The begins at the outer end of the magnet, and he inner end of the section. When the is completed, the temporary binding is The outer ends of 1 and 2 are connected and the outer ends of 3 and 4 are con- The inner ends of 2 and 4 are connected. r end of 3 is to be connected with the tor brush *f*. The inner end of 1 is to be d with the binding post *g*′, and the bind- *g* is to be connected with the commutator

eld-magnet is now placed upon a base locks of suitable height to support it in a l position. A block is placed between to prevent the top of the magnet from down upon the armature, and the magnet d in place by brass straps, as shown in

mature is wrapped with three or four es of heavy paper, and inserted in the rt of the field-magnet, the paper serving the armature of the magnet. The arma- t is levelled, and arranged at right angles field-magnet. The posts in which the shaft is journalled are bored transversely an the shaft, and a hole is bored from top d, so as to communicate with the trans- e. To prevent the binding of the journal e exposed ends of armature shaft are with a thin wash of pure clay and allowed The posts are secured to the base, with the he armature shaft received in the trans- les. Washers of pasteboard are placed shaft on opposite sides of the posts to he melted metal which is to form the boxes. Babbitt metal, or, in its absence, tal, is melted and poured into the space he shaft through the vertical hole in the he journal boxes thus formed are each with an oil hole, extending from the top ost downward. If, after cleaning and e boxes, the shaft does not turn freely, should be reamed or scraped until the reedom is secured.

t is now required to complete the motor mmutator brushes *f f*′. They each consist or four strips of thin, hard, rolled copper, s shown in Fig. 4, to cause them to bear screws in the end of the hub G. The are secured by small bolts to a disc of vulcanised fibre or vulcanite, at diametrically opposite points, as shown in dotted lines in Fig. 5, and the brushes are arranged in the direction of the rotation of the armature. In the brush-carrying disc is formed a curved slot for receiving a screw, shown in Fig. 6. which passes through the slot into the post, and serves to bind the disc in any position. The disc is mounted on a boss projecting from the inner side of the post concentric with the armature shaft. The brushes are connected up by means of flexible cord, as shown in Figs. 1 and 9. The most favourable position for the brushes may soon be found after applying the current to the motor. The ends of both brushes will lie approximately in the same horizontal plane. When the motor is in operation the direction of the current in the conductor of the field-magnet is such as to produce consequent poles above and below the armature.

Eight cells of plunging bichromate battery, each having one zinc plate 5 by 7in. and two carbon plates of the same size, will develop sufficient power in the motor to run in an ordinary foot lathe or two or three sewing machines.

The dimensions of the parts of the motor are tabulated below:—

Length of field magnet (inside)......	$10\frac{1}{2}$in.
Internal diameter of polar section of magnet..................................	$3\frac{5}{8}$in.
Width of magnet core	$2\frac{1}{2}$in.
No. of layers of wire to each coil of magnet	5
No. of convolutions in each layer ...	34
Length of wire in each coil (approximate)	95ft.
Size of wire, Am. W. G.	No. 16
Outside diameter of armature.........	$3\frac{1}{2}$in.
Inside diameter of armature core ...	$2\frac{3}{16}$in.
Thickness " " " ...	$\frac{3}{8}$in.
Width " " " ...	2in.
Width " " wound...	$2\frac{1}{2}$in.
No. of coils on armature	12
No. of layers in each coil	4
No. of convolutions in each layer ...	8
Length of wire in each armature coil (approximate).....................	30ft.
Size of wire on armature, Am. W. G.	No. 16
Length of armature shaft	$7\frac{1}{4}$in.
Diameter of armature shaft............	$\frac{9}{32}$in.
Diameter of wooden hub...............	$1\frac{3}{4}$in.
Distance between standards	$5\frac{1}{2}$in.
Total weight of wire in armature and field magnet........................	6lb.

TWO GEOMETRICAL PUZZLES.

Three Circles that Intersect at Right Angles.

TAKE three discs of equal size formed of some material easy to saw, and, with a saw of the same thickness as the discs, make incisions in the latter such as are shown in the engravings (Fig. 1). First, assemble discs 2 and 3 by placing the part B of 3 upon the B′ of 2. This gives two circles that intersect at right angles. Next, take disc 1 and place the part A of it upon the part A′ of 2, and the three discs will be in place. In order to separate them, it is necessary to take off the last disc that was put in place. But, as all the discs have the same appearance, it is difficult to do this. It can be effected only by trying all the combinations possible. After one of the discs has been removed, the separation of the two others is easy enough.

The Accommodating Plug.

Having three apertures, round, square, and triangular, of the same diameter (say 1in.) formed in wood, metal, or any other material, how shall we make one plug that shall be capable of passing into each of the apertures, so as to close it accu-

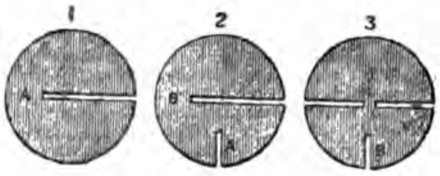


FIG. 1.

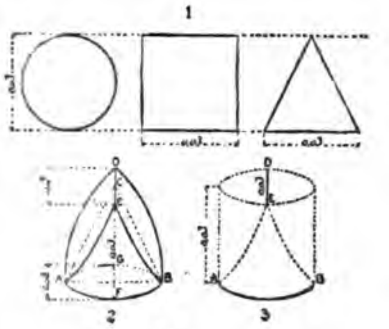


FIG. 2

rately? No. 2 (Fig. 2) shows the form to be given to the plug. It is obtained by making a cylinder 1in. in diameter and 1in. in length, and cutting off the dotted portions, A E D and B E D (No. 3). The round aperture will be closed by the circumference whose diameter is A B, the square one by the part D E F G, and the triangular one by the part A B C.—*La Nature.*

DR. RICHARDSON ON IDEAL FOOD.*

AT the Memorial Hall, Farringdon-street, E.C., on Friday evening, the 23rd ult., Dr. B. W. Richardson, F.R.S., delivered the fourth of the above series of six lectures, entitled "The Selection of Foods for Strength and for Work." The Ven. Archdeacon Farrar, D.D., was in the chair.

Dr. Richardson, F.R.S., in delivering his last lecture, dealt with the question of the supplies of food from the animal and vegetable worlds. He dwelt upon the qualities of food, and showed, with considerable care, how they played their part in the building up of the body. He further referred to the great sources of supply, and finished by giving an account of that derived specially from wheat, putting before them, as he intended to do again that evening, for a particular purpose, the very beautiful diagram of the wheat-corn prepared by Prof. George Henslow. They would pass to the ideal food in regard to strength and work; and here they would come upon a very important matter, both as regarded themselves and their individual homes, and with regard to the nation at large. They had to consider strength and work in reference to the body; and the first point to learn was the nature of strength. What was meant by strength and by work? For until they had obtained a fair knowledge of that, they could not understand the food question at all. In the first place, then, strength and work meant a certain measure of labour carried out by the body. By some individuals—those termed "strong"—a great amount of work might be performed; by others, called "weak," a smaller quantity; but it all amounted to the fact, with regard to the nature of work, that man and all animals living on the globe were struggling against the great influence which reigned over everything—the attraction of gravity, the earth drawing all things at all times to itself; and unless there was set up against it, to use very simple terms, a counter-influence to meet gravitation, work came to rest. They would see this illustrated in the spinning of a top, or the revolving of a wheel on which they could ride when going rapidly; here they were opposing this natural force of gravity. So, when a person said, "I feel faint," and began to fall, there was a reason for that. He was being drawn to the earth, by its attraction for himself. Weakness was merely the power of the earth declaring itself drawing the individual down to itself, and, if he died, they might practically say *into* itself; as against the power which was in him to resist the attraction.

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* From the *Vegetarian.*

That realised the meaning of weakness; and strength was the ability of man, from his own animal mechanism and physical powers generally, and the food which he took, to carry on that work—to oppose that constant force which was always telling upon him. Physiologists, when writing or descanting on strength or the work of the body, spoke of two kinds of work—one they called internal, and the other external work. It must be remembered by everyone that they had two kinds of work always going on in regard to life: internal and external. Internal work was that performed without their cognisance; in other words, it was that work which went on to keep the body living, independent of any act of their own. This internal work went on, whether they liked it or not, apart from themselves; and the amount of work which food had to supply for this purpose was considerable. He would not complicate these lectures by dwelling on a subject so difficult to explain; it would suffice for them to understand it in that elementary form. One illustration of this internal work was the work of the heart, in the circulation of the blood. Depicted on the screen before them was a very beautiful diagram, showing one part of the circulation, which came down to them from one of the old anatomists. In the centre was the heart; and then, passing off from that like the branches of a tree, was a series of elastic tubes or pipes, to all parts of the body. The lecturer then described the structure of the heart, and the passage of the blood through its several cavities into the arterial and venous system. The heart was always pulsating, always going on at a certain rate, and giving out a certain amount of work and power. To summarise, the work performed by the heart equalled 5,400ft. each hour, or 126 tons each day of 24 hours. These tons were foot-tons, and applied solely to that and the work they were going to consider later on. Wherever there was any measurement of work done by the body, it was calculated by the foot-ton, meaning that amount of energy expended in raising a ton weight one foot from the ground. It was really very remarkable that a little organ like the heart should be able to lift 126 tons in 24 hours. This action went on independent of themselves; it was very heavy work indeed, and had to be supplied by the food, or some portion of it. The breath was another form of internal work; as also the digestion—this latter a very important work, calling forth a great deal of power, both chemically and mechanically. There were other internal forms of work in the secretory and excretory processes of the body. It was external work, however, that principally concerned them that evening; the strength and the work which were visible, work which would come out of doing something that everybody could witness, as, for example, the turning of a crank, or the pulling or lifting of a weight, or the driving of a vehicle, or anything of that sort. This was external work, and was a cause of waste, requiring to be sustained and added to continually.

Passing now from the internal work, they came to that which they could see—external work—and would presently inquire what foods ministered thereto. They had in the external work of the body two classes of instruments of power to consider; first, the muscular system, and then the nervous system. The muscular was a very powerful mechanism for the propulsion of the body and the lifting of weights, and by its alternate contraction and expansion, it performed engine-like work. On the screen was depicted the muscles of the back of the leg. There they could see the outline of the leg and the large round piece of muscular flesh, ending in a strong band or tendon passing down to the lower part of the foot. That muscle was the engine which worked to produce the movement of the limb, and it consisted of a series of fibres of flesh in the form of bundles, and by the contraction and relaxation of those muscles they got motion. In the steam-engine they had seen the work produced by the action of the piston going backwards and forwards. In the higher-class animals motion was produced by the contraction of one muscle and then the contraction of a corresponding muscle which counterbalanced it, and thus one counteracted the other. In the front of the arm was a muscle called the biceps; make that contract, and the arm was drawn up. Another muscle at the back of the arm, termed the triceps, by its contraction pulled the limb back, and thus formed an opposing force to the biceps. When the muscle was bidden to contract, its parts came closer together, and became wider and therefore shorter. This, then, was the work of the muscle, and they wanted food to sustain that contraction and relaxation. They required food, first of all, to give the motive power by which the muscle should contract; but they wanted something more. In each of these acts of contraction and relaxation, a portion of the muscle had worn away, and that waste must be repaired. A portion of the food they took in stimulated the action of the muscle, and a portion also went to make up for waste; so that they really required two kinds of food—namely, one for the supply of the motive power, and the other for filling the place of that broken up in action, and which had passed away in the blood through the kidneys. And, last of all, they required here a certain amount of water. These muscles would not act unless supplied with water. If overcharged with water, they lost their power altogether. An animal charged with five times its own weight of water, lost its muscular power altogether, and became partly paralysed. But if water was removed from these very largely, the muscles became spasmodically affected and rigid. So in cholera, where a large quantity of water was thrown out of the body, these fibres became firm and rigid, and ceased to move; all the power was expended in contraction, and the muscle became hard and firm, like a solid substance. So for muscular action they required first a substance to excite contraction and relaxation, secondly something to build up the structure, and lastly water.

This muscular system must be acted upon: there must be something to tell it when to act; and that they had in the nervous system. There was in the body the brain and spinal cord and nervous cords. This was the directing centre, and it also must be fed and sustained. The precise seat of this motor power was as yet an open question. Whether the actual power—the motive power which enabled the body to move—lay in the muscles themselves or in the nervous centres he did not know—nobody knew. They knew that the muscular and nervous systems acted together; but whether the nervous system supplied force or only directed it was yet to be learned. Some supposed that the muscles were themselves charged, and that the nervous system held the same relation thereto as the cap did to the gun charged with powder, caused excitation and set the muscle in motion. Others, again, thought this force was contained in the nervous system itself. But that was a question yet to be solved. They knew that the muscle would not act unless it was receiving blood freely from the circulation, and unless it received an impetus or power, whatever it might be, from the nervous system. Divide the nervous system or cut the nerve off: the muscle began to contract for a little time and then sank into a firm rigidity—relaxation took place no longer. The lecturer here traced on the diagram the great nervous centres, their ramifications, and their relation to the muscular system. For health and strength these nervous centres required to be fed. They must be supplied with a certain amount of material when they are worn out, in some cases very rapidly, and there must be supply to fill up the empty space. Then, again, as to the force which passed from the nervous system to the muscles, whether it was primary or secondary force they could not understand, that also must be supplied. Therefore, they required three classes of food for the nervous system: foods that built up, foods that yielded motive power, and again also water.

Referring once more to the composition of food, they had water at the top; then came the jelly-like, albuminous, structure-building foods, to fill up the gaps in the muscles caused by their wasting during action. This, in animal flesh, they called fibrine; in wheat, gluten. Albumen, which was by some supposed to be the origin of them all, would be seen very clearly in white of egg; caseine was present in cheese, and some of the pulses; and, lastly, they had gelatine. Then, just as the steam-engine wanted fuel, so the body wanted food, which gave power or motive force. This they had in the gums, sugars, starches, oils, and fats. These were the substances which, when burnt in the body, produced heat, motion, force. Lastly, the body required saline foods, mainly to give solidity to the skeleton. He dwelt more particularly on that subject last week, and showed that the salines were phosphate of lime. They also required for the blood a metal, iron, with some other saline, mineral, crystalloid foods, so called because they assumed, in many cases, crystalline forms. All these foods were derived from their mother the earth; they were changed by plant life into new combinations, and afterwards passed into the animal world; and this was why one animal could live upon another.

It was found that the essential diet, whether taken at one meal or at several, whether derived from animal or vegetable substances, would require 75° water, 20° fuel food, 4° flesh-formers in a dry state, and 1° mineral matter. And the work that could be got out of such a diet in the course of a day would be nearly 150 foot-tons. To begin with the characteristics and quantities of food, he took, in the first place, milk. This they knew to be an animal secretion, the first food which Nature put before the mammalian class of animals in the early part of life. It contained, as they would see on the screen, 86° of water. In taking milk, it was, of course, assumed that no other drink was required, and in infancy this was seen to be the case. The child, when in a perfectly natural state, required nothing else to drink but milk. The proportion of fuel food was 9°; of flesh-formers, 4°; of mineral substance, 1°. Milk was not a high-class food for producing a great amount of work, because the quantity of water was so large and th fuel comparatively small, as were the flesh-forme also. It was sufficient, however, for the requir ments of infancy, the amount of external wor that could be got out of it amounting to 78 foo tons. They would take the potato next; and the saw it contained water, 75°; fuel in the form starch, 21°; flesh-formers, 3°; mineral, 1°; an the amount of work produced in the body was 1 foot-tons. The potato, when supplemented b some other food, as by the Irish with butter-mil made one of the most perfect meals that could b conceived. For very many years the Galwa farmers and their people were the most strong fed people in the world by this diet of butte milk and potatoes. Next came the prime c of English beef; and here was foun water, 50°; fuel, 30°; structure building, 15° mineral, 5°. The gravy of beef, that which flowe into the dish when the meat was cut, was very ric in the mineral constituents of food. The work t be derived from beef represented 177 foot-ton In eggs they had 73° water; 11° fuel, consistin largely of oil and fatty matter; of flesh-former albumen, they had a large quantity, 14°; mineral substances, 1·5°. The work to be derive was 283 foot-tons. In rice they had a good illu tration of a rich fuel food. Starch was not th strongest of fuel food. There was a food, a nu which consisted almost entirely of fat, and ther fore was a more valuable motor food than thi In rice there was very little water, only 15°; fue 77°; flesh-formers, 7·5°; and a very large amoun particularly in some varieties, of mineral, 5°. Th was a food largely lived upon, particularly in war climates, and it was found that rice, with som little flavouring and water to make up its deficienc was nearly sufficient of itself to meet all th actual requirements of a working man or woma It might well be made the basis of nearly all food and with little modification it might be made model food. For work it showed 466 foot-ton beating beef altogether in that respect. Mutto would compare worse still, and so with veal and a kinds of fish. Following rice came the haric bean, with water 14°; fuel, 58°; flesh-forme 23°; mineral 5°; power for work, 466 foot-tons. Th lecturer dwelt shortly on the valuable properti of the caseine in this bean, as reported in our la issue. Peas afforded another illustration of th class of foods: water, 14°; fuel food, 60°; fles forming caseine 22, and mineral 3. This was a extremely valuable food, and admitted of a immense deal of modification so as to bring it in general use. There were many who took objecti to the very singular flavour of pea-flour; and u doubtedly if the flavour from the pea could be manipulated in the laboratory that the essen whatever it might be, which gave this pecul flavour could be removed, and if it could be ma quite neutral in character, as they got flour fr corn, they would have from peas a wonderf store of food indeed—fuel high, flesh very goo mineral moderate, and the work got out of 468 foot-tons. And this, moreover, was one of the best home products, upon which they must dir their attention in future in regard to getting fo for the people. The next table showed a me sample of wheat flour. This had been their sta so far, and a very good one too. It was not t whole wheat flour. It contained a little less the flesh-forming substances and the minerals, a a little more starch, owing to the dressing of t grain; but it was a fair specimen, taking whe of all kinds, distributed over the country. It co tained water, 14°; fuel, 75°; flesh, 10°; miner 1°; work, 477 foot-tons.

Dr. Richardson then examined and described t structure and value of the wheat grain as shown the screen, for the benefit of those who were n present at his last lecture, a résumé of which w be found in our last issue. In oatmeal they had food of extreme importance. The quantity water was small, 5°; fuel, 73°; flesh foods, 2 mineral, 2°: work obtainable, 488 foot-tons, whi placed this article of diet above all the rest regarded the amount of work that could be got o of it, and which justified the canny Scotchman holding still closely to his oatmeal.

Each time he took up this matter for study, th more clearly he saw that the vegetarian world w crowded with a very great number of most impor ant facts, which must be utilised, and which real and truly, when properly and systematical brought out, stood for truth from the beginning the end of the chapter. The failure that h occurred in the introduction of the vegetari system to the world at large was consequent on th fact not being fully recognised. A great numb of important facts had been brought together a learned by practice, but nothing comparatively w done to methodise them, and therefore they we not studied as they should be. He further thou there had been a mistake in calling it "Vegetarian" system, because vegetable play insignificant part in their dietary. Fresh tables might contain from 85° to 92° of water from this fact undoubtedly the most erroneo pressions had gone abroad with regard to their value. Novices, again, in commencing the system would sometimes measure their wants by the proportion of animal food they had formerly taken, and thus would consume an amount of haricot beans, peas, or oatmeal far in excess of their requirements, and which they were quite incapable of digesting, the result being they were almost paralysed by the amount of food taken, the evil effects of which were attributed to the system instead of to their own lack of knowledge.

The Ven. Archdeacon Farrar said he believed it was his duty as chairman to move a vote of thanks to the lecturer for the discourse he had just given. It was a subject of which he had no independent knowledge; but, like the rest of those present, he hoped he was quite capable of admiring the manner, the scientific spirit, and the large research which had gone to produce a lecture like that. He was not personally a vegetarian, although he had, he thought, learned some lessons from that body; but his position towards the vegetarian movement was one of perfect candour and perfect sympathy. He was a candid inquirer, because he approached the subject without the least particle of prejudice; and he was a sympathetic inquirer for many reasons. Undoubtedly, in beginning the vegetarian course, a certain amount of self-sacrifice was, he supposed, required, and to his mind there was nothing more beautiful in anyone than the spirit of sacrifice. After a brief but eloquent address he accordingly moved a vote of thanks to the lecturer, which was duly seconded and responded to.

SCIENTIFIC SOCIETIES.

ASTRONOMICAL SOCIETY OF FRANCE.

THE March meeting was held on the 7th, M. Flammarion, President, in the chair.

M. Valderrama, of Madrid, sent an observation of a sunspot with white spots in its interior, drawn on Jan. 15th. M. Schmoll showed a drawing of the same spot on Jan. 14th; the two drawings are remarkably similar. M. Trouvelot thinks the appearance is caused by a bridge crossing the spot, sufficiently thin in some parts to escape detection.

M. Bruguière has observed the Zodiacal light on March 7th at 7 o'clock in the evening at Marseilles. Its base was about 45° broad, its height about 10° or 12°. The phenomenon was very luminous and colourless.

M. G. Giovannozzi has observed the Zodiacal light at Florence on Feb. 7th. The cone of light reached the Pleiades, and was more luminous than the Milky Way.

M. Gourdet sent a note on 66 Ceti; M. Guiot an observation of Mira Ceti and ν Leporis.

M. Dumenil, at Yebleron (Seine Inférieure) has observed a meteor whose trace remained visible from five to six minutes of Feb. 19th at 6h. 40m. a.m. M. Mabire observed a remarkable meteor at at Paris on Feb. 24th at 7 p.m. Its course, starting from Orion's belt, was from east to west.

M. de la Fresnaye sent a plan of binocular telescope with two object-glasses and two oculars receiving the light by total-reflection prisms, so as to bring the oculars sufficiently near together for the use of both eyes.

M. Armelin writes that the Calendar Reform is entering a new phase. He has been asked several lectures on the subject.

The president read a letter of M. Holmes published in the ENGLISH MECHANIC. The meeting thanks M. Holmes for the sympathetic feelings which he has expressed towards the society. M. Holmes's observation of the *comes* to Polaris with a telescope of 1½in. aperture is thought remarkable.

M. Flammarion read a paper on the relations which may exist between the movements of our sun and those of the nearest star, α Centauri.

General Parmentier read a paper on the "Distribution of the Asteroids." The new planets discovered have not filled up the gaps upon which General Parmentier called attention formerly.

Various communications:—On the Lunar Eclipse of Jan. 28th, by M. Moussette; a drawing of Plato, by M. Schmoll; observations on the Aurora Borealis, by M. Trouvelot; on a natural classification of double and multiple stars, by M. Flammarion; "Vogel's Chart of Stellar Spectra," presented by M. Secrétan.

THE following statement appears in the high-priced professional serials without comment:—"According to Prof. Stuart, earthenware may be perforated by using, instead of a drill, a soft copper rod or pipe fed with a mixture of emery powder and linseed oil. The emery is embedded in the copper by the friction, and cuts through the hardest material in a very short time." If Prof. Stuart ever made such a statement, he no doubt also said that his grandfather told him.

SCIENTIFIC NEWS.

WE are already in the month of April, and only comet A, 1888, has been discovered, and even that is gradually fading. Those who are interested may like to know that on April 9 its position for Berlin midnight is R.A. 22h. 32m. 55s.; N. Dec. 13° 31·7′, and its brightness not much more than half what it was when discovered on Feb. 18.

The death is announced of the Rev. Charles William King, M.A., the Senior Fellow of Trinity College, Cambridge, which he entered more than fifty years ago. Mr. King devoted himself to the study of antiquities, especially antique gems, and his cabinet is described as the most valuable possessed by any one in Great Britain. In 1860 he published the result of years of study in his "Antique Gems, their Origin, Uses, and Value," and his edition of Horace, illustrated from antique gems, is treasured by scholars. Mr. King also published two works on the natural history of gems, but he is chiefly notable from the fact that he was throughout life a student.

Amongst the lectures announced for the "after-Easter" session of the Royal Institution we notice three on "The Plant in the War of Nature," by Mr. Walter Gardiner; six by Prof. Dewar on "The Chemical Arts"; three by Prof. Bonney on "The Growth and Sculpture of the Alps"; while the Friday evening meetings will be devoted to discourses by Prof. Flower on "The Pygmy Races of Men"; by Sir W. Grove on "Antagonism"; by Mr. J. Wimshurst on "Electrical Influence Machines"; by Prof. Laughton on "The Invincible Armada"; by Mr. Barlow on "The New Tay Bridge"; by Mr. F. Galton on "Personal Identification and Description"; and by Prof. Ewing on "Earthquakes, and How to Measure Them." Prof. Dewar will also deliver a discourse.

During the summer a new branch of the London Geological Field Class will study the chalk formation around London under the direction of Prof. H. G. Seeley, F.R.S. Particulars can be obtained from Messrs. Philip and Son, 32, Fleet-street. The other branch will continue its investigations of the general geological features of the London district, which, it need scarcely be said, now covers a very large area.

At the annual general meeting of the Chemical Society, the president, Mr. Crookes, F.R.S., delivered an address on the Elements and Meta-elements, and subsequently presented the medal founded by Dr. Longstaff to Dr. W. H. Perkin, F.R.S., for his interesting and important researches on the magnetic rotary polarisation of compounds in relation to their chemical constitution.

The *Times* recently stated, referring to the snowstorms in America, that "for some reason or other, snow does not replenish the springs like its equivalent amount of rain"—a statement which anyone capable of thinking knows to be incorrect. However, Mr. E. Hull, F.R.S., has been allowed to set the "misleading journal" right, which he does by pointing out that "in the first place, snow remains for a longer period on the ground than rain. During this period, in consequence of the warmth of the ground, the snow generally is in a melting condition in contact with the surface of the ground, and the process of percolation goes on slowly but steadily, while the snow remains. In this manner the water finds its way down the fissures and planes of lamination and jointage—which ultimately lead down to the underground reservoirs. In the second place, owing to the low temperature of the air, evaporation is slow, and little of the moisture which falls in the form of snow is carried away as is the case when the temperature is high. These general remarks will, perhaps, suffice to show that snow is the very best agent for supplying the underground reservoirs of water, which have been reduced to an extraordinary low condition by the deficiency of rainfall during the past year; and if this be so, we may look forward with some confidence to the replenishment of our springs to a large extent after the snow has disappeared, and thus the threatened drought will be averted, or, at least, materially mitigated." The matter is, perhaps, scarcely worth the space devoted to it; but it serves as an example of the ignorance of rudimentary facts which now appears to permeate modern journalism. And these very journals assume to be teachers!

The *Athenæum* says:—"With an average of fifteen deaths a year, the Royal Society have lost since their last anniversary (a space of less than four months) no fewer than ten Fellows, besides two foreign members. These were nearly all over sixty years of age, and seven out of the twelve gave an average of seventy-nine years. A fact like this testifies strongly to the trying character of the past, or, rather present, winter. The patriarch of the Society is still, we believe, the venerable Sir John Davis, who was elected to the Fellowship in 1822, and next to him stands the Duke of Devonshire, elected in 1829. Of the foreign members, M. Michel Chevreul has been longest on the list, having been elected in 1826.

The Norwegian Greenland Expedition, under Mr. Nansen, will leave Copenhagen on the 5th of May, per steamer, for Issafiord, in Iceland, where the party will embark on the Norwegian sealer the *Jasen*. In this vessel, which will be under the command of Captain Jacobson, an old Arctic skipper, Mr. Nansen and his colleagues will be conveyed to the coast of Greenland. The party will cross Greenland on snow shoes, but food and baggage will probably be conveyed in reindeer sleighs. Mr. Nansen is curator of the Bergen Museum and champion snow-shoe walker of Norway.

On April 9, at the Society of Arts, Mr. Bannister commences a course of lectures on "Milk Supply and Butter and Cheese-making," which, if widely circulated when printed, may do something to wake up our farmers to the necessity for availing themselves of the opportunities for earning money which await their attention. The first lecture, on Monday evening, April 9, will be devoted to the consideration of our milk supply, in which methods of milk examination in the dairy, the depot, and the laboratory will be described. The second lecture, on April 16, will deal with our butter supply, and the different ways of making up butter for market, the improvement in English methods being pointed out; butter substitutes, margarine (butterine), and the legislation on the subject will also be dealt with. The third lecture, on April 23, will be devoted to our cheese supply, in which home-made cheese, Cheddar, Gloucester, Cheshire, Derbyshire, North Wilts, and Stilton, and foreign-made cheese, American, Dutch, and fancy cheese, Gruyère, Gorgonzola, Roquefort, will all be described.

At a recent meeting of the Chemical Society Mr. T. Cuthbert Day communicated a paper describing a new method of estimating nitrites, either alone or in presence of nitrates and chlorides. The method consists in saturating the solution containing the nitrite with solid ammonium chloride, boiling the mixture in a suitable apparatus, after removal of the air by carbonic anhydride, and collecting and measuring the nitrogen evolved; interaction takes place according to the equation $NO_2K+NH_4Cl=KCl+2OH_2+N_2$; hence the quantity of nitrite present in the substance under analysis is calculated from half the volume of nitrogen obtained.

Another application of electricity—this time to the familiar method of breaking glass tubes into lengths. The fine wire is placed round the tube, a current passed through sufficient to make the wire red hot, and then a drop of water is applied, which causes a clean breakage. Rather a roundabout way of doing a very simple thing; but some of the electrical papers evidently think it a great discovery.

Mr. Hugo Blanck, of Pittsburg, Pennsylvania, says that the "passing of an electric current through water kills all the germs of disease that are in it." No doubt it does—if it is strong enough. Naturally the paragraph in which we find this intelligent news goes on to say that an enterprising capitalist proposes to supply Pittsburg with water made pure by electrical means.

The River Severn has just been enriched by a consignment of 20,000 yearling salmon. This was the result of fish-cultural operations undertaken by the Severn Fishery Board, at the instigation of Mr. J. W. Willis-Bund, last year when a large quantity of ova was taken from fish in that river, and incubated in the hatchery of the Board. They have since been reared by Mr. William Burgess, in his ponds at the Midland Counties Fish-Culture Establishment, Malvern Wells, at his own cost. To prove the great success attained it may be stated that upon examination it was found that there was but a slight decadence in the number of fish originally planted in their fry stage. The fish were transferred by Mr. Burgess, from his establishment, in special carriers made with the object of preventing injury to fish through excessive turbulence of the water during transit. On arrival at Worcester, where they were turned in, only about four fish had succumbed on the journey. Mr. Burgess is about to make a grant of trout to the Fleet Ponds at Aldershot.

A committee of "experts" is, it is said, sitting at St. Petersburg to determine the momentous question as to which system of burning liquid fuel should receive a gold medal. If they are "experts" they should be able to invent conjointly a perfectly safe and economical method of burning liquid fuel in locomotives (for that is the real subject-matter), and so might award the gold medal to themselves. As a matter of fact, liquid fuel has been employed for years in a factory not far from St. Paul's; but it is well known that, unless it happens to be refuse with practically no appreciable selling value, coal is much cheaper.

At a recent meeting of the Physical Society of Berlin, Dr. Gumlich referred to Newton's rings as seen by transmitted light, as he had verified the formulæ given many years ago by Prof. Wangerin for the rings when viewed by reflected light. When the light is incident at right angles, the rings are circles lying in one plane; when the angle of incidence is less than a right angle, the rings lie on a surface of extremely complicated shape, which is characterised by a primary ordinate, and an oblique ordinate at right angles to the former, which do not coincide at the point of intersection. By means of an apparatus which Dr. Gumlich showed and carefully described, he had experimentally tested the accuracy of his calculations, and found them fully confirmed. When the light is incident obliquely, the rings are no longer circles, as they are when it falls on to and passes through the medium at right angles, but are then ellipses whose axes bear a ratio to each other which is dependent on the angle of incidence of the light. It was not found possible to obtain any definite results as regards the width of the rings, since this is very largely affected by temperature.

It is proposed to establish a "technical and art school" at the East End for teaching wood-carving, turning, metal working, leather stamping, glass painting, and so on. It may be as well to point out that the teaching of any craft is not technical, but technological, education, and that little good will be done by supplanting the ordinary training of the workshop by special training in "schools." It is technical education that is wanted, not "training" in trades. Principles should be taught, not details.

A Submerged Forest.—During the late violent storms in the Channel the sea washed through a high and hard sandbank near St. Malo, nearly four metres thick, laying bare a portion of an ancient forest which was already passing into the condition of coal. This forest at the beginning of our era covered an extensive tract of the coast, but with the sinking of the land it became submerged and covered up by the drifting sand. Mont Saint Michel once stood in the middle of it. The forest had quite disappeared by the middle of the [illegible] century. Occasionally, at very low tides after storms, remains of it are disclosed, just as at present. It is believed that some centuries ago the highest tides rose about [illegible] metres above the level of the lowest ebb. Now the high water level is [illegible] metres above the lowest.

The United States Making a Big Gun.—A Pittsburg despatch says:—"The steel cast gun has been taken from the annealing furnace at the Pittsburg Steel Casting Company's works, and is said to be perfect. Superintendent Hainsworth stated that if the gun is a success, he will [illegible] to make a cast steel gun of the same [illegible] and of a better quality than the great English 111-ton gun for [illegible]dols. The cost of the English gun was 225,000dols.

LETTERS TO THE EDITOR.

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[We do not hold ourselves responsible for the opinions of our correspondents. The editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, *332, Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

*** *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

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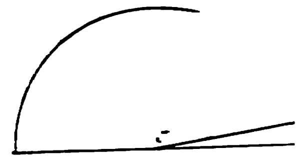
ADMISSION TO THE FELLOWSHIP OF THE LEARNED SOCIETIES—ILLUMINATION OF THE ECLIPSED MOON BY THE CORONA?—COMETS, FLOODS, AND GRAVELS—PARALLAX OF THE SUN AND MOON—POSITION OF THE SUN—TELESCOPE—NORTH POINT ON MAPS—TRANSIT OF THE FIRST POINT OF ARIES ON MARCH 21—QUADRANT VERNIER—VELOCITY OF THE EARTH IN HER ORBIT.

[28581.]—THE Liverpool Astronomical Society will, I think, do well to adopt the very excellent suggestion made by Mr. Woulfe Brenan at their last meeting, as reported on p. 77. I have often thought that some sort of competitive examination should be made a *sine quâ non* for admission to every one of the learned societies. I know that, as far as the Royal Astronomical Society is concerned, we have advertising tradesmen and puffing schoolmasters in it who could not off-hand tell the difference between Precession and North Polar Distance; and with whom aberration and anomaly are practically convertible terms. The fact is that, as matters stand at present, if nothing is known *against* a man who is put up for the Fellowship of a learned society, he is sure to be elected. This should not be.

I am, unfortunately, unable to reply to the request preferred by Mr. Jones, in the concluding paragraph of letter 28530, on p. 79, as I cannot lay my hand upon Wolf's tables at this moment anywhere. If my memory serves me, however, the theory of a certain school is that the more extensive corona is developed at the epoch of minima of sunspots, and the smaller corona at that of a maximum. Now 1884 was a year of sunspot maximum, and the present year we may regard as one of minimum. Since writing letter 28469 (p. 31), however, I have considered the matter more carefully, and have arrived at precisely the same conclusion as Mr. Maunder has done (letter 28529, p. 79). Hence I should regard it as a needless waste of time to investigate any imaginary coincidence in detail.

May I venture to point out to Mr. Godden (letter 28533, p. 80) that the fact of my inability to prove that such a thing as a watery comet never did exist, by no means whatever establishes as a fact that it did? Suppose that I chose to assert that the inhabitants of Venus eat pork sausages on Mondays, Wednesdays, and Fridays, and defy him to prove that they do not, would he admit, from his utter incompetence to furnish such proof, that I had shown that the denizens of the Planet of Love were nourished in the manner alleged? Our sole means of determining the chemical constitution of comets is afforded by the spectroscope, by the aid of which hydrogen, the hydrocarbons, iron, chlorine, and sodium have been detected in the spectra of these mysterious bodies, but assuredly no lines traceable to water. Passing, now, to the alluvial gravel of which your correspondent speaks, this is ages older than the alleged time of the Noachian flood, even on the violent assumption that that cataclysm ever reached within thousands of miles of where London now stands. Moreover if, as Mr. Godden alleges, the London clay was pierced at [illegible] and the gravel found subjacent, this settles the entire question at once and for ever, inasmuch as the London clay is of Middle Eocene date. Did it ever strike Mr. G. that [illegible] is all that is needed for the mightiest deposits? As to the oscillation in level of the Lincolnshire coast, it may well be that one part is sinking and another rising. The level of the sea is unalterable; the land sinks; it is not the sea that rises.

In reply to query [illegible] the method of reducing the equatorial horizontal parallax of either the sun or moon is a matter of the most absolutely elementary trigonometry, for in the subjoined figure, let S be the sun, and E Q the earth's [illegible] S this radius [illegible] angle E S Q [illegible] cut, of 8·9", and [illegible]



angle E S Q is the [illegible] sin. 8·9" : 3963 8 : : 1 : [illegible] have only to divide [illegible] to get the sun's distance from the [illegible]

[illegible]

91,852,72[illegible] miles, log [illegible]

In the case of the moon the [illegible] stand thus: Calling her [illegible] parallax 57' 2[illegible], we say—

[illegible]

238,852[illegible] miles, log [illegible]

I am a little afraid that [illegible] expressive phrase [illegible] ging" Mr. May [illegible] He enters the sign Pisces [illegible] Aquarius) about the [illegible] year. He takes a [illegible] enters Aries about March [illegible]

In connection with [illegible] only regret that I am [illegible] understanding the theory [illegible] now than I (if possible [illegible]

"J. R." (query [illegible] tical lines at the [illegible] South ones, and the [illegible] bottom of it as East and West [illegible] his compass has a fixed [illegible] needle playing over them [illegible] England at present [illegible] South lines of the divided [illegible] 0° and 180° coincide with [illegible] map, and then turn map and [illegible] needle points 18° west of North [illegible] meridian, by the way, if drawn [illegible] accurate result.

If "Inquirer" (query [illegible] back a page on the [illegible] that the intersection of the Equator [illegible] Ecliptic (technically known as the First [illegible] Aries), will cross the meridian [illegible] on March 20 and the same [illegible] The sidereal day is 23h. [illegible] time long.—or that interval [illegible] ordinary mean, time clock elapses [illegible] transit of any star and the next [illegible] solar day is 3m. 55·91s. longer than [illegible] day, and when the right ascension of [illegible] approximately 0h. 0h. 0s. it will be [illegible] that a star (and for our present purpose [illegible] Point of Aries may be regarded as a [illegible] come twice to the meridian between two [illegible] noons. As a matter of course, "Inquirer [illegible] that the astronomical day of the [illegible] *Almanac* begins at noon: so that [illegible] what in civil life we should call [illegible] January 1st would be astronomically [illegible] December 31st, 23h.

I cannot help thinking that "Ignoramus [illegible] 64908, p. 113) is mistaken about the divi[illegible] vernier of his quadrant. Is he quite sure [illegible] not 19 of his 20' divisions on the limb, whi[illegible] the 20 divisions of the vernier in length [illegible] because this is how such quadrants are [illegible] divided. If this is so, his vernier reads [illegible] minutes of arc.

The velocity of the earth in its orbit (f[illegible] "Esne Caralita" asks in query 64937, ca[illegible] may be taken to be 17·78 miles per seco[illegible] in aphelion, and 19·02 miles per second [illegible] perihelion.

A Fellow of the Royal Astronomical [illegible]

SATURN, RING C—SELENOGRAP[illegible] TO "JASON."

[28582.]—DR. TERBY (letter 28513), [illegible]mendable caution, considers that some of [illegible] markable appearances recorded of late by [illegible] observers in connection with the dusky rin[illegible] confirmation by large telescopes before [illegible] be accepted as having a real objective [illegible] In this view I, for one, most cordially a[illegible] him, and trust that his communication [illegible] the much-to-be-desired effect of bringing [illegible] these giant instruments to bear upon [illegible] before the ring system becomes less [illegible] presented. I think, however, even [illegible] ppeal to the higher powers, a very strong case may made out to support the contention that the nomalous aspect of C is no figment of the imagi- ation or optical delusion. As regards my own bservations last year, I may say that up to the nonth of February I had always seen and regarded he dusky ring as uniform in tone and as regular in orm as it is shown in Bond's great monograph, so hat when dark areas were suspected on its sur- ace they were at first considered to be merely ima- inary. On reobserving them with greater dis- inctness on 21st February, the adjustment of the nirror was examined; but this was found perfectly atisfactory. On following nights not only were he dark spots again seen, but the inner edge of C ras clearly indented. Four eyepieces, magnifying rom 284 to 480, were tried, with the result that hese features were visible with all, and never so rell as "*dans les moments fugitifs de calme irré- rochable de l'image.*" From the latter end of ebruary to April 20, every suitable night con- rmed the earlier observations, as I have recorded lsewhere; and this year, though the opportuni- ies for observing have been much curtailed by ad weather, on the few good nights which have een available very similar anomalous appearances ave been recorded, not only by myself, but by thers. At the close of the season I hope to be ble to show, by a comparison of the records, that e reality of the phenomena is in the highest egree probable.

In reply to "Jason" (letter 28531), with the ditor's permission, I shall be glad to send a etch of the Leibnitz Mts. when time and weather rmit. **Thos. Gwyn Elger.**

Kempston, Beds., April 2.

ISIBILITY OF THE ECLIPSED MOON.

[28583.]—OBSERVING that a suggestion of mine the possible agency of the solar corona in pro- ing variations in the visibility of the moon ring total eclipses has been the subject of com- t in your journal, I ask leave to state my views. y suggestion was first published after the eclipse of ober, 1884, and as I had seen no criticism upon I reproduced it in a published account of the e eclipse. In doing so I was influenced rather an impression of the unsatisfactory character of explanations commonly given than by any confidence of my own.

part from self-luminosity, due to previous osure to the sun's rays (a cause not perhaps te unworthy of consideration), there would to be but two possible sources of the light which mines the moon during total eclipse—namely the outer portion of the sun's disc (with which be included the inner bright portion of the ona), and (2) the outer fainter portion of the ona; the rays from the first source reaching the on by refraction through the earth's atmosphere, without doubt undergoing loss in transmission; rays from the second source reaching the moon ly and without loss. There can be no ques- that light in more or less quantity is shed the moon from both these sources; neither there be any question that one of them at is subject to great variation—to such varia- in fact, as to account for the moon being ible in some eclipses, and a conspicuous object hers. If this variation is to be sought in the cted rays from the solar disc and contiguous na, it must, I suppose, be mainly due to the ying transparency of the refracting medium. the other hand, the variation is in the outer al light, it may be due to changes in the na itself. Which of these two suppositions is least improbable?

ith regard to the corona, observations are not ps sufficiently numerous or complete to y a positive statement that the corona does in its intrinsic brightness. The variations ved may possibly be explained by variations atmospheric conditions or in the methods servation; but at least it may be said that is nothing improbable in the idea that such ges are real. On the other hand, the diffi- in supposing an entire ring of the earth's phere to be subject to such great variations problem requires are, to my mind, insur- table.

ay refer here to a curious discrepancy which to have escaped notice in the views of those agree in referring the variations in the moon's lity to variations in the condition of the 's atmosphere. According to some, it is a ted condition of the air, which, trans- specially the red rays, renders the moon ally visible at the same time that it gives coppery tint. According to others, it is this same saturated condition which so reduces n's light as to render the moon invisible. latter view, although not, I believe, the rite one, is certainly more in accordance the other with some observed facts to be ned immediately.

xposition of the first-named view, which is, ve, generally adopted, I quote the following words from an article published in the *Times* newspaper in anticipation of the eclipse of October, 1884:—"If the part of the terrestrial atmosphere through which the solar rays pass be tolerably free from vapour, the red rays are almost entirely absorbed, leaving the blue rays, which give too feeble an illumination to render the moon visible; while, on the other hand, if the atmosphere be highly saturated, the blue rays are more effectually absorbed, and the red rays transmitted to the moon, thus rendering it visible." That is to say, a humid atmosphere, transmitting the red rays, increases illumination; a dry atmosphere, absorbing the red rays, reduces illumination. But this, I submit, is exactly contrary to what we habitually observe. When the sun sets with a red disc, its light, instead of being increased, is so much reduced that we can gaze at it without discomfort. The same thing occurs when the sun is seen like a red ball through a fog. In certain states of the atmosphere the sun, even at setting, shows no redness, and then it is too bright to look at even when the greater part of its orb has dipped beneath the horizon. Indeed, I believe the law to be universal, that whatever state of atmosphere reddens the sun also reduces its brightness. But in truth the question of the moon's visibility in eclipse is not a question of colour: it is a question of brightness only. I doubt if there is any evidence that the colour, so far as it can be separated from the brightness, differs materially in different eclipses.

Sir John Herschel adopted an explanation differing from both of those just referred to. He supposed that the unusual obscuration of the moon in certain eclipses was due to an unusual prevalence of *cloud* in the great circle of the atmosphere through which the sun's rays would have to pass. It cannot be objected to this view that it is at variance with observed facts, for we know that clouds will intercept the sun's rays. But it is open to the same objection that applies to every theory which seeks to explain the variation in the moon's visibility by variations in the condition of the earth's atmosphere. For my own part, I find it exceedingly difficult to believe that a tract of atmosphere twenty-four thousand miles in length, and many hundreds of miles in breadth (from the changing longitude of the atmospheric ring as the earth rotates) can present any considerable variations in its aggregate or average condition at any two epochs.

The same line of argument may, I think, be fairly carried a step further. It seems to me important to note that, so far as our knowledge goes, the character of a lunar eclipse is persistent throughout its duration. The light eclipses are light from first to last; the dark eclipses are dark from first to last. Unless, therefore, we suppose a number of remarkable coincidences, we must believe that the particular condition which determines the lightness or the darkness of an eclipse is persistent through a length of time much exceeding the duration of the eclipse. If we suppose this condition to persist for twelve hours, and to be seated in the earth's atmosphere, it must be a condition involving by far the greater part of the atmosphere. To suppose that the atmosphere over, say, three-fourths of the globe can be greatly more humid or greatly more cloudy at one time than at another, would be manifestly unreasonable.

It might help the inquiry if some physical astronomer would tell us, as the result of calculation, what proportion of the sun's disc should be visible by refraction to an observer in the moon centrally placed in the line of the earth and sun? or, in other words, what proportion of the sun's apparent diameter would be included in the annulus of solar light which would to an observer so placed encircle the dark body of the earth? If it should appear that it is only a narrow margin of the sun's disc from which rays can reach the moon, then, considering the loss of light sustained in traversing a double length of terrestrial atmospheres, it may not appear extravagant to regard the coronal light as possibly the principal illuminant of the moon during total eclipse.

The coppery hue of the eclipsed moon is no doubt in harmony with the view usually held, and it is evident that the white corona cannot be answerable for that. But may we not suppose the surface of the moon to be intrinsically of a coppery tint, the colour being extinguished under ordinary circumstances by the intensity of the illumination, and only appearing when the illumination is much reduced by an eclipse, or when the dark part of the young or old moon is feebly illuminated by earth-light.

In the foregoing remarks I have taken no account of the spectroscopic evidence, partly because this evidence is, at present, ambiguous; and partly because I have some doubt whether, from the nature of the case, it can ever be conclusive. We know by theory that both the solar light and the coronal light must fall upon the moon, and it is difficult to see what more the spectroscope can tell us.

George F. Burder, M.D.

Clifton, April 2.

"ASTRONOMY FOR AMATEURS."

[28584.]—IN connection with your review of Oliver's "Astronomy for Amateurs," in No. 1,201, pp. 93, 94, I shall be glad if you will kindly correct a misstatement, caused by the accidental omission of my initials at the end of the article on the "Moon" in this book. Whatever credit, or discredit, it may deserve is due to me alone as author. The map was also prepared by me.

Thos. Gwyn Elger.

Kempston, Beds, April 2.

THE GLACIAL PERIOD AND THE MOON'S WATER.

[28585.]—W. POTTER (letter 28535) asks, Is it proved beyond a doubt that the asperities and inequalities we see on the moon's surface are the results of volcanic action? Such a force would unquestionably be sufficient to cause these appearances, and it is the only one with which we are acquainted that could do so. We, therefore, accept it till some more probable cause can be adduced. The statement that these apparent craters may be nothing more than masses of ice, is not worth a moment's consideration, when we consider the absolute permanency of their appearance, which could not be the case if they were ice, as the moon must necessarily be exposed to a very high temperature for several days when she is near the Full.

Your correspondent dwells on the intensity of the cold on the moon's surface; but that is only during the half of her orbit from last quarter to first quarter. His idea of the moon's attraction drawing off some of the water from the earth is preposterous; he asks, Is it not quite possible? Certainly not. For the sun himself, if placed as near as the moon, could not rob the earth of any of its water. In referring to the reciprocal attraction of the earth and moon, he says it might more sensibly be considered as one pulling against the other. I beg to inform him that it is not a case of one pulling against the other, for they actually pull towards one another, the effect of which is that they are forced to move around the centre of gravity of both, which is situated about three thousand miles from the earth's surface. Again, he thinks that the increase in the earth's mass caused by the fall of aërolites (which is indubitable) must be, or probably is, counterbalanced by the abstraction of an equivalent weight of water by the moon: otherwise, he says, the earth could not "keep its position" in space. I presume he means that it could not pursue its regular orbit around the sun. Now to entertain such an hypothesis, he must be unacquainted with even the elementary laws of gravitation which regulate planetary motion. Now if a mass of matter equal to the moon herself fell on the earth, it would not alter in the least the course of her journey round the sun, nor the period in which she would accomplish it, for it is a matter of certainty that any increment in her mass which would increase the centripetal force, would also in a corresponding degree increase the centrifugal balancing force. Again, your correspondent says there is plenty of evidence that more water had been on the earth. I doubt that there is, and if it were true, there is a more probable and sensible way of accounting for its disappearance than by supposing that it flew off to the moon—viz., that the earth has drawn it into its interior. An acquaintance with physical laws would also teach him that if ice existed on the moon there must be an atmosphere there of, at any rate, the vapour of water. Certainly, during the epoch of volcanic activity we must suppose she was surrounded by a gaseous envelope, the product of the intense heat and chemical action which caused these tremendous eruptions; but it is not necessary to suppose that the moon is still surrounded by that atmosphere, for it may, as in the case of any water that may have been on her surface in past ages have been sucked into her interior.

Ilford. **E. T. C.**

SPARROW-SWALLOWING FROGS.

[28586.]—"EOS'S" instructive anecdotes of natural history remind me of one which might be of interest to your readers. I was stationed at Hazareebagh, in Bengal, at the time. It was during the rainy season, when returning home one morning I heard a sparrow uttering shrill cries of distress. The sound came from a patch of grass in the corner of my compound, which is the name given to the plot of ground which surrounds a bungalow in India. I hurried to the spot, but no sparrow was to be seen. I carefully eyed the grass from the moment I heard the cry, so that I was convinced that the bird had not flown away. The only creature that I saw in that patch of grass was a large bull frog, which I passed several times in my hunt for the sparrow. At last, despairing of satisfactorily accounting for the noise, I was about to go to my house, when I thought I would stir up my friend the frog. What was my surprise when I saw the tail and feet of the sparrow sticking out of its mouth! The cause of the poor sparrow's distress was now accounted for. I took up the frog and put it in the verandah, with a morah (which is a kind of cane stool) over it, and during the rest of the day it was an object of curiosity to several of my friends. By the evening the tail had almost disappeared, and it had quite done so by next morning, when I released froggy. What bounds he took across the walks and garden to his damp haunt at the far corner of the compound!—quite 16ft. or 18ft. at a leap.

Ubique.

CURIOUS ALLOYS.

[28587.]—IN reply to Mr. S. Bottone, I must state that I have no practical acquaintance with the alloy of platinum and gold, of which its remarkable property as regards solubility was described to the students at the Calcutta Laboratory nearly 50 years ago. I add a few more interesting alloys from the same source.

Compounds of Antimony.—One part of antimony to 1,000 parts of gold renders the latter metal as brittle as glass. Seventy parts of antimony fused with 35 of iron produces an alloy giving off abundance of sparks when filed. A mixture of antimony and potassium properly prepared is so inflammable that it ignites gunpowder under water, and has such an attraction for oxygen that it may be substituted for potassium in many experiments. To the late distinguished Serullas we are indebted for many simple processes for the preparation of these alloys.

When metallic antimony in powder is mixed with an equal weight of incinerated cream of tartar, and heated strongly, a fused alloy of antimony and potassium is formed. This resembles antimony in appearance, but instantaneously decomposes water, generating hydrogen gas. It takes fire when touched by moistened paper.

If 75 parts of incinerated cream of tartar, 100 of antimony, and 12 of lampblack be heated to redness in a close crucible and allowed to cool, the resulting alloy spontaneously inflames on opening the crucible, and with such violence that the compound is projected in a ball of fire like a rocket. Thirty parts of tartar emetic and one of lampblack, heated together to redness in a glass tube and the tube sealed, form a powerful mixture of this description.

Bismuth.—This metal has the property of giving extreme fusibility to soft solders (those of tin and lead, I mean). Two parts of bismuth, one of lead, and one of tin form a compound so fusible that it melts below the boiling point of water. When I was a boy magic teaspoons were sold wherewith we perplexed our female relatives. On using one of these the lady found naught but the handle left in her fingers!

Eos.

LAWS OF MOTION—FRICTION—LAMPS.

[28588.]—ABOUT three years ago, in order to illustrate a discussion then pending in the pages of the *Engineer*, I made a little apparatus much like that extracted from the *Scientific American*. Mine was mounted on rollers (a good exercise for the pole lathe!); but as the third law only was in question, the ingenious arrangement of marbles was not required, the sliding piece being replaced by a lead roller with a thin axle, on which the rubber bands were looped.

The apparatus exhibits most beautifully the great principle that no action between a group of bodies can affect the position of their common centre of gravity. I flattered myself before I made this apparatus that I had a fairly clear apprehension of the law; but it was fog compared to what I saw when the foolish-looking toy was in action. Most heartily do I recommend all who puzzle over laws of motion and matter, or in any way regard such things, to make it for themselves. Mr. Potter, I am sure, would find it throw light even on the moon. Before the toy had lost the first fresh charm of novelty, he would ask himself, What will happen to the earth's water when it reaches the moon, will not the far greater pull of the earth fetch it back again? But perhaps I rate the thing over-highly. Let me suggest two variant forms. For the hole through which the marble drops, substitute a transverse stop; put the slide on rollers, and fire the thread (I find sharp scissors as good as fire for any ordinary use). When the marble reaches the stop, what happens? Secondly, remove the bands and slider, and shoot the marble down the slide schoolboy fashion. Again, when it hits the stop, what happens?

I don't think "Ursa Minor" makes his meaning quite clear (or perhaps he does not mean clearly). Is it not the distance of the frictional resistance from the centre about which it acts, rather than the actual extent of surface, that is the important factor in the example quoted?

As to paraffin lamps, a lamp long disused, brought out in an emergency is exactly in the condition to produce disaster. The holes through which the air should pass to cool the burner are all choked with charred wick and dust soaked in paraffin, which rapidly heat and give off stinking vapours, and possibly ignite. Small wonder if a glass fount cracks or even explodes under these conditions. But that a fairly well-made metal lamp ever exploded I have never seen asserted. The explosions in the papers are nearly all upsettings or crackings of very cheap glass lamps. The small sizes of common flat wick burners burn equally well with any cotton near about the right size. I have seen a $\frac{5}{8}$in. tube with a $\frac{1}{2}$in. wick. On blowing out the lamp a great rush of flame issued from the body of the lamp—this in a solid bronze lamp; in a glass one, disaster might have followed. The only so-called explosion of a metal lamp I have read of was a soldered tin lamp, in which some very light oil fired and melted the solder seams. Again, a lamp should be heavy enough not to upset very easily, and then it is also heavy enough to put itself out if it be upset, and gravity is far more certainly automatic than any spring extinguisher.

Kensington. **W. A. S. B.**

HANDY STOOLS.

[28589.]—I MUCH doubt whether many benchmen among the readers of the "E. M." would trust themselves on the uncomfortable-looking perch suggested by "Ursa Minor." To me it looks the most rickety contrivance that any workman would trust himself on. As a pedestal for a table it may do well enough; but with a longer stem and stouter socket. I cannot see the advantage of the large screw, which is sure to work shaky after a little wear. Let me advise all who have to sit long for any work requiring a steady seat, with facility of bodily motion right or left, to construct one as nearly resembling an ordinary riding saddle as possible. That is to say, the legs of the workman should be on each side of the seat, instead of in front. Instead of a square or round top, take a piece of wood 12in. long, 3in. wide, and 1in. thick; nail a strip of carpet or canvas, of not less than 5in. wide, along each side, and hard-stuff it till it is quite round along the ridge of the seat. This may be set upon four legs or three, like any other stool. But the ease and handiness of such a stool would not be believed until it is tried, and it is just as useful for a desk stool as for the work-bench. Nothing can be cheaper, or easier put out of the way when not wanted. And even those who do not care about the cost will find this the only true position for any work where standing is not absolutely necessary. A cross-bar may be put in front of the fore-legs if too high for the feet to rest on. I invented it some years ago, as a driving-box, instead of the very unsafe lean-to cushion. It gives the same grip as on horseback, and if the wheel-horse tumbles head over heels, the coachman need not be dislodged with the violence inevitable from the ordinary cushion. I can speak from long experience, and I am sure many of our readers will thank me for the hint.

John Hampden.

P.S.—If used for a driving-box, the cushion would be made to resemble an ordinary saddle, and also for the workshop, where 6s. or 8s., more or less, would be no object. The one I first described would be made for 1s. or 1s. 6d.—J. H.

POLISHING AND NICKEL-PLATING.

(*Continued from page 106.*)

[28590.]—NOW it will be seen that the requirements of a good plating machine are suitable electro-motive force, coolness in working, and no liability to reverse current. These three qualities are essential, and should be insisted on. Next, it will be found that a compound-wound machine will keep the E.M.F. almost constant under the ever-varying conditions of a plating vat. Again, one commutator and one pair of brushes are less trouble to manage, and cost half the amount in repairs that two would do, and lastly, a strongly-built and compact machine has generally less vibration and longer wear in it than some of the light, fancy-built ones.

I might say a few words on indicators, as they are now used in many plating shops. They go under many names, from the old-fashioned "galvanometer" or "voltameter" to the *high falutin'* "dynamo-electric pressure meter."

Any voltameter, no matter what name it goes under, is of little practical use when fixed in the usual manner—i.e., direct on to the terminals of the dynamo. True, it shows the E.M.F. of dynamo, but it gives no idea of what is flowing through the vat. The dynamo may be all right and the instrument showing its three or four volts, but it will do this whether the machine is connected to vats or whether it is not, so of what use is it to the plater? The plater requires an instrument that shows the current flowing through vats—an instrument that is inserted into the vat circuit. He sees at a glance then what he is doing, and any dirty connection or other fault, no matter if in the circuit or in the machine, shows up at once. I have an instrument of the right kind; it is inserted in the main circuit. A maximum c
dynamo gives a deflection of 265° roun
a usual working deflection is 220°. I
tion suddenly or gradually falls a
something is wrong either in the mach
vat circuit. It can be localised imn
connecting the main leads behind the
If the machine is right, the deflect
265°, and I look for a loose joint am
nectors on the vats. If the deflec
increase when the short circuit wa
should know the fault is in the machin
first try the adjustment of the brushes,
nine times out of the hundred this
I get the 265° deflection, and then t
circuit off; it drops down to the 2
keeps so till something requires atten

I should recommend all platers
instrument. It can be adjusted
dynamo, and can be seen from any
shop if screwed to the wall.

There are no magnetised needles i
is not much chance of it varying in
and it is very sensitive. It not only
explosion in a modern "Otto" engin
article put in or taken out of the va
deflection. The pointer moves three
the circle 270°, or at the point, abo
there is plenty of scale to show very li
of current.

Now we will fetch our work out of
follow it through the finishing proce
connect the hanging wires from the
article out of the solution, and swil
water, drain off, and plunge into the boi
then lift out and drain off again, and i
sawdust; cover up so that every part get
Repeat till the vat is cleared.

Now, if the current was right, we sh
deposit with a bright but yellowish
signs of roughness at the points or ed
appearance of stripping off, and shall
on to the polishing lathe again.

Having fixed a calico mop to the spi
a small quantity of the rouge compo,
mop over the surface of the plated
perfect black lustre appears. Then ta
down mop and rouge powder and go
again, and the appearance should be pe

In this last process the articles m
handled with the bare hands, no matte
they may pretend to be. Hold with
tissue paper round it, and you will be r

Should the deposit peel off during th
it must be done again from the commen
amount of patching will make it
Stripping is caused either by not
article perfectly clean before plating, o
too much nickel on, or by using t
E.M.F. The slower the deposit the
and the greater thickness may be p
nothing but experience can teach
medium, and when you have learnt it
any kind of deposit to suit the class o
have in hand. As an example, whiteni
ferrules and plating surgical instrum
two extremes. In the one case almost
would do, but in the other it must be
A surgeon would look *sideways* at a pai
having curls of nickel with their
standing about them. Or take the case
knife: if the deposit was hard, the first
used would spoil it. In the case of pla
having handles, such as fruit knives, &c.
must be used in the cleaning, as you m
these handles in potash or scald the
plating.

Now, in conclusion, let me warn all
plating shop leech. He is a man past
of life that has "had all the best j
country" (and could never keep one of
has a SECRET: "It will put your solu
(even if it was never wrong). "It will
much whiter than silver!"

If you have resisted the bait so fa
has gone down from five shillings to ha
and for a shilling he will "clean all t
tions and put the place to rights."

But beware of him, for he has a way
nitric acid in cyanide solutions, and put
more of carbonate of iron in a nickel s
clean it"! If you are in doubt on any
query shall have the best attention of

(*To be continued.*)

LOCOMOTIVES.

[28591.]—I HAVE read the interest
by Mr. C. R. Martin, and also the art
Engineer to which your correspondent, "
refers, page 101, No. 28560, and I am gla
that speeds of over 80 miles an hour are
mythical.

It is very easy to talk of running at 8
miles an hour; but if the resistance and
pressure be taken into account, the im
of attaining anything above 80 mile
becomes apparent. I have carefully t

down all the important inclines in this during the past 20 years; but, from my I find that I have never travelled at a ipeed than 74½ miles an hour, and that was t up for a very short distance. It will be practice that speeds of 60 miles an hour ards are seldom attained upon the level by trains, although 70 to 73 miles an hour run upon favourable gradients.

veral brake trials, and also when riding gines, I have observed that when the lever has been put forward to obtain a peed, the pace has at once been reduced, the fact that the engine could not get rid exhaust steam quickly enough—and this becomes more apparent in engines having ames, inside cylinders 18in. diameter, and s placed between them.

ot agree with "Scientific" that the expansteam is pushed to its full extent, nor that ipound engine is the proper principle to on. It is a well-known fact that upon the and North-Western Railway the "Precelass, having cylinders 17 by 24, with wheels, were overpowered by the traffic, engines of greater power were necessary. npounds were therefore introduced, but mparison between the two principles or nnot be made so long as the boiler presunequal.

ld be interesting to know what results given by the "Precedent" class if their essure were to be increased to that of the ds. It would also be interesting to what results could have been obtained if, f the Compounds, a much larger edition Precedent" class had been constructed, ylinders 18½ or 19in. diameter; stroke iving-wheels of 6ft. 9in. or 7ft. diameter, h a boiler pressure the same as the ds—namely, 175lb. There can be no that such an engine would be powerful o work the heaviest express traffic, and no reason to suppose that it would not do ll, or better, and as cheaply, as any comigine. It will also be remembered that a e with three cylinders and three sets of must cost more to construct, and more to than an engine having only two cylinerefore, even granting, for the sake of , that a Compound can run with a coal, we have to consider whether the ing (if any) in coal repays for the extra nstruction and maintenance.

gard to the increase of boiler pressure to Scientific" refers, I may say that I am see that "high pressure" is coming into eral use, being of opinion that if economy aintained, the engines must have more ge cylinders, and, above all, larger firehe value of a large fire-grate and ample eating surface can hardly be over-esti-

Clement E. Stretton.

ngineer, Associated Society of Enginemen and Firemen.

er, March 30th.

ICATES FOR ENGINE-DRIVERS.

]—I AM glad to observe that your corre- "An Old Express Driver," p. 101 (letter s directed the attention of your readers l now before Parliament with reference nting of "certificates" to engine-drivers, nd those in charge of boilers. Locomoemen and firemen do not appear to have subject that careful consideration which ance to them deserves, and it will be a great regret if any Bill is allowed to w, which may in any way turn out to ntageous to their interests.

ry proper that all persons who have the such an important power as a steam uld be efficient in their duties, and fully d the dangers that neglect may cause.

l does not appear to have been printed , nor can it be known what alterations ients may be added during the time it is rough the House. Those who advocate iem to consider that enginemen should prove of the "principle," leaving minor be afterwards arranged. But enginemen efully refrain from expressing an opinion know distinctly what kind of examinawill be required to pass, and also by examination is to be made.

ificates" for drivers and firemen are rove that Mr. —— has been a driver Railway for a certain number of years, e is an efficient man, then there can be n whatever to the Bill, and the possescertificate" may prove of use and value er thereof.

n the other hand, drivers are to be put stiff examination as to a number of natters with regard to points of theory h even locomotive engineers cannot I am of opinion that it will be a very serious matter for the drivers and for those who are looking forward to being the drivers of the future. Any "examination" to do justice to drivers and firemen should, I consider, be of a strictly "practical" character; it should be made upon the locomotive by a practical man—that is, by one who has himself been a driver.

I know myself several engine-drivers, as practical and efficient men as can be found, yet they are no scholars, and would absolutely fail to pass any stiff examination.

Railway men have seen quite enough of "scientific tests," with reference to eyesight, testing with dots and wool—they are only too well aware that in many instances these eyesight tests have been unfairly applied, and made use of simply to get certain drivers removed from the foot-plate.

It has been contended by some that the "Bill" would be of value in case of a "strike" as no one without a *certificate* could work an engine; this idea, however, is entirely wrong, as before the "Bill" is allowed to pass a clause is to be added to suspend its action during such a dispute.

It has also been considered by some that the possession of a "certificate" will enable the holder to obtain a higher rate of wages. This is, however, very doubtful. It is a well-known fact that the *supply* of locomotive drivers and firemen far exceeds the demand, and so long as that is the case, I fail to see that an increase in wages is possible.

From these few remarks, I trust engine-drivers and firemen will see that the "certificate" question is very like a "two-edged" sword hanging between themselves and the companies, and certainly at present it is not at all clear as to which way it will cut the most. I therefore trust that railway men will neither oppose nor support the Bill until they are in full possession of the details, nor until they ascertain whether the Bill will be of advantage to them or detrimental to their interests.

Clement E. Stretton, C.E.

TWISTING TREES AND TWINING PLANTS.

[28593.]—IT may be of interest to "O. J. L." and others who have written on the above subject to refer to the exhaustive observations in that direction made by Darwin in his works on "The Movements of Plants" and "Twining Plants." The introduction to the former work and the first chapter of the latter are particularly interesting as giving the results and conclusions to which Darwin arrived; the remainder of the books are more especially composed of descriptions of his investigations and his methods of experiment. The subject is treated with all the minuteness and accuracy characteristic of Darwin, and nobody who wishes to go into the matter should omit, if possible, a reference to the above-mentioned works. Of course, it would be useless to attempt to include in the limits of a letter anything like a résumé of the results arrived at; but it may be remarked that the twining motion of creepers and the axial torsion of the plant-stem itself which so often accompanies it (and which is the same in kind as the spiral twisting of stems of trees) are two distinct motions of growth; and that whereas the former is intimately connected with the internal growth movement of every growing part of every plant ("Movements of Plants"—Introduction), the latter is more or less incidental, arising from external causes, especially obstacles in the upward growth.

The question of the twining plants, with very many experiments, is most fully discussed in the work bearing that name; while for exhaustive treatises on the question of the spiral twisting, Darwin refers to H. de Vries "Arbeiten des Bot. Institute in Würzburg," Heft. iii. pp. 331-336, and Sach's "Textbook of Botany," English translation, 1875, and an article on twisted trees in the "Scottish Fauna," about 770.

J. Barclay Lloyd, Isthmian Club.

INDIAN AND CHINA TEA.

[28594.]—I AM afraid your correspondent, S. E. Peal (letter No. 28546), writes under several misapprehensions which I would like to controvert.

Placing such weight as he does on the purity of Indian tea seems to imply that China tea is not pure, while in the case of the latter his argument as to the plentifulness of the tea-leaf (of one quality or other) applies equally. Besides, since the Adulteration Act came in force Government inspectors see that all tea entered for consumption is genuine, and they are aided by the watchful trade. It is not the case that the difference between the price on the market and the retail price is so great as represented. On the contrary, in most instances where I have seen tea sent in a few chest or half-chest lots to friends direct from the gardens, the price is charged pence per pound more than that for which the same quality could be obtained through the trade. Each grower of Indian tea seems to think his own garden perfect tea, worth a high price, and is disappointed if it does not fetch it. Indian tea varies infinitely in quality. The market is the crucible in which are tried side by side the products of gardens in every district of India—to the extent of 7,000 or, it may be, 10,000 packages in one day. The samples representing these may be probably 300 or 400; they are carefully tested and valued by hundreds of experts, and the values marked in the catalogues. The buyers are in eager competition, trying to secure their respective choices under or at the value fixed. Of the teas secured, samples are drawn and sent to representatives that very day to be turned over as quickly as possible. The competition restricts the profit, and if the teas are not soon sold they, as a rule, "go off" in freshness, and perhaps the tails of the parcels are sold at 1d. or 2d. per lb. loss. Why the members of the tea trade in keen competition with one another can be called "a huge ring" and "pure speculators" I do not understand. They certainly apply marvellous skill in valuing, and intense energy in distributing to retailers tea on the closest terms. It is quite true, however, that "outside speculators" have often burned their fingers buying importers' teas, and also in importing tea. I do not wish to disparage certain growths and qualities of Indian tea, but it would interest me much to have the opinion of some of our chemical friends as to what is "strength" in Indian tea, whether tannin or theine, and its relation in respect of these properties to fine China tea.

Souchong.

ENGLISH AND CONTINENTAL OBJECTIVES.

[28595.]—CAN any of your numerous microscopists inform me how to compare the English and Continental nomenclature of objectives?

In Swift's Catalogue 1in. with an A eyepiece magnifies 50 diameters.

Ziess' 16 millimètres focal length with No. 4, which I suppose corresponds to an A eyepiece, magnifies 62 diameters.

Reicherts, in his Catalogue, has an objective No. 3, 15·5mm. focal length, corresponding, so he says, to ½in., which, with his No. 1 ocular, magnifies 50 diameters. So that you see a 1in. is equal to ½in.

If some reader would kindly make a list of the English and a corresponding in power Continental objectives, also show the corresponding apertures, I am sure it would simplify matters, and assist many who, like myself, are struggling microscopists.

A Constant Reader.

MICROSCOPICAL—TO MR. NELSON.

[28596.]—I TRIED to obtain an approximate estimate of the aperture of a water immersion $\frac{1}{16}$ the other day, by the following plan:—Having placed a droplet of water on the front lens, after a few trials I got this droplet of a fairly hemispherical figure, then, by means of two candle flames and a little trigonometry, I obtained an angle of 127°—128°, when the images of the flames were at the margins of the back lens. I took care that the images were well within the margin. This would result in an aperture of about 1·18 N.A. And I do not think the lens can have so much—i.e., judging from performance on *Amphipleura pellucida*. I would be very glad if Mr. Nelson or some of your readers would give me an opinion as to whether my plan was, or was not, faulty. I should like to compare the measurement with the result given by Abbe apertometers, but do not possess the latter.

I am of opinion, however, that the lens in question must have fully 1·0 N.A., since I can get background illumination by means of the extreme marginal light from my Abbe illuminator of N.A. 1·2, care being taken to connect the front of the illuminator to the slide by oil.

I would also like to know of the *lowest apertured* objective which has *undoubtedly* resolved *Amphipleura*. According to the table in the *Microscopical Journal*, 150° *dry* ought to do it.

Fras. D'Agen.

"DIRECT TRANSFORMERS," OR INDUCTION COILS.

[28597.]—"COILTONIAN," in query 64841, raises a pertinent question, one which certainly needs clearing up. I agree with Mr. Bottone (*vide* his reply last week) that querists on this subject—and they are not few in number—would benefit by reading other answers than those to their especial queries. I wish to add some remarks of my own on this subject.

In the first place, as regards names. Most "coils" have primary and secondary wires in varying proportions, though for medical or "shocking" purposes, one coil is generally enough, using the "extra" *vice* "induced extra" current.

Now, a coil having primary and secondary is variously called an induction, intensity, spark, shock, medical, or Ruhmkorff coil, or simply coil alone, with resultant confusion in the minds of novices.

Why not have a definite name—e.g., direct transformer—"direct," to distinguish it from "alternate" transformers, as used in electric lighting? An intermittent direct current being used in the first instance, an alternating current in the second instance.

Next, regarding size and number of turns of primary. The object is—greatest magnetising power, or, which is the same thing, greatest number of ampère turns, depending on available battery power or E.M.F. on the space at disposal, &c.

In alternate transformers, among other things, great attention is paid with the object of getting closed magnetic circuits, which, as everyone should know, increases the efficiency by facilitating the rapid magnetisation and demagnetisation of the iron.

Why not apply this principle in the construction of "direct transformers" or induction coils? Of course there are increased difficulties and expense involved; yet I feel sure such would be compensated for by greatly-increased efficiency.

I think discussion on this subject by our electrical correspondents would prove interesting.

W. Perren-Maycock, A.S.T.E.

THEORY OF ELECTRICITY.

[28598.]—If a plate of copper and a plate of amalgamated zinc be immersed, without touching each other, in a vessel of dilute sulphuric acid, and the outside terminals of the plates be connected by wires with a quadrant electrometer, or a condensing electroscope, it can be shown that the two plates are at different potentials, the copper being positive to the zinc. If the vessel be insulated, the copper can be shown to be positive to the earth, and the zinc negative to the earth. If "Daddy" (letter 28571) will bear in mind that the terms positive and negative are used to define the direction in which the current is supposed to flow—viz., from positive to negative, he will no longer find it necessary to be puzzled. In the cell the current flows from the zinc to the copper, therefore the zinc is + and the copper −. Outside the cell the current flows from the copper to the zinc, and therefore the copper terminal is + and the zinc terminal −.

Sm.

[28599.]—I quite agree with the view of your correspondent, "Daddy," p. 103, that zinc is negative to the exciting liquid in the cell. It is so because it has an affinity for one of the ions (oxygen) in the liquid. The difference of potential between the zinc and the liquid is measured by the algebraic sum of the heats of combination concerned in the reaction. If we carry the reasoning a step further, we see that copper, and even platinum or carbon, are also probably negative to the liquid in so far as they have any affinity for oxygen; but, therefore, to a much less extent than zinc. This point may appear clearer if we take a cell composed of sodium—water—zinc, in which the current will flow from sodium through the liquid to zinc, or a cell of carbon—fused nitre—copper at a red heat, in which the current flows from carbon through the liquid to copper. The carbon being violently attacked and consumed at this temperature. In these cases the liquid is, of course, more positive to the sodium or carbon than to the zinc or copper; hence the direction of current.

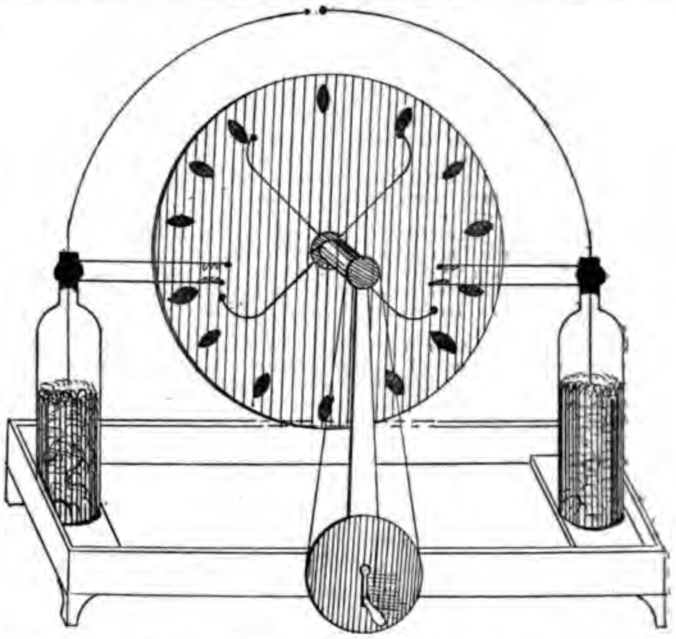
In the ordinary cell, however, the affinity of platinum or carbon for oxygen may be practically neglected, and hence they may be supposed to act, as "Daddy" says, merely as collectors of the current from the positive liquid, and may be taken as at sensibly the same potential as the liquid. Although this hypothesis has been advanced before, it does not seem to be generally accepted, owing largely to the absurd theory of "contact electricity," which supposes zinc to become positive to copper, carbon, platinum, &c., by merely touching these metals; whereas in the experiments of Volta and others, supposed to lead to this conclusion, the electric state of the metals is not measured at all, but only that of the film of condensed gas, or moisture on their surfaces. This moisture-film is, of course, positive to the zinc or other oxidisable metal: hence the mistake.

In a paper by the present writer, published in the *Proceedings* of the Royal Society, Vol. XLI. p. 248, this part of the subject is treated more fully. An abstract of the paper appeared in English Mechanic, No. 1,126.

Belfast. **J. Brown.**

A CHEAP BUT EFFICIENT FORM OF WIMSHURST INFLUENCE MACHINE —HOW TO MAKE IT.

[28600.]—It will require 8ft. of matchboard, ½in. thick, 7in. wide, 1ft. of hardwood, ¾in. thick, 7in. wide, 9ft. of brass wire, ⅛in. or ¼in. diameter, four brass knobs, sheet brass, 9in. by 7½in., for sectors, nine large cotton-reels, 5lb. gunshot, small size, two ordinary white glass bottles, piece of tin, 2½ft. of *steel or iron wire,* marine glue, &c.



The stand is made like a box without top or bottom, 3in. deep, 26in. long, 8in. wide; at the ends are made two boxes, just wide enough to take the bottles (see drawing).

Insulating pillars are two common light glass bottles, with a good coat of shellac varnish inside and out; when dry, put some pieces of silk inside, about an inch thick; also 2½lb. of fine gunshot. On the outside about 3in. of tinfoil, or tinned iron I prefer, as it is stronger, and seems better. Let a piece of wood take the place of corks, with a hole in the centre; small cotton-reels will do well, fixed in with marine glue. On these are fitted the hollow parts of two brass knobs, such as are used on doors; in the tops draw holes to receive discharging rods. At each side drill holes, to solder in pieces of brass rod, bent so as to form the letter U, just long enough to reach about 1in. on discs; fix on these metal brushes, which will serve as collecting combs (see drawing).

Discharging rods are made from brass wire, with brass balls; large one is 2¼in., smaller one is 1¼in., filled with gunshot.

Discs are made of plate-glass ¼in. thick, 13½in. diam.; either one hole about 1in. is drilled in the centre, or one just large enough to let the brass tube through, and two small ones to receive screws for screwing discs to bosses. These are drilled with an ordinary steel bit, holding the drill in a slanting position, keeping the hole well supplied with paraffin and salad oil. This done, give them a good coat of shellac varnish.

Sectors are cut from sheet brass; they are 2¼in. long, ¾in. wide at one end, ½in. at the other, 14 in number; warm them and give them a coat of marine glue, put them on an equal distance apart on discs, and a ¼in. from the edges; press down with a warm iron, which will fasten them to the glass.

Bosses and spindle: Take 10in. of brass tubing, 9¾in. of steel, or iron wire, to fit inside tubing, at 1in. from each end drill a small hole to receive screws; these are to secure spindle and tubes to stanchions. On each end solder binding screws, straight form, with removable nut, to hold neutralising rods in their places. Remove the spindle, and cut the tube in the centre, and at 1½in. from each end, on the long pieces fit the large cotton reels to form bosses and pulleys. Discs are first fixed with marine glue, then screwed on. Use good metal brushes on neutralising rods. It will be seen that a machine as thus described need not cost more than 13s. or 14s., and if properly constructed will give a 7in. spark.

A few words about working the machine: To get the longest spark I find it best to have the neutralising brushes about 3in. apart, and the plates about ¾in. apart, the discharging balls much larger than usual, and the machine driven slowly for a few seconds, then rapidly, till discharged, the report being very loud from my machine. I have had no trouble to get a 7in. spark during the frosty weather, and sometimes 8in.

So many readers of the "E. M." have written to me for detailed information, that with the Editor's kind permission perhaps this simple account in our valuable paper may be interesting to others also.

Haslemere. **F. S. Fowler**

INCANDESCENT LAMPS.

[28601.]—I have been too busily engaged to reply to "Engineer, Govan's" letter, in which he disagrees with some of my opinions. He has a great deal of reason on his side, but has not, I expect, had experience of lamps containing other than carbon filaments, as such are not common. I reply to his letter from memory; so I trust he will ascribe any errors I may make to this cause, and not as an intentional misinterpretation. I alluded to my lamps in series for central station lighting, where storage is more costly than duplicate plant, which is quite as great a safeguard against accident, and is otherwise more economical. The lighting station of the future will be required to produce heat and power as well as light, so it will necessarily run twenty-four hours a day. Hence storage cells would be only an expensive luxury.

The other objection raised was partly based, I think, on a misconception of my meaning. I do not mean to say that my lamps contain gas at the ordinary atmospheric pressure, but I do mean to say that a sufficiently high exhaustion can be obtained by an ordinary air-pump.

I admit that a higher vacuum would give greater efficiency, but it would necessitate the employment of more hands, and much more time, for the same output of lamps, to say nothing of the constant expense entailed by the use of mercury pumps. Only those who have had experience of these know the trouble they are.

As fully exhausted lamps would cost more to make, they would have to be sold at a higher price; and would, therefore (vide my previous letter), to obtain the highest economy, require to be run at a longer life, which means at a lower efficiency.

Again, molecular bombardment, which, as a matter of fact, is present (although only in a small degree) in every lamp, is eliminated. At the temperature at which a carbon filament incandescent lamp is run, it is insignificant; but if one of these lamps were run at the same colour as my compound filament lamps (which are run much whiter), the high temperature required would soon give indications of the bombardment taking place.

If "Engineer, Govan," likes to send me his address, I shall be pleased to send him a lamp to test.

Whilst on the subject of incandescent lamps, I may be pardoned for pointing out some facts not understood by the general public, as is proved by many of the letters I receive.

The first of these is as regards the voltage and candle-power of lamps. Has anyone ever made a satisfactory two-volt lamp yet? In my opinion, this is almost impossible, because the filament has to be so short that but very little light is obtainable. To look at, these lamps appear all platinum and no filament. Again, it is very difficult to get them all of even colour, whilst their economy is wretched. My advice to the public is—Never buy two-volt lamps. Four-volt, or even three-volt, lamps are much more satisfactory, and their economy is greater. Setting aside the heavy-current lamps for series lighting (which are not in the market, so far as I am concerned), economical lamps can be made of from 3½ volts upwards.

Another point not noticed by the public at large is the overrunning of lamps. A three-volt lamp taking but half an ampère or so is put on to a two-cell chromic battery without any resistance in circuit, and the natural consequence is that the lamp is quickly destroyed. "One volt cannot make much difference if the lamp is any good"; thereerdict is that the lamp is bad. These le would laugh at anyone running a mp on 100-volt circuit, and yet the precisely similar. The increase is exactly percentage in either case. This is more with a fine filament than with a stouter naturally withstands the increased curle longer.

ps run in parallel, lamps of 45 to 75 volts st economical. Above that the filaments and below 45 volts it is more difficult to ight candle-power.

d a list of the lowest voltages at which -power can be satisfactorily obtained :—

andle-power	3 volts.
" "	4 "
" "	4 "
d 4 candle-power	5 "
d 6 " "	6 "
d 10 " "	8 "
andle-power	10 "
" "	12 to 13 volts.
" "	25 to 30 volts.

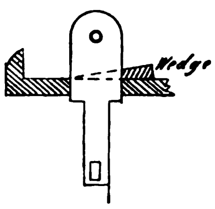
are for actual candle-power, and are or a really good efficiency.

mean to say that these are advisable but are the lowest at which lamps of dle-power can be made except at fancy ich, however, pay neither the maker nor

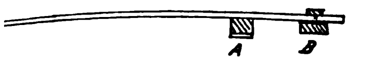
Bay. **W. Hamilton.**

LE LATHE—TO "W.A.S.B."

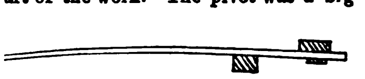
—VERY well done; but the left-hand pit rather complicates the rest arrange-ich is best made by cutting mortises in sts, and wedging a couple of bits out



ard wood is then laid across from one e other. If it lies too loosely, pass a behind it. Chairmakers who used to lathes seldom had to alter the rest, l the pieces were nearly of one size. My pts were made on a pole lathe, and the soon caught. I must add, however, in your pole, that you will not find it satis-thus, because you cannot shift the cord er end of the wood. The ordinary pole d near one end, and rested on a beam,



beam, and B another, with pivot. The then swung round as required to come art of the work. The pivot was a big-



lt. Sometimes it was under one beam e other, in this fashion. **O. J. L.**

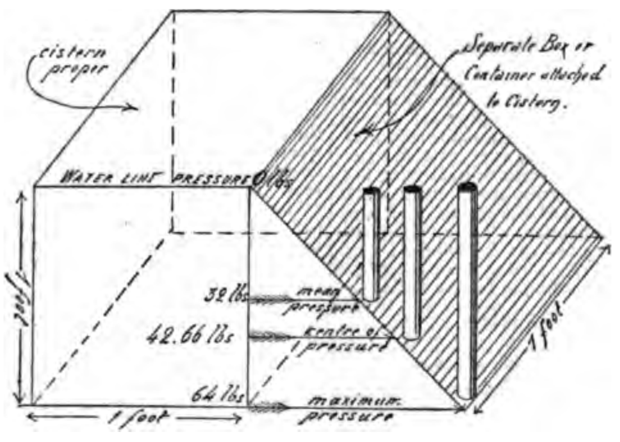
STATICS AND STRESSES ON IRON CISTERNS.

—THE query (64759) of "J. R. G." as er pressures on an iron cistern admirably the mental fog in which even the most student invariably finds himself en-hen first seriously approaching questions ressure.

fog he may long grope, and from it may y emerge if left to himself; and yet the fellow-student may lift him up clean nce and for all in a few minutes!

hardly say how glad I should be if the lanations I am now going to offer should ful in this way, not only to "J. R. G.," y other minds similarly exercised.

to still-water pressures, or hydrostatics. the diagram) is a cistern which, mea-"long" by 1ft. "wide" by 1ft. deep, xactly 1c.ft. of space. By weighing the st empty, and then full of water, we weight of water by deducting the result from that of the second experiment. Thus



we find the *actual weight* of a cubic foot of fresh water is nearly 62½lb., and of sea-water is 64lb.

If the cistern contained, instead of water, a cubic foot of, say, oak (or any other solid), weighing 64lb., the pressure of that oak on the cistern-bottom would be 64lb.; and there would be no pressure against the "sides" and "ends" of cistern. But when full of sea-water, the cistern-bottom would experience a pressure of 64lb.; and each of the cistern "sides" and "ends" would have at same time a pressure of 32lb.; and the cistern-top (if there were one) would undergo no pressure whatever.

Against the "side" or "end" of cistern let there be placed (as per diagram) a three-cornered box, or container, full of water, not communicating with cistern, but self-contained; the base of this box being of equal length to its perpendicular height—viz., 1ft. The various intensities of water-pressure against each of the "sides" and "ends" of cistern at the various levels may now be correctly represented by horizontal lines or arrows drawn on the triangular end of the three-cornered box. Each arrow will show the intensity of pressure at the particular level on which that arrow is drawn. Between the longest arrow (1ft.) at base of triangle, and, so to speak, the shortest arrow (*nil*) at apex of triangle, an infinite number of arrows may be drawn, representing by their differences of length the infinite number of infinitesimal differences of pressure from maximum to minimum.

The mean length of arrow, and likewise the mean pressure, is $\frac{\text{max. 1ft.} + \text{min. 0}}{2} = \frac{1}{2}\text{ft.}$

Let the student examine the vertical glass tubes or pressure-gauges fitted to the slanting top of the three-cornered box, and he will find (if the box is full of water) those gauges will *all* show the water up to the top level of the water in the box—i.e., up to the apex level. Then the length of each horizontal arrow will be found to exactly equal the height of the water in the tube which stands on the point of that arrow, and in this way the student may realise that the horizontal pressure of water is the same as the vertical pressure at each level. And so it comes about that the mean horizontal pressure against "sides" and "ends" of cistern is the same as the mean vertical pressure—i.e., 32lb., as above shown. Thus, universally, the mean pressure of still water is half the pressure present at its full depth; and the pressure of water at any point is the same in all directions at once; so that not only do the *vertical* and *horizontal* pressures equal each other, but also all the *oblique* pressures of every angle of obliquity have the same intensity as the vertical pressure. Thus, if the water-gauges on the box were inclined at any angle, still the water would rise to its level—viz., to the apex, if the box were kept full.

[Some people will be ready to ask, "Why write facts so patent?" Because these facts, though patent enough to the *cognoscenti*, are not patent to everybody. Had the mighty Romans known and realised these simple facts, they would not have built their great aqueducts. And we of the 19th century are of both classes—viz., younger and less informed, as well as older and wiser. We don't *all* of us know more than the Romans knew. Therefore we need "line upon line, and precept upon precept." The more ignorant among us do not need information more than the less ignorant among us need patience and humility to learn and teach things old as well as "things new."]

We now know that we must provide strength in our cistern to resist at "sides" and "ends" a pressure of 32lb. per foot, or per "side" and "end," as the case is. Let us suppose that, from reasons which need not now be particularised, we cannot expect our cistern shell to stand (without unduly straining) a pressure of more than 16lb. per foot. Then we need to provide stays or tension-rods to take up the remaining 16lb. of stress. Thus the mean pressure governs the strength of material required; for after finding what tension will come upon the tie-rod or stay, we know what diameter to make it.

But the knowledge of the mean pressure does not direct us at what height on the vertical shell of the cistern to fix the stays. This height should (except other conditions decree otherwise) be such as to insure that each stay should be at the true centre of the pressure it is called on to resist.

The student needs special warning against the danger every learner is in of confounding the *centre of pressure* with the *mean pressure*. He cannot be too clear on this. The distinction is vital. *The mean pressure does not occur at the centre of pressure.* The *mean pressure* is always at *half* the depth, while the *centre of pressure* always occurs at *two-thirds* the depth, measured down from the water line. There are thousands of persons who know this, but do not know why it is so. The triangular end of the three-cornered box will show the "reason why." For it is evident that if we were to saw the triangular box asunder by a horizontal cut at half the perpendicular height (i.e., a cut right along the arrow, or line, of mean pressure), the top end of the box would not hold nearly so much water as the bottom end—or "bigger half," as Pat might term it. But if the saw-cut, instead of being at ½ height, were at ⅔ height, measured down from apex—though the pressure local to that ⅔ level is as much greater than the mean pressure as ⅔ is greater than ½—yet the upper portion of the box severed at this two-thirds level will hold exactly the same quantity of water as the lower portion will contain, which proves that the centre of the volume of pressure is at the two-thirds level, as the centre of gravity of the triangle is always at two-thirds height below apex.

Applying this to the case of the cistern of "J. R. G.," which is, he says, 10ft. long by 8ft. wide by 4½ft. deep, we calculate as follows:—Mean pressure on sides and ends $= \frac{4\frac{1}{2}}{2} \times 62\frac{1}{2}$lb. freshwater $= 140\frac{5}{8}$lb. per square foot of (vertical) sides and ends, which gives—

$$10 \times 4\tfrac{1}{2} \times 140\tfrac{5}{8} = 6{,}330\text{lb. per side,}$$

and $$8 \times 4\tfrac{1}{2} \times 140\tfrac{5}{8} = 5{,}064\text{lb. per end,}$$

the pressure on the bottom of cistern being—

$$10 \times 8 \times 4\tfrac{1}{2} \times 62\tfrac{1}{2} = 22{,}500\text{lb.}$$

Then the stays would have to be put in at the level of the centre of pressure $= \frac{2}{3}(4\frac{1}{2}) = 3$ft. down from the top edge of cistern, or from the intended water-line. At least that is the position in which the stays should lie, *if other considerations than those above named do not enter in.* The sides and ends, however, are not acting alone, but in conjunction with the bottom, which bottom itself constitutes a most powerful tensional web, absolutely preventing any horizontal deflection of the vertical plates along their bottom edge. This circumstance induces a state of stress in the cistern, which we may glance at now.

If the cistern bottom, instead of resting on a solid floor, is supported, as is usual, on a narrow bearing round its four edges only, and if the bottom were unattached to sides and ends of cistern, but had its four edges encastré, it would be under the stress of a flat plate encastré, pure and simple.

Taking $\frac{3}{16}$in. (i.e. ·1875in.) as its thickness, we find the coefficient (f) of greater stress as follows—

$$f = \frac{1}{2}\;\frac{120\text{in. long}^4}{120^4 + 96\text{in. broad}^4} \times \frac{96^2}{\cdot 1875^2} = 9298.$$

Area of cistern bottom = 10 × 8 × 144 = 11,520in.

$$\frac{\text{Weight on cistern-bottom} = 22{,}500\text{lb.}}{\text{Area of cistern-bottom} \;\; = 11{,}520\text{in.}} = 1{\cdot}953\text{lb.}$$

per inch pressure on cistern-bottom. So that the greatest stress per inch will be = 1·953 × 9,298 = 18,159lb.

The ultimate tenacity of iron being only, say

= 44,800lb. per inch, the factor of safety would be only = $\frac{44{,}800}{18{,}159}$ = 2·467. So that, though the bottom would carry the weight, it would not have enough spare strength in hand quite, for the factor of safety ought to be = 3, at least. So much for the bottom *per se*. Now let us glance at the side pressure *per se*. It is in effect the same as if the side of cistern, instead of being vertical, were lying flat, rigidly secured and supported round its two end edges, and one of its longer edges; the other long edge being quite unsupported. Taking the plate as = ·1875in. thick, we find f as follows:—

The length of fixed edge of this side plate would be 10ft. + 2 × 4·5ft. × 12in. per foot = 228in.

$$f = \tfrac{1}{8} \times \frac{228^2}{\cdot 1875^2} = 184832.$$

Area of side plate = 10 × 4·5 × 144 = 6,480in.

$$\frac{\text{Pressure on side plate} = 6{,}330\text{lb.}}{\text{Area of side plate} = 6{,}480\text{in.}} = \cdot 977\text{lb. per inch}$$

pressure on cistern side.

So that the greatest stress per inch against the side will be = ·977 × 184,832 = 180,581lb. But as the ultimate tenacity is only 44,800lb. per inch, the sides evidently are quite incapable of resisting the pressure, without being stayed or otherwise strengthened.

In the same way the strength of the end plate considered alone may be calculated thus:—

Length of fixed edge = 8ft. + 2 × 4·5ft. × 12 = 204in.

$$f = \tfrac{1}{8} \frac{204^2}{\cdot 1875^2} = 147{,}932.$$

Area end plate = 8 × 4·5 × 144 = 5,184in.

$$\frac{\text{Pressure on end plate} = 5{,}064\text{lb.}}{\text{Area of end plate} = 5{,}184\text{in.}} = \cdot 977\text{lb. per inch}$$

pressure on cistern ends.

So that the greatest stress per inch against the end will be = ·977lb. × 147,932 = 144,529lb.; which proves that the ends also need strengthening by stays or otherwise.

We have thus considered the sides, ends, and bottom of cistern, each as a separate plate; the latter with its four edges encastré, and each of the two former with only one edge and two ends encastré. Considered thus separately, they are each evidently more or less too weak for the pressure they have to bear. And since we have taken the edges as encastré it is not easy to see that the sides, ends, and bottom would, when acting in combination be able to mutually afford each other any more assistance than the encastrement of edges would afford. Thus it seems evident that, if we adhere to the $\frac{3}{16}$in. thickness of plates, one or more intermediate floor girders should be provided to support the cistern bottom, and the sides and ends must be strengthened by other means.

The first means to adopt for the latter object is an angle-iron rim to the cistern, which itself should be cross-stayed, so as to be strong enough to render the top edges of cistern virtually encastré.

This angle-iron rim then reduces the maximum stress on sides as per following calculation—

$$f = \tfrac{1}{2} \frac{120\text{in.}^4}{120^4 + 54\text{in.}^4} \times \frac{54^2}{\cdot 1875^2} = 39{,}875.$$

$$\frac{\text{Pressure on side plate} = 6{,}330\text{lb.}}{\text{Area of side plate} = 6{,}480} = \cdot 977\text{lb. per in.}$$

Greatest stress on side = ·977 × 39,875 = 38,469lb. per inch, which gives a factor of safety = $\frac{44800}{38469}$ = 1·16. But this factor should be not less than 3, as before remarked. Hence the rigid rim is not alone sufficient to strengthen sides as required, and thus the necessity for lower (i.e., submerged) cross stays is demonstrated.

To pursue the calculation further in this paper (which is already too long) is out of the question. It will suffice to say that the stays should be, say, about ¾in. diam., one lengthwise and one or two crosswise will suffice, fixed at centre of pressure level.

My object herein, as will be seen, is to assist students to *think out for themselves* the questions involved in such problems, rather than merely to give dimensions of one solitary cistern.

Of course, by using a larger number of cross stays, the plates can be made thinner than $\frac{3}{16}$in., and the stay rods lighter than ¾in.; but practical considerations favour the first named arrangement. I think galvanising is advisable; but it should not be forgotten that galvanising not unfrequently reduces the tensional strength of thin iron plates.

Sunderland. **Frank Caws.**

SPIDERS AND SULPHATE OF ZINC—MESMERISM.

[28604.]—IN an old work on chemistry in my possession there is the following curious statement:—"It has been discovered by Mr. Holt, the secretary of the Cork Society, that spiders will feed upon sulphate of zinc. One of these insects kept in a box for six months was found to have *eaten nearly 4oz.* of the salt. See Thomson's *'Annals,' Vol. XII. p. 454.*"

This, if true (which I greatly doubt), would be a most extraordinary fact, and well worth investigating. Perhaps some reader of the "E. M." will try the experiment, which would be a very inexpensive one, weighing the spider at the beginning of his course of metallic diet and at the end of the same, and analysing the excreta to ascertain whether the creature (I believe a spider is not an insect) has assimilated the metal or the sulphuric acid. It might be well to afterwards analyse the spider. I expect the whole thing, however, is on a par with the spontaneous-generation results obtained from imperfect conditions of experiment. Still, far be it from me to assert any untried experiment to be impossible.

If any of the readers of the "E. M." who have addressed questions to me (under the *nom de plume* of "Garrison Gunner") as to the curing of dipsomania by mesmerism will obtain the monthly number of the *Proceedings* of the Psychical Investigation Society for March last, they will find a well-authenticated case of perfect cure of a confirmed drunkard by these means.

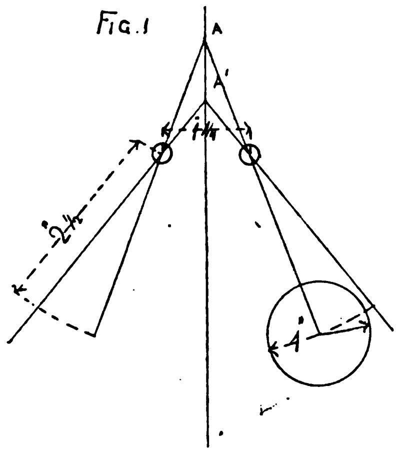
T. Preston Battersby, Capt. R.A., F.R.A.S.

HIGH-SPEED GOVERNORS.

[28605.]—I WISH to enlarge upom my query of last week (64928). I found some useful replies by "W. J. R." in Vol. XLIII. pp. 88 and 196; but without a sketch of the governor he describes, I do not quite understand his calculations. Could we persuade him to write further, giving illustrations of different forms of high-speed governors, with the calculations of their proportions and power? I should like to see some articles on the subject by "W. J. R.," who seems to understand it so well.

Am I right in supposing that when the point of suspension of the balls is outside of the vertical centre of revolution, the angle of the arms must be produced upwards to form the apex of the cone, as at *a a'*, Fig. 1. I hope "W. J. R." will not despise the little governor I sketch as a toy. The balls are to be 1in. diameter, of gun-metal, therefore weight ·157lb. At 30° inclination of arms, I make the revolutions 108, and height of cone 3in. To speed it up to 210 revolutions, I took the formula given by "T. C.," on p. 88, Vol. XLIII.

FIG. 1



$$\frac{h'}{h} = \frac{w}{W+w} \quad \text{taking } R = 210 \quad \text{makes } h' = \cdot 81$$

then—

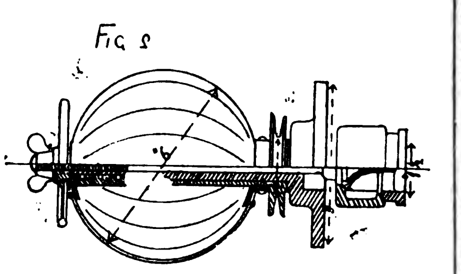
$$W = \frac{110 \times \cdot 157}{\cdot 81} = 21{\cdot}31\text{lb.}$$

for the right weight to hold the governor down to 30° at 210 revolutions, which is surely a wrong result?

As a contribution to the examples of high-speed governors, which I hope some may be good enough to send us, I send Fig. 2, which is traced from Messrs. John Bourne's "Description of a Horizontal High-pressure Steam-Engine," published by themselves. It is mounted on the cover of the equilibrium throttle valve, and is simply a hollow sphere of thin brass, cut into segments longitudinally, so that it may become oblate or flattened at the poles when rapidly revolved. One pole being fixed, the other (outer) one pushes the central spindle inwards so as to close the valve. I cannot make out what provision there is for packing that spindle, but the scale is very small. This plan seems to me the prettiest thing of the kind I have seen; but I do not know whether they have been found to answer well. I believe it is not a patent.

F. A. M.

FIG. 2



PARAFFIN-OIL LAMPS.

[28606.]—AS an old correspondent on this subject, permit me fully to endorse Mr. S. Ray's observation (letter 28580) that "a paraffin-oil lamp, properly constructed and treated, cannot explode."

In Vol. XLI. of this paper (letter 24208, p. 215) I entered at length into the use of "Mineral Oils as Domestic Illuminants," and will here limit my observations to the safety or danger in the use of these oils. Doubtless many accidents do occur, with fatal results, from their use, yet I am convinced that if the public were in possession of all the facts of each case, they would find that some neglect or ignorant use of these oils caused the damage. It cannot be too strongly affirmed that the oil never can explode: it is only the vapour, and that only at a high temperature, and when mixed with atmospheric air, that can explode.

If lamps are properly constructed, there should be no communication between the flame and the container except the wick-sheath; consequently any vapour rising from the oil must pass through this, and if the wick is a proper full fit, the vapour is at once brought into contact with the flame and consumed without any danger.

Most accidents (?) reported in newspapers, however, occur from the destructive fracture of the lamp either from falling from a height or being thrown from the hand in temper. This creates a condition of the oil that can never exist in fair use; the violence of the impact causes the mass of the oil (if it escapes from the container) to spray, and in this state it is highly explosive and combustible, and sure to ignite all inflammable matter with which it comes in contact: in this condition only is the oil of itself dangerous. The most terrible instance of this fatality was the destruction of the Irish Mail at Abergele some years since.

Except from fracture, the only danger in a well-made lamp is from having the wick too narrow for the sheath, which enables the vapour to rise directly to the flame, and may cause a slight explosion, or (if a lamp is *so conditioned*) blowing down the chimney may ignite the gas; really, however, the great precautions to be taken are to avoid the violent fracture of the lamp, careless trimming, accumulation of dirt and consumed wick at the bottom of the fittings, or turning the wick down too quickly, or too far, and letting it drop into the vase while still smouldering or alight.

Many accidents happen by the substitution of benzoline for paraffin. This material is highly explosive, and should never be used as a domestic illuminant.

In conclusion, let me state a few *facts* showing the safety of these oils. I, and my two brothers, use them as illuminants, our consumption is about 120 gallons a year each; we have used this quantity for ten years; say the three households have burned over 3,000 gallons in this time. Between us we have about thirty lamps in use, of seven different makes, and in all that time we have had no accident whatever. We buy our oil by the cask, but keep it in iron drums. Some would-be consumers fear the storage of oil in their houses. Let them be assured of its safety from the following facts:—A fire occurred in an oilshop in Kingsland some time since, and the place was nearly burned out, the solder on the ornamental rings of the oil-drums was melted, and the rings fell off, yet their contents, 80 gallons of paraffin, were uninjured. Again, at the fatal fire in the Southwark oilshop, where a brave girl was lost in endeavouring to save some children, the insurance experts found little salvage except three casks of mineral oil, greatly charred, and nearly burned through, but with their contents quite safe. I have used the word "paraffin," but my observations include all mineral oils.

J. B.

AN exhibition of Irish industries is to be held at Olympia, Kensington, during the coming summer, in which will be made a comprehensive display of the products and manufactures of that country. With a view to giving the humble Irish artisan the same opportunities for display as the large manufacturer, no charge will be made for the space occupied except in special cases. The exhibition will be opened on the 4th of June, and will remain open until the end of October. Among the special features will be the representation of an Irish village, with veritable peasants at work upon their cottage industries—the dyeing of yarn, making lace, knitting, &c.

REPLIES TO QUERIES.

**** In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[64216.] — **Coal-Washing Machines.**—For economy in working and simplicity of arrangement the trough-washing system is one of the best where there is a moderately good supply of water. One man and two or three boys should be sufficient to work it.—T. O. D.

[64231.]—**Preservation of Slate Roof.**—Any colouring matter, such as plasterers use, mixed with the cement will do, but I doubt if you can get the cement to stick. We of the trade consider an old and leaky roof incurable. SLATER.

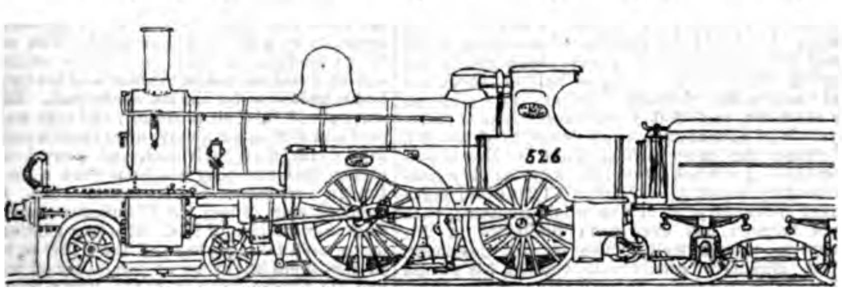
[64293.]—**Electric Lighting.**—Gaulard and Gibbs were, I believe, the first to apply the alternating current transformer for lighting on a large scale. Their first application of the transformer in this country was in 1884 (though they had exhibited at the Aquarium in the previous year), when they lighted the five stations on the Metropolitan Railway. The installation was not a success, owing to the converters being but then in an experimental stage and placed in series.—F. C. ALLSOP.

[64359.]—**Wheatmeal Bread.**—Though "Elementary Chemist" may think my statement astounding, yet I shall adhere to it unless he can convince me different. But I am in duty bound, I think, to quote from something after such an imperative demand, from such an august personage, if you, Mr. Editor, will find room for it. I give below part copy of a table of the composition of foods, I have by me, which include wheatmeal (average of 14 analyses), household flour (best quality), fine flour (from white, soft, English wheat), and coarse bran—

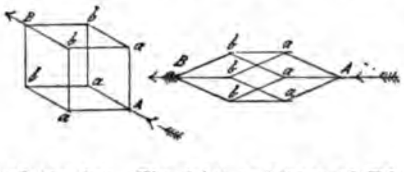
100 Parts Contain.	Flesh formers.	Heat producers.		Mineral matter.	Water.
		Starch, Sugar, &c.	Fat.		
Wheatmeal	14·6	67	1·2	1·6	14
Household flour.	16·2	70	1	·7	12
Fine flour	10·5	74	0·8	·7	13
Coarse Bran	15	44	4	6	14

Please note particularly the two columns, Fat, and Mineral matter. Liebig says that whole-wheat meal contains 60 per cent. more phosphates than meat, and 200 per cent. more than white bread. Now, if the phosphatic salts are necessary for building up and sustaining the bone of our bodies, besides tissue, I think it is not needful for me to tell "E. C." again that for a foundation food to be deficient in those qualities would be delusive (to put it mildly). But, I say further, by taking that away which nature has endowed it with (in this case) makes it unwholesome, and "almost" worse than useless. I do not base my assertion so much on what, chemically speaking, white bread contains, but from what it does not contain. When "E. C." has had some practical personal experience of what a food is capable of doing for the system (either for good or evil) according to its composition, he will find that to be robbed even of its innutritious substance would in time produce ill results. Let me here say I speak for the poor, or those who have to make white bread their chief food.—HYGIENIST.

[64369.]—**South-Western Engine.**—I inclose sketch ($\frac{1}{8}$in. = foot), as perhaps he and a few other readers may like to have a memento of it. On Monday, March 6th, this engine took a train composed of nine heavy bogie-carriages and two vans, to Bournemouth and back (230½ miles) on the occasion of the opening of the new line to the above-mentioned place. She is now at Salisbury, and one day runs from there to London and back (166 miles), and on the next to Exeter and back (177 miles), taking the usual main line trains, which consist on the average of between nine and twelve coaches; but of course it is impossible to state exact numbers. I hope to be able to give Mr. Grey some fuller and better particulars at a future date.—S. S.



[64379.] — **Resistance.** — By symmetry it is evident that the potentials at *b b b* are equal, and that the potentials at *a a a* are equal. We may, therefore, imagine *b b b* joined together and *a a a* joined together. The joint resistance of B*b* is $\frac{1}{3}$ ohm, of A*a* likewise $\frac{1}{3}$ ohm, of the six wires which connect them $\frac{1}{6}$ ohm. Hence total R. is $\frac{1}{3} + \frac{1}{3} + \frac{1}{6} = \frac{5}{6}$ ohm.—HERODOTE.



[64424.] — **Telescope.** — Now I have shown "F.R.A.S." "the way through the looking-glass," I will explain to "H. H." (presuming it is to gain knowledge), what he asks. When a pencil of light impinges on a plane of homogeneous glass at any other angle than a right angle, it is either totally reflected or else transmitted. In the former case the critical angle of the glass has to be reached, which depends upon its refractive index, and under these conditions the incident ray is totally reflected; in the latter case, however, the ray passing obliquely from a rarer to a denser medium—viz., from air to glass, is bent out of its original course, and this deviation is termed refraction. When the angle of incidence is 90° the ray passes through as if the glass were not in its path.—SOLAR RADIANCE.

[64547.]—**Problem.**—Those who have read my reply on p. 107 will have noticed an hiatus at the top of the middle column. A sentence was accidentally omitted from the 4th line. It should have read as follows: "Let us first put down those containing *a b*. They are five in number.—F. S. S."

[64547.]—**Problem.**—(Why not put every query a more definite heading?) This gave me, as it did "F. S. S.," the notion that no man was to have the same follower twice; and as each has but 11 comrades, how can he enter into more than 11 ring arrangements? In a straight line, too, he must be followed by one of the 11 or by nobody. How can more than 12 changes then be possible? I saw these were only upper limits, and the variations might be fewer, as "F. S. S." seems to prove. It seems they can only be an even number, and can only equal the individuals when these are even and ranked in a row. In a circle the changes are one less than the men if odd, and otherwise two less. As "F. S. S." is by no means so right about "Magic Squares," p. 101, and tells us that, for those summing 1888, the extreme even numbers introducible are 22 and 942, it may be allowable perhaps to subjoin one with the lowest and highest even numbers, and another with the lowest and highest possible.

337	875	540	136	747	246	99	796
674	2	471	741	295	600	943	50
404	808	607	69	845	148	197	698
473	203	270	942	1	894	649	344

I offered Mr. Hampden one containing any two numbers he pleases, but if he pitches on 472 for one of them, it will have to be repeated. You see, when the eight low numbers are fixed, the eight high must be their complements to 944, so that 472 will require itself as complement. The eight low numbers may be any arithmetical progression whose highest does not exceed 471. Now, let us see how many such progressions are possible. The largest step for the progression is 67, as in one of the above squares, and it may be any number below that. In my other square it is 49; in Mr. Hampden's it is 60. The range plainly admits only two progressions with step of 67, but 9 with the step 66, and seven more with each lesser step, till with a step of 1 it admits 464. The number of progressions we can use is the sum of 67 terms, whose lowest is 2 and highest 464, so that the mean term is 233, which, multiplied by 67, gives 15,611. This is how many distinct sets of 16 numbers we can use. But any set of these can be arranged in three inconvertible ways, as a pattern of wall-paper, from each of which patterns any square of 16 will have all the properties of "C. P.'s" "nasik and four-ply" square (p. 60). The square may be so taken as to have at its upper left-hand corner any figure we please of the 16. Thus the 3 patterns give 48 radically distinct "nasik" squares, not reckoning as variations the turning any on each of its four sides, or reversing as in a mirror. If we reckoned those as distinct, our varieties would be eight times as many; but confining our count to those quite inconvertible, there are 48 times 15,611, or 749,328, each as perfect as that of "C. P." As for those no better than Mr. Hampden's American one, their variety must be manifold greater.—E. L. G.

[64533.]—**Two-Tint Writing.**—I regret my inability to answer J. A. Lockwood's inquiry as to any other kind of shading-pens. Indeed, I know nothing of the one under discussion, for, as I stated previously, I accidentally met with the advertisement in an American publication—the *Phonographic Magazine*, December, 1887. With regard to his remark that, although he sent cash, he did not receive the pen, I may point out that my first communication only appeared in "E. M." on March 2. Surely, when ordering anything by mail from U.S.A., it is not unreasonable to allow from ten to twelve days each way for postage, and perhaps a trifling delay in receipt of order or despatch of goods. Probably in the next issue J. A. Lockwood will inform us that he has duly received the pen, and at the same time will let us know how it works.—J. DROWLEY.

[64554.]—**Vapour Pump.**—Surely this querist should mention what sort of ice machine he means? However, he will find ample information in back volumes of all sorts—including those using ammonia and sulphuric acid, and those depending solely on compressed air. I do not know of any book on the subject.—E. G.

[64555.] — **Repolishing Piano.** — The carved work must be cleaned out thoroughly with soda and water, then turpentine, and repolished with "brush polish."—S. J.

[64563.]—**Kiln.**—If you cannot see back volumes try and get the loan of Muspratt's "Chemistry," Vol. II.—E. P.

[64592.]—**Model Boiler.**—Would not this query be best answered by referring to many replies in back numbers? The boiler must be caulked in the usual way with a caulking tool—that is, a sort of chisel, which, with the aid of a hammer, drives the metal close down to the plate underneath it. Caulking is really a spreading of the edge of the plate.—S. P.

[64599.] — **Razors.** — Cut what better when dipped in hot water? Probably because the hot water softens the hair, if that is what is being cut. —SELIM.

[64605.] — **Valves of Smith's Bellows.**— These are simply flap valves, as a rule. As to how fixed, it would be necessary to have a diagram to understand the query.—W. J.

[64608.]—**Zoophytes or Corallines.**—I think they are preserved from shrivelling by a thin coat of varnish—perhaps collodion is the best. — NATURALIST.

[64610.]—**Photo. Lenses.**—This question would need many pages and several diagrams to answer correctly. The shape of the lenses, and the material of which they are composed, depend to a certain extent on the combination it is desired to produce. Much information on the subject can be found in back volumes.—NUN. DOR.

[64613.]—**Lens - Polishing.**—I think "Isis" will find the method of polishing with paper in the articles by "Prismatique" in Nos. 976 (especially), 982, and 990.—NUN. DOR.

[64642.] — **Hot-water Fittings.** — The hot-water fittings of a house are perhaps at once the most simple and most complicated part of the house fittings. It is simple, for all that is wanted is (1) a cistern, (2) a pipe from cistern, (3) a boiler, (4) two pipes, one from top and one from bottom of boiler to top and bottom of (5) tank, or storage boiler, or cistern, (6) pipe from top of tank to roof, open at the end and supply of hot-water taken off this pipe, what could be more simple? But look at sketch in last week's "E. M." Suppose a frost to set in, supply pipe is frozen, but there is plenty of hot water; this, too, runs down. Next day perhaps there is a thaw. Cook has had a good fire, but is lamenting the want of hot water when—hiss!—bang!—and the doctor says that cook will get better, but will always bear the marks of the burns. What has gone wrong? Why, the front of the boiler was almost red-hot when the water came on, and, of course, the steam generating suddenly, burst the boiler; but if the supply scullery had been taken from the top of circulating tank (or figure Y in sketch, provided Y be large enough, say, 30 or 40gal.), this could not have happened, because it would have taken some weeks to have evaporated so much water, placed as it would be at a considerable distance from the fire. If the querist cares to advertise his address, I will give him particulars of fittings required for such a house as he may have to fit up, and prices also, if he wishes.—Shilings Road.

[64652.]—**Musical Watch.**—Thanks to J. Skinner for his reply. In the inside of the case of the watch we have, there is a diamond-shaped stamp, in which are the letters B. G., and something else that I can't make out. Underneath the stamp there is the figure 2. I forgot to say that the watch also chimes the quarters.—G. E. H.

[64682.]—**Battery.**—To Mr. Bottone.—When the external resistance is greater than the internal, the addition in series increases the current. About 32 square inches of negative surface in each cell will be ample.—S. Bottone.

[64699.]—**Soap-Bubbles.**—In America I received the following recipe: Shave Castile soap thin, and make a saturated solution of it in pure water. When dissolved, add an equal bulk of glycerine. Let stand for a week. Decant clear liquor, then stand for another week and decant again, and this for six weeks. The resulting clear liquid will be ready for use, and will keep. I found it difficult to decant or to siphon off, for the murky part so readily flows over with the clear, so I filtered it through four folds of muslin. With a 2in. or 2½in. ebonite or glass funnel fixed in the end of an indiarubber tube, I have blown bubbles over 2ft. in diameter with this liquid. When first mixed, it gave the "black spot" most perfectly on a flat film formed with a ring of brass wire; but now I cannot get this appearance, the mixture being some 18 months' old, and rather viscid. One curious effect I got was that two bubbles could be bounced or rubbed against each other without joining. Pepper's "Playbook of Science" gives a simple recipe, p. 57, with the experiment of floating a bubble on carbonic acid gas, and lighting it up with oxy-hydrogen lantern.—T. F. S. T.

[64707.]—**Sulphuretted Hydrogen.**—The whole point of the apparatus I described has been accidentally omitted—viz., that the rubber tube C permits the inner tube A to be drawn up away from the acid when not in use, while at the same time fitting airtight round A. When required for use A is pushed down into the acid, which enters through the small hole in A and attacks the sulphide.—Ursa Minor.

[64737.]—**Pharmacy.**—I should think the letters referred to by "G. C." were the chemist's private mark by which he indicated the price he had charged.—Doctor Med.

[64737.]—**Pharmacy.**—"G. C." need not be alarmed at the addition of the letters "v. g." to the prescription by the druggist who dispensed it. It is a concerted method of letting his brother druggists know the price he has charged for the infusion, so that when they come to make it up at a future time they will make the same charge, and so avoid the "evil-speaking" of customers. A word is agreed on—such as "vermifugal"—the first letter signifying one, and so on; if this happened to be the word agreed on in your town the price of your infusion was 1s. 8d.—B.Sc., Plymouth.

[64745.]—**Separation of Tin.**—If you have a quantity you had better sell. If you want to do a little experimentally you can dissolve your alloy by boiling in strong nitric acid (cost about 8d. per pound). The lead, copper, and zinc will dissolve the tin, and antimony will be converted into oxides, which are insoluble in nitric acid, thus remaining as a white insoluble sediment, which may be obtained by filtering the solution (after diluting with water) through blotting (or filter) paper, placed in a glass or porcelain funnel. The separation of tin and antimony is a rather complicated operation, and hardly to be undertaken by any but a practical chemist. If "T. J. N." wishes to know how to proceed further, I shall be pleased to give him the information. There are many side issues, even in the above simple process, which may seriously affect the result.—Metallurgist.

[64750.]—**Diaphragm of Telephone.**—About six layers, 10in. or 12in.—S. Bottone.

[64754.]—**Percentage of Oxygen.**—I see that this query, concerning which I have received a post-card from "A Workman," has been answered this week by "Chemist." The reaction of hydroxyl and potassium permanganate on each other is very remarkable; both have an excess of oxygen, and they evolve it free.—Wm. John Grey, F.C.S., Analytical Chemist, Newcastle-on-Tyne.

[64758.]—**Engine.**—It is impossible in the space which could be afforded in these columns, and in the absence of particulars, to give you advice which could be of any value. Possibly your engine could be improved at a slight expense and made to work economically; but it all depends on circumstances, as does also the question of what kind of engine it would be best to put down. If you like to write to me direct (preferably as soon as possible), and give particulars, I shall have pleasure in affording you any help on the matter, and tell you what would be your best course to take.—G. N., 5, Iron-street, Park-street, Newport, Mon.

[64761.]—**Steam Launch.**—It is practically impossible to do as you purpose. An engine, powerful enough to drive the boat at a speed of even three miles an hour, with a pressure of steam allowable for ⅛in. boiler plate, would of itself be of enormous weight—far too heavy for the boat to carry. The boilers also would take up the available space in the boat. What is your obstacle to using plate more than ⅛th for boiler? If you will let me know particulars of your difficulty and tell me exactly what you want to do, I shall have pleasure in affording you any help on the matter that you may require.—G. N.

[64763.]—**Heat of Combustion.**—The heat developed by the combustion of a compound almost invariably differs from the value calculated from its elements, being less if heat has been evolved in forming the compound, but more if heat has been absorbed. This principle is well illustrated by marsh gas and ethylene. The calculated calorific power of CH_4 is—

$$(8{,}000 \times 12) + (34{,}000 \times 4) = 232{,}000,$$

its actual power is 209,600, and the difference (22,400) is usually taken to represent the heat evolved by the action

$$C + 2H_2 = CH_4.$$

It must be noticed, however, that the actual heat of the last equation is really the difference between two actions—i.e., the heat evolved by the chemical action and the heat absorbed in rendering the carbon gaseous. In the case of ethylene we have for its calculated power

$$(8{,}000 \times 24) + (34{,}000 \times 4) = 328{,}000,$$

its actual power is 333,200, hence the equation

$$C_2 + 2H_2 = C_2H_4$$

involves the absorption of 5,200 units of heat, subject to the correction above mentioned. The calculated heat of a carbohydrate is that due to the carbon alone, and taking the formula of starch as $C_6H_{10}O_5$, its calculated calorific power would be 576,000 units per molecule, or about 3,600 units per lb. If it really yields the quantity stated by the querist, then the equation

$$C_6 + H_{10} + O_5 = C_6H_{10}O_5$$

represents the absorption of 1,296,000 units of heat.—Wm. John Grey, F.C.S., Analytical Chemist, Newcastle-on-Tyne.

[64783.]—**To Weld Steel.**—I have no doubt any information on this subject would be very acceptable to very many of "ours," especially if the rationale of the various processes can be given. It is ignorance of the latter that causes a large proportion of the failures, especially in welding cast steel. The principal mistakes made by those not accustomed to the work are to heat too hot and to hammer too hard. Of course iron (in the absence of a tendency to "red-shortness") may be heated with impunity, and the hotter the easier it works; but over-heated steel is comparatively worthless for many purposes. The amount of heat required varies (inversely) as the amount of carbon in the steel. When once sufficiently heated remove instantly; tap lightly at first till it begins to adhere, then increase force of blows by degrees. The flux used is mostly borax, though many samples require an even more fusible one, to produce which a small proportion of sal-ammoniac is added. The use of the flux is necessitated by the fact that in heating a film of oxide of iron is formed on the surfaces, and the object of the borax, &c., is to render this as fluid as possible; but a perfect flux should do more. It should be capable of restoring to the steel any carbon that may have been eliminated during the heating. Now, as neither borax nor sal-ammoniac contains carbon, an addition is advisable, and that found most useful is ferrocyanide of potassium (yellow prussiate of potash). Perhaps the most perfect fluid is Dr. Rust's formula. I was not aware till I saw the very interesting replies on pp. 109-110, No. 1,201 (each worth many times the price of the whole number), that this formula had ever been published in this country, though well known on the Continent. Will "Engineer" kindly state whether his second formula is correctly printed (the rosin being omitted in the copy)? The origin of this form of the recipe was: borax 64, sal-ammoniac 20, prussiate 10, rosin 5, the whole to be boiled with a little water, stirring constantly until a homogeneous mass is formed, which is allowed to dry slowly in the same iron vessel in which it is formed. After many experiments Rust modified the recipe as follows, producing a compound by which it is claimed that the welding can be done at a light yellow heat, or a temperature between that and a white heat, the quality of the steel not being in the least deteriorated: Borax 61, sal-ammoniac 17¼, prussiate 16¾, rosin 5. The borax and sal-ammoniac are powdered, mixed, and gradually heated till they melt in the water of crystallisation of the former, and the heating continued, stirring constantly till the odour of ammonia, at first very strong, is scarcely perceptible, water being added to replace that lost in vapour. The powdered prussiate and rosin are then added, and the heating continued, with constant stirring, till a thick paste is formed, and till a weak odour of cyanogen is observed, when the heating must at once be interrupted, or the prussiate will be decomposed. The thick paste is spread out on a sheet-iron plate in a layer not more than ½in. thick, and dried at a moderate temperature. To facilitate the drying, the paste is turned with a spatula so as to form lumps, which are to be put away for use. When required, a sufficient portion of one of these lumps is to be powdered and scattered on the article to be welded (already heated to a light red). It is then heated to a strong yellow, and the welding accomplished in the usual manner. Now, by considering the chemical reactions occurring in above process, Rust was led to devise a simpler formula. In the process the borax (sodium biborate) and sal-ammoniac (ammonium chloride) are decomposed, boracic acid and sodium chloride (common salt) being formed, and ammonium expelled (as stated). So that a composition having the same properties can be formed directly by using boracic acid 41½, well-dried salt 35, prussiate 15½, rosin 7½, dried sodium carbonate 5, which, it will be seen, is almost identical with "Engineer's" formula (p. 109). It may perhaps be advisable to mention that carbonate of soda in this recipe means carbonate of soda (that is, washing soda), not the bicarbonate, as used in cookery, &c. The washing soda is dried by placing in a shallow vessel and applying heat (say in an oven), when it will soon melt in its water of crystallisation, which will rapidly evaporate, leaving the soda dry. The great objection to this (simplified) formula is that it decomposes so readily. But as it can be so readily prepared some would no doubt prefer this to the previous formula, which is not open to this objection. Possibly the composition mentioned by "A Blacksmith" (p. 89) might be one of these. As will be readily believed by many of "ours," I get hundreds of formulæ of this and other kinds offered me from all parts of the world. Among others I have one from Austria, and another from nearer home, of welding fluxes, which, if as good as stated, must be valuable indeed, as they are even simpler than the last formula given, and can be produced at a cost barely exceeding 1d. per pound. As I have not at present the necessary time and convenience for testing these, I shall be glad to furnish both forms free (by post) to anyone interested, for the mere trouble of testing the same.—Percy W. Stanley, 5, Billson-street, Poplar, London.

[64787.]—**Dying by an Effort of Will.**—In an American quarterly periodical I find this story, on English authority, which seems worth the notice of "F.R.A.S." and your readers:—"It is the case of a Fakir who in 1837, at Lahore, voluntarily passed into a state of apparent death, in the presence of Runjeet Singh, was interred in a tomb whose only door of access was closely locked, the lock being sealed with Runjeet Singh's private seal, and remained thus closed for six weeks! The Indian ruler who was entirely sceptical as to the ability of the Fakir to return to vital action as he had promised" [the Singhs are the Sikh royal family, who have renounced the Hindoo religion for a kind of Positivist philosophy], "had placed a detachment of his own private guard on duty to watch the tomb day and night, report being made each two hours. At the expiration of the time, Runjeet Singh invited Sir Claude Wade, who had been cognisant of the burial, though he had arrived a few hours too late to be present at the event, to witness the disinterment. The seal was found perfect, the tomb absolutely undisturbed, and no doubt existed in the minds of the two that it had remained so for the six weeks past. The tomb was opened in their presence; the man was found cold and stiff as a mummy—eyes sunken and glazed as in death, flesh shrivelled, and everything indicating that the body had been dead a long time, though without decomposition. An English medical man, whom Sir Claude summoned, could find no indication of life. The two gentlemen sat down, each taking a hand of the Fakir in his own, so that there might be no possibility of collusion, and the Hindoo friends of the Fakir commenced the work of resuscitation, by means of heat, friction, &c. After many minutes signs of life were manifest, and in less than an hour the man was fully recovered, to the intense astonishment of all except the Hindoo enthusiasts, who had all the time perfect faith in the Fakir's powers." The American quoter proceeds to point out the important differences from Christ's case—that the nly claimed power to lay down his life, not e it again," the recovery being professedly ent on his friends; and that he received no , even in his hands.—E. L. G.

5.]—**Wimshurst Machine.**—2¼in. long, in. by ½in., made from sheet brass, 14 in . I have with a glass rod drawn an 8in. rom the machine.—F. S. FOWLER.

8.]—**Swing-Back.**—This querist scarcely o have got the information he seeks. Swing- lens throws the centre of the focussed owards the edge of the plate, and may thus e opposite edge (and corners) outside the lens is intended to cover sharply. Swing- plate holder or focussing screen keeps the f the picture opposite centre of lens, and of the plate within the area intended to be by the cone of light coming from the lens; nay occasionally enable an object very near era on one side to be brought into focus, t throwing out of focus an object far off he camera towards the other edge of the .—T. F. S. T.

8.]—**Photography, Swing Back.**—If al to the view" means that the lens must be vertical, this is not the case when the is tilted up in order to take in, say, the a high building, nor is the base-board then The converging lines on a tilted focussing are corrected by the back, which simply the bottom of the screen, say, an inch he bottom of the front, the top of the and the top of the front remaining *in uo.* Now, I want to know if I can get ne correction by moving the bottom of the like distance from the foot of the screen. ears to me that by swinging the front of d camera, the lens is, or may be, brought normal position, if that position is vertical. as with swing fronts are advertised. Can e used only in conjunction with swing —D. G.

7.] — **Photography.—View Meter.**—I ry I can't give page references where they scribed, as my *British Journals of Photo-* are at the binders; but there are many in ar's volume. The best and simplest I know t possibly it won't suit your camera) is the focussing glass is hinged. All you have hen is to procure a spectacle glass of the ocus as your lens, and fix it up with wire liding valve on the front of your camera, it is centred on the focussing screen (when rned up), just the same as your lens centres screen when it is down in its place; then e you are watching for a yacht to pass the of the plate: you focus the camera sharply part of the sea where you expect the yacht ; then turn up the focussing screen into a l position, fix it, and focus your spectacle arp on it; put in your dark slide, draw the , hold the drop of your pneumatic or other in hand, and watch your focussing glass cted on by the spectacle or single lens) until e the yacht in position; drop the shutter, our picture will be in position. This de- on needs no specifications or drawings; so I trespassed on the Editor's valuable space, you can't get access to Journals.—B.SC., uth.

07.]—**View Meter.**—I send sketch of a eter I made myself a year or two ago, and ost useful. Fig. 1 is a front view, as it is

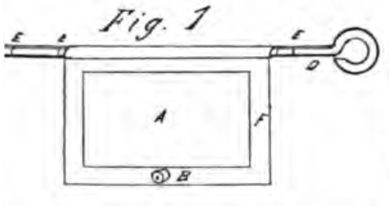


Fig. 1

d in the pocket; Fig. 2 the side-view, as in It is made of thin sheet brass, rolled over the upper edge to take the wire stem D. The re A is of the same *proportions* as the plates

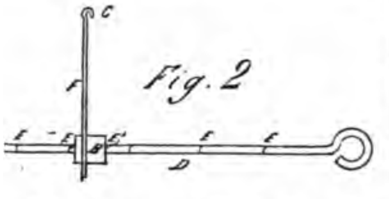


Fig. 2

sed (in your case, say, 2½in. by 2in.) B is a iece of brass tube, about ⅜in. long, soldered hole in the lower part of the frame. It is fitted with a piece of cork, through which the stem D slides stiffly when in use. To graduate it, focus your camera on some fairly distant view, and notice how much is taken in on the focussing screen. hold up the view-meter, as Fig. 2, with the looped end of D touching your cheek-bone, and slide the frame F along D, until it takes in just the same amount of view as the lens. Then file a notch E′ on D, close to the end of tube B. Do the same for each lens, as at E E.—URSA MINOR.

[64810.]—**Chemical Analysis of Steel.**—To describe what "Not a Chemist" wants, to do it properly and intelligibly, would occupy several columns of the "E.M."; and if the querist knows as little of the subject as his *nom de plume* seems to imply would be of doubtful use. A proficient iron or steel analyst has gone through a long, and probably costly, studentship and apprenticeship, and the querist must not think he can learn what he wants in a few hours through the medium of this paper. If a public library is accessible, consult suitable works; there aremany such.—METALLURGIST.

[64817.]—**Testing Oxygen.**—Procure a tube closed at one end, say ½in. or ¾in. diameter, 1ft. long. Fill it completely with water, and invert same over a basin of water supporting the tube by suitable means, so that its open mouth may dip a couple of inches below the surface of the water in the basin. There should be no bubble of air at the top of the tube. Now replace the water by oxygen gas conducted to the lower end of the tube by a length of glass or rubber tubing. Half-fill your tube thus with oxygen, and introduce into the gas to be tested, by means of a bent wire, a lump of phosphorus which should be placed in contact with the closed end of the tube. The phosphorus and the oxygen will combine, forming an oxide of phosphorus which will dissolve in the water. The level of the water will consequently continue to rise until the whole of the oxygen or the phosphorus is consumed (the latter contingency can be insured against by employing a sure excess of the phosphorus). If any nitrogen were present in the sample of oxygen, it will remain in its normal and uncombined state during the whole process, and any space at the top of the tube not occupied by water after, say, 24 hours. "Phosphorising" may be attributed to this or other gaseous impurity.—METALLURGIST.

[64817.]—**Oxygen.**—The following is a simple method, by means of which you may determine the percentage of oxygen in your gas. The apparatus required consists of some phosphorus (yellow), a piece of copper wire, a piece of glass tubing about ⅛in. in diameter, and a glass measuring cylinder, about ½in. in diameter. In order to make an estimation with this apparatus, the first proceeding is to melt some of the phosphorus under water in a small basin, and then carefully suck about two inches into the narrow glass tubing, down which has been inserted the copper wire. The phosphorus is kept in position in the tube by placing the finger over the top, and cold water is poured round the tube until the phosphorus becomes solid, which is then drawn out by the copper wire, and is now ready for the next operation, which consists of filling and inverting the graduated measure in a trough of water, and then collecting a sample of the gas. The phosphorus is now pushed well up into the gas by means of the wire; a slow oxidation of the phosphorus takes place, and phosphorus and phosphoric anhydrides are produced, which dissolve in the water, forming the corresponding acids (H_3PO_3 and HPO_3). In about two days all the oxygen will be absorbed. The difference between the volume after absorption and the original volume gives the quantity of oxygen in the volume taken, and this may easily be expressed in per cent. as follows: $\frac{a - b \times 100}{a}$, where a = original vol. of gas taken, and b the vol. after absorption. This, of course, neglects temperature and pressure. The graduated tube may easily be made out of a piece of combustion tubing, by sealing one end, and graduated by pouring in successive portions of water. It is as well not to use too large a quantity of gas (about 50 cubic centimètres is a good quantity to work on), or the phosphorus might need renewing. Mr. Bottone's proposal of burning phosphorus in the gas is entirely impracticable, as the violence of the burning of the phosphorus is so very great that it would certainly crack any suitable measuring cylinder, to say nothing of phosphorus being extinguished by the sudden inrush of water.—CHEMIST.

[64821.]—**Measuring Buildings.**—My method of calculating this I will try to explain without a diagram. Draw the figure on paper, taking care that the angle A B C is square. Cut out one of the triangles P A B, and, using B as a centre, slew this triangle round so that the point A comes on C, and half the point P will take up a new position, which call Q. Fix the triangle in this position, and draw a line from P to Q. This forms an additional triangle P B Q, containing two sides 40 long, a right angle at B, and the other angles 45° each. From these data can be calculated the length P Q, thus giving the whole triangle C P Q with its three sides known, from which can be calculated the angle at Q, and, finally, the required length, B C, which is 31·488.—SIMONIDES.

[64821.]—**Measuring Buildings.**—Call line joining P with left-hand corner *a*; ditto to nearest corner *c*, and the same to right-hand corner *b*; also call the side of the square *x*. Then at the nearest corner we have two obtuse angles and the right angle of the square. Call the left-hand obtuse angle A, and the right-hand angle B. Then we have B = 360° − (A + 90°) = 270° − A, and therefore cos. B = − sin. A, and therefore $\cos.^2 B = 1 - \cos^2. A$. We can now substitute for these cosines their values in terms of the sides of the two triangles to which the angles A and B respectively belong, and thus, after clearing of fractions, we get the equation—

$$(2cx)^2 - (x^2 + c^2 - a^2)^2 = (b^2 - c^2 - x^2)^2.$$

The numerical values of *a*, *b*, and *c* may now be substituted; but instead of 50, 40, and 70, it will be easier to put 5, 4, and 7, and multiply the final result by 10. It will be found that, after squaring and arranging terms, we have a quadratic in x^2, and that we get two results, or rather four, because x^2 must give two values, but the negative values may be ignored. The two values of x are 31·5 yards and 86·7 yards nearly. The first only is applicable to this case, as the latter could only be plotted on a plan if the point P were taken inside the square.—M.I.C.E., Bath.

[64830.]—**Delta Metal.**—I have just had some castings made in Delta metal, which seem very satisfactory, though I have not yet worked them up. The metal seems tougher than ordinary brass, and is supposed to have a breaking strain equal to wrought iron, though it will not stand as much bending about as the latter. I believe it can be forged hot. In colour and hardness it resembles gun-metal. The price is, I believe, about the same as that of the best brass. I do not know anything practically about its casting properties, but I believe it runs freely, and casts sound and clean. I should think it would be an advantageous substitute for brass for model work, &c.—URSA MINOR.

[64830.] — **Delta Metal.** — I am not at the moment able to give the price of Delta metal as compared with brass, the values of both metals having changed so violently during the last few months. According to my ideas, you may reckon it at about 2½ times the price of brass. It has a somewhat higher melting point than brass, but there is not so much difference as to give any difficulty. It makes beautiful castings, remarkably free from blow-holes. It is, however, very hard, far harder than the hardest brass, and I have even known some of it to be as hard as steel. Will "C. T." (query No. 64864) please note this latter remark?—METALLURGIST.

[64831.]—**Mathematical.**—Let r = radius O C, R = distance from C to the centre of gravity of Q. Then P r = Q R. From which equation (as P, r, and R are known), Q will be found. To find centre of gravity of the crescent Q, cut out its exact shape in stiff paper, and suspend same successively from any two points (say near the two horns). Let plumb-line descend from same points of suspension, and mark this line on the paper in both cases. Where the two plumb-lines, as thus successively marked, intersect, will be the required centre of gravity. Stick a needle through the paper at that centre. Hold the needle horizontally and turn the crescent round thereon. You will find the crescent will rest in any position, which will prove your centre is correct. I fail to grasp the meaning of the following part of query—viz., O C = C O B = A. The cent. grav. of Q may be found by calculation or by construction; but I think the experimental method preferable in this case.—FRANK CAWS, Sunderland.

[64837.]—**Watch Repairs.**—The jewel-holes of all watches, when there is friction by the pivots, should be oiled;—the cylinder of horizontals also, which is generally done by oiling the 'scape-wheel teeth, which in turn oil the cylinder. The ruby pin of levers should never be oiled; but always oil the 'scape-wheel teeth (excepting chronometers or duplex crown teeth). You can get an assortment of cylinder plugs, but it requires care to replace one, having first to remove the broken one. There are many ways of replacing broken pivots; the simplest way I know of is by the wax lathe. First get a suitable chuck, then soften work (if too hard to drill), secure work true with shellac, heated by spirit-lamp placed under or near chuck, at the same time holding against it a piece of pith or pegwood. When true extinguish lamp and remove pith or pegwood, then turn centre with graver, drill hole; file piece of tempered steel to fit; secure and turn true; then finish in turns or jacot tool.—F. T. REID, 33, Howell-road, Exeter.

[64833.]—**Brass Furnace.**—Herewith I append sketch of small furnace which I have had in use

Fig. 1

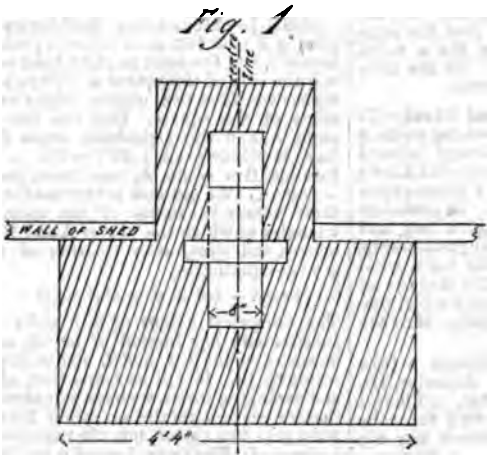
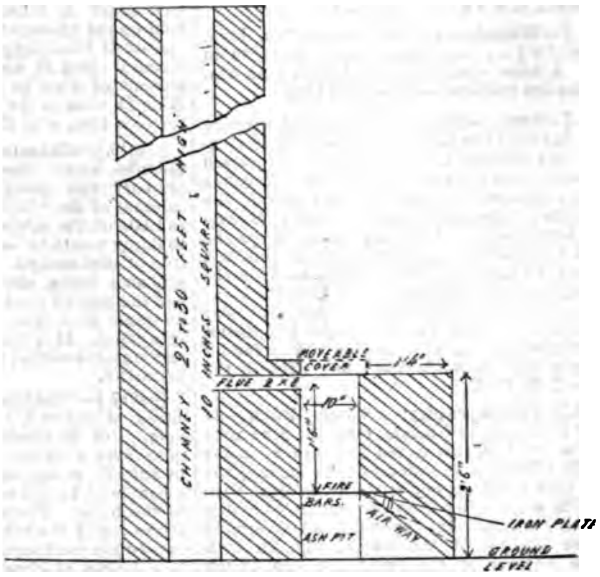


Fig. 2



for some time. By using selected foundry coke I have even melted several pounds of cast iron in it. The coke should be broken in pieces about the size of a hen's egg, and all dust sifted from it. Coal is quite inadmissible in this type of furnace. I should say that with charcoal as fuel, it would be quite practicable to braze. I use this furnace for all kinds of metallurgical experiments. The iron plate carrying the firebars ought to be a casting at least ¾in. thick, 2ft. 6in. square, having in its centre the rectangular space 10in. by 8in., forming the furnace. The movable cover may be formed of two bricks clamped together, and should always be kept on while melting. The furnace should never be filled with fuel above the level of the flue. Fig. 1 is plan; fig. 2, section along centre line of plan.—METALLURGIST.

[64840.]—**Science and Art May Examination.**—The best for urea is to make a concentrated solution of the salt, and then to add about an equal bulk of strong nitric acid; after a little time, crystals of urea nitrate will appear. The following are tests for morphia:—1. On addition of conc. HNO_3 to powdered morphia or its salts, an orange-red colour is produced, which after some time changes to yellow. $SnCl_2$ destroys the colour. 2. Sulphuric acid alone produces no colouration with morphia or its salts; but on adding a crystal of $K_2Cr_2O_7$ to liquid, a bright green colour is produced. 3. Morphia, free or combined, reduces iodic acid, liberating iodine, which colours the liquid brown. A piece of filter paper soaked in starch solution is turned blue when dipped in liquid. —M. ISADER, Lewes.

[64847.]—**Fuller's Battery.**—How would it do to reverse the arrangement of this battery and put the zinc as a cylinder outside the porous cell? It is evident by the zinc being in porous cell the outer solution soon saturates the fluid surrounding the zinc, whereas by reversing it, the liquid area being greater, it would take a much longer time diffusing itself.—ASSOC.INST.ELEC. ENGS.

[64847.]—**Fuller's Battery.**—I have had a great deal to do with this type of cell, and therefore hasten to correct the very bad opinion of its working powers which Mr. T. G. Slater's (p. 111) communication is likely to create in some minds. I will admit that a Fuller set up with a very thin, unparaffined, porous pot will certainly come to grief, owing to the rapid diffusion of the solutions and destruction of zinc by the bichromate. These cells were designed for telegraph and railway work, where a high int. r. is of no consequence. For these purposes the pots are invariably paraffined, in some cases the extent of working or porous surface not exceeding 1½sq.in. This cell has in great measure replaced the Daniell at the postal telegraphs, and is very extensively used on British and foreign railways.—W. PERREN-MAYCOCK.

[64849.]—**Centre-Seconds Watch.**—The appendage you mean is a laminated arm, composed of brass and steel, to compensate for the effect of expansion and contraction of the hair-spring and balance under influences of heat and cold. It acts upon the hair spring only. With heat it closes the curb pins, and gives the hair-spring less play; and with cold the reverse action, and, therefore, in a manner, fulfils the purpose of a compensation balance.—F. T. REID, 33, Howell-road, Exeter.

[64852.]—**Sail for Canoe.**—A A A, Fig. 2, is *not* the yard at the head of the sail, but a kind of supplementary yard inserted in a bag sewn to the sail 2ft. from the tack at K, 2ft. 9in. from the clew —i.e., the other end of the boom, B B. The blocks for reefing, D, E, F, G, are bound to this batten, spaces being cut out of the bag for the purpose. "Reefing," "Fife" seems to think, means taking in the whole sail; if so, he is in error. "Reefing" means taking in a part of a sail so as to expose a less surface to the wind. The greatest length to be taken in by the reefing gear is 2ft. 9in., not 9ft. 9in. The batten also keeps the sail flat, thereby making it hold the wind better. If this is not clear, I will explain again.—GOLDEN SLIPPERS.

[64855.]—**Dirty Water in Steam Boilers.**—I should say, from the explanation given, the water contains iron in solution; this, when fed into the boiler, is converted to brown ferric hydrate, or rust, from the liberation of carbonic acid by boiling. This iron can be removed by filtration through a proper medium; but no filter fixed to the suction of a pump would answer. If "H. E. P." would supply me with about a quart of the water in a clean bottle, I should be most happy to test it and forward him the result, as I am much interested in the subject myself. I have advertised my address this week.—CHAS. E. GITTINS.

[64858.]—**Copper Boiler.**—You do not say how longitudinal joint is made; but taking same at 65 per cent. of the solid plate, then bursting pressure equals about 90lb. per square inch; so work at 20lb. if ends are properly put in. The boiler is very thin for its size, so should be well supported. —TARA.

[64858.]—**Copper Boiler.**—If ends had been flat, they would have been weakest parts of boiler unless stayed. But domed ends are strongest parts —in fact, the endwise strength is double the crosswise strength when ends are domed. The calculation in present case is as follows: Take the strength at joint (i.e., at weakest part of boiler) as, say, 10 tons per inch of sectional area. Then multiply twice the ⅛in. thickness by 10 tons, and divide by 54in. diameter, and the answer is = ·0463 ton = 103·7lb. per inch bursting pressure. The safe pressure would, therefore, be 15lb., say, per inch, which would allow a factor of safety of 7 nearly. Anderson's "Strength of Materials" is a very good book on this subject.—FRANK CAWS, Sunderland.

[64872.]—**Electro-Gilding.**—Heating the bath causes the deposit to be of a darker colour. A redder colour is also produced by mixing in suitable proportions the electro-copper solution described in my answer to question 64882 with the gold solution, also given in same answer. The greater the proportion of copper solution used, the redder will be the colour of the gold deposited. Most likely the cause of the yellowish tinge of your plated articles is due to the deposit by galvanic action of a sub-cyanide of silver, which is rapidly decomposed and darkened by light. The sub-cyanide may be removed by either of the two following: —1. By leaving the articles for some time in the solution after the current has been stopped, when it is dissolved off by the cyanide of potassium. 2. By reversing the current for a few seconds, when it is carried off by the current in preference to the silver. Bisulphide of carbon in small proportion causes the deposited silver to have a bright lustre. One ounce of carbon bisulphide is added to a pint of a strong silver solution containing
cyanide of potassium; this is well sha
left for one or two days. When wanted
quantity of this solution is added to th
bath; but be careful to add only a very
time, as excess of carbon bisulphide is
spoil the solution.—M. ISADER, Lewes.

[64873.]—**Cement for Glass and**
Get an ounce or two of the best plaster
it must be quite fresh, or your trouble
vain. Put two spoonfuls of the powd
measure) into a cup, and add just one sp
water. Mix quickly, and well smear insid
collar and round neck of bottle with t
fit into places, and lay on small weight to
all superfluous matter. The great thin
quick about a job of this kind, so as
plaster begin to set before the parts ar
G. E. H.

[64873.]—**Cement for Glass and**
2lb. wax, 10lb. rosin, 4oz. plaster of Paris
ochre; or rosin 1lb., plaster of Paris (
These two require both brass and gl
heated to the melting-point of the cemen
it hold securely. The following does n
fine white sand, 1 pint litharge, ⅔rds of
finely-powdered rosin. Mix and keep i
bottle. For use, mix with boiled oil an
the consistency of putty. Do not mix
at once, as it dries quickly.—URSA MIN

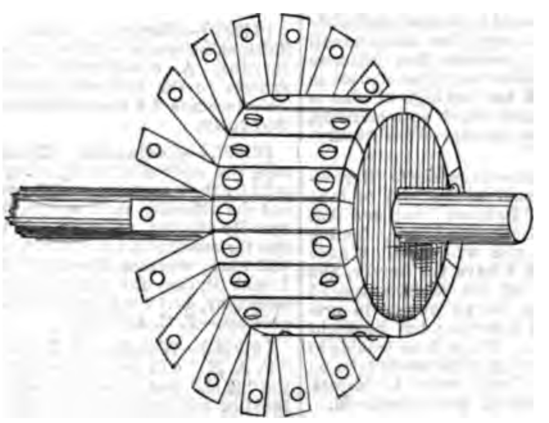
[64880.]—**Mounting Insects.**—Use
and cement to the slides with marine
insert the insect, &c., and put the ordi
circle over the top. These glass cell
more than pieces of glass tubing) can b
at all microscopical instrument dealers.
also use varnish cells (asphalte or blac
the best). Take a camel's-hair brush,
put the varnish on in a circle the size
make your cell, allowing each lot to
applying another.—S. S.

[64880.]—**Microscopical—To Moun**
without Disfiguration by Pressure
a store of slips of material of different
paper, cloth, leather, &c., of the usual
slide dimensions; punch in them ho
required diameter. Select, by trial,
thickness that when interposed be
3in. by 1in. slips of thin glass (G and G
approach so that, without compressing
in the cell thus formed, they are just
in contact with it to prevent its slippi
place therein. Glue the slip by, say,
solution to G, and superimpose G^2, at f
it close with thread, so that if it is pr
evaporation of moisture in the insect
dimness on the inclosing glass, it may b
before permanently gluing down G
mounted insects of all sizes up to mot
in this manner, and have been quite sa
the results. The object can be exami
well from either side of the slide, whic
otherwise if it were attached by an
material to the glass.—J. H. STOURES

[64880.]—**Mounting Insects.**—In
your query as to the way to mount smal
think you will find the following one
Having killed your insect with chl
ether, it is to be washed in three or f
taking care not to injure it in any wa
handling. It is then immersed in liqu

dge of the time that it should remain in ion can only be gained by experience; eneral rule, the object will assume a cer- nt of transparency when it has been long the alkali. When this has been found case it must be left to soak for two or rs in distilled water. It must now be with a gentle rolling motion, with a air brush to expel the soft contents of nen. The brush should be laid on the nd gradually rolled down over the Great assistance can be gained by now and then under the microscope f the soft parts are being removed oper manner. When this has been hed, take the object up with the brush t on a piece of thick, smooth writing- Arrange it in its proper position, place iece of the same paper on top, and put etween two glass slips, which must be d with one of those American clips. now be allowed to dry, which it prob- do in about 24 hours. Now unfold the ry cautiously, so as not to damage the hich must be placed in turpentine. The ing which it should remain in this liquid nd very much upon the density of the e wings of flies, &c., requiring much less ecome perfectly transparent than denser . When this has been done it must be e centre of a clean glass slide; a drop a balsam is dropped on to it. Warm side of the slide to cause the balsam ll into the tissue, and then allow a cover all slowly over it, taking care to let one e down first, and then lower the other id of a needle, thus driving the air- before it in a wave. A little clip should n to keep it well down until the balsam ny superfluous balsam which may leak e removed when dry by a piece of rag n chloroform. It may afterwards be suit the taste.—J. H. KIRK.

]—**Commutator.**—Get a number of segments, cast in gunmetal or brass, he number of sections on your armature. be cleaned up and fastened, by means of a boxwood or pear-wood core previously th asbestos. Great care should be used sections at equal distances all round the e core should be bored to fit tightly on the commutator itself trued up on the r the sections have been fitted on the e commutator can be held in its place on by a keyway and feather. In the free f the L-pieces holes are drilled to which of the armature can be secured either by or, better, by soldering. Annexed is a owing the style of commutator advised. TONE.



]—**Electro-Depositing.**—For a gilding dissolve 50 grammes of gold in "aqua parts of hydrochloric acid to 1 part of d), evaporate to the consistency of a water and 50 grains of potassium cy- d boil the mixture. When gilding, the ld be at a temperature between 60° C. and o make a silvering solution, 8oz. of silver dissolved in 5 quarts of water, and then rts of pure potassium cyanide. Stir the d filter from any iron which was con- the cyanide. This solution may be used or cold. For a copper-depositing solu- following formula is good. Water, 2½ stallised acetate of copper, bicarbonate of als, bisulphite of soda, and pure cyanide ium, each 1oz. To prepare this solution, e of copper is made into a paste with e sodium carbonate and some water to this, and the whole stirred. Then phite of soda and some more water are d, lastly, add the remainder of the water and the cyanide of potassium. If, after the complete solution of the cyanide, the liquor is not colourless, add more cyanide. When using this solution, it is best to have the surface of the copper anode nearly equal to that of the immersed articles. —M. ISADER, Lewes.

[64883.]—**Polishing Amber.**—"Turned works (in amber) are generally polished first with glass-paper then with rottenstone and oil" (Holtzapffel, Vol. III.)—URSA MINOR.

[64885.]—**Piccolo Lip Plate.**—Of what material is the plate? I have an idea that the taste may be traced to electro-chemical action.—W. PERREN-MAYCOCK.

[64886.]—**Orange Stain for Leather.**—"Journeyman" should procure a supply of the aniline dyes and experiment with them. By orange I understand him to mean what is termed yellowish buff, which, formerly obtained by a decoction of Persian berries and logwood, is now produced by the aid of naphthol yellow four parts to one of eosine. A "straw" would be produced by the aid of naphthol yellow alone.—NUN. DOR.

[64888.]—**Cork Composition.**—If mixed with raw indiarubber, about two of cork to one of rubber by weight, you will have the material called "kamptulicon"; if with oxidised linseed oil, that known as "linoleum"; and if with a solution of rubber and wood naphtha, that known as "cork carpet." But all these processes require powerful machinery quite beyond the means of an amateur. —T. C., Bristol.

[64890.]—**North Point on Maps.**—Clearly, if the map is unmarked, and you are ignorant of the bearings of the locality, it is impossible to set the map to the compass.—W. PERREN-MAYCOCK.

[64890.]—**North Point on Maps.**—Most maps (where the points of the compass are not indicated) are drawn as if the north were at the top, and so on; but when "J. R." is on his pedestrian tour he can easily test his map with a pocket-compass. Let him, on the first straight road he comes to, take out his compass and look the direction it goes in—N. to S., or E.N.E. to W.S.W., and so on. Having got this line, he can draw all the other compass points on his map for future reference.—B.SC., Plymouth.

[64891.]—**Hospital Floors.**—I have "walked" all the great hospital floors in Europe, and have seen all sorts of floors—stone, brick, tiles, wood, and even dried clay (in Africa); and I prefer (not personally, for I have often nearly fallen on them) oak floors, well waxed daily (red pine would, I think, be almost as good). The wax hinders the absorption of the messes which are unavoidable in a hospital.—B.SC., Plymouth.

[64893.]—**Micro. Slides.**—You do not say the medium on which your blood slides are mounted. If they are done by the drying method, which is one of the best, I think it will be impossible to get off the cover-glass without disturbing the forms. If moist, such as in solutions of mercuric chloride or potassic bichromate, the only difficulty will be in the possible hardness of the gold size. I use a very fine knife, first take off all the ringing varnish, then work the knife very carefully between the cover and the slide, only using enough force to bend up the cover-glass, not break it; in a very short time the cover rises off.—B.SC., Plymouth.

{64897.]—**Indicator Diagram.**—The fault appears to me to be in the indicator. Are you sure it is properly oiled and quite free to work. The diagram would be a good one if properly taken.—WM. GRIMSHAW.

[64897.]—**Indicator Diagram.**—This is probably caused by a dirty indicator. Take out the piston and clean it thoroughly, using a little paraffin. Notice if the cylinder is scored; if so, it had better be sent to the maker.—W. M. J., Dublin.

[64897.]—**Indicator Diagram.**—The fault does not lie with the engine but with the indicator; the spring appears weak and oscillates. Draw a line midway between the hills and valleys to obtain a mean. The diagram does not appear bad, but would be improved with a little more compression.—T. C., Bristol.

[64897.]—**Indicator Diagram.**—You did not mention the speed of the engine in question: it is probable that the excessive vibration due to a high rate of speed of the piston of the indicator is the sole cause of the irregular steam line on the diagram. Otherwise, the general appearance is good, showing a fair allowance for "cushioning," but also indicating that the steam pipe or ports might be increased in area with advantage if the engine is to run at a high rate of speed. However, the chief fault appears to lie in the indicator, not in the fixing, because the atmospheric and exhaust lines are good, but may be due to want of lubrication, a bent rod or cap on the indicator piston; but still we think that you will get a better diagram by another trial with a reduction in the rate of speed of the engine.—FREDERICK WALKER AND HYDE.

[64898.]—**Strength of Cast-Iron Pipe.**—Plenty strong enough for the pressure.—T. C., Bristol.

[64898.]—**Strength of Cast-Iron Pipe.**—Barely thick enough, especially when the stresses due to expansion sometimes come awkwardly on to a Tee-piece. Far better to take it out and put a wrought-iron pipe in its place.—W. M. J., Dublin.

[64900.]—**Fan Blast.**—A square wooden trough used to be a common conductor; but there is no objection to cast-iron pipes if made large enough. Another kind is the common earthenware sewer-pipes, jointed with Portland cement. A branch length at each hearth. Pipes, say, 9in. bore. Llyod's "Silent Fan" has a good reputation. Some correspondent might give their address.—W. M. J., Dublin.

[64903.]—**Bursting Pressure of Tank.**—The pressure on bottom due to depth = 5·2lb. per sq. in.; and as the pressure of fluid is equal in all directions, there is an outward pressure of nearly 5·2lb. per sq. in. on last inch of depth. The diameter being 96in., there is a bursting pressure = 96 × 5·2 = 500lb. nearly.—T. C., Bristol.

[64903.]—**Bursting Pressure of Tank.**—The diameter has nothing to do with the pressure; but the weight borne by the bottom is as its area by the head. The outward pressure at the bottom is also the head, or in this case 5·2lb. per square inch, or on the bottom area 6·68cwt. per square foot, or about 16¾ tons total weight. Thus, the total weight has to be provided for by the supports underneath the vessel, and the vessel itself must be strong enough for the outward pressure of 5·2lb. per square inch.—W. M. J., Dublin.

[64904.]—**Pebbles.**—Holes in pebbles are usually formed by the friction of sand set in motion by the movement of the waves. They are "pot holes" on a small scale.—SM.

[64905.]—**Great Orme's Head.**—From Orme, Scandinavian for serpent. Worm's head is another promontory whose name is similarly derived. See Taylor's "Words and Places."—ARTHUR MEE.

[64906.]—**Electric Clocks.**—TO "ACOLYTE" OR MR. BOTTONE.—I regret to say that not having seen the articles in *Industries*, I am unable to give an intelligent reply. If you would care to send me a copy, I would cheerfully advise, if I know anything about the matter.—S. BOTTONE.

[64907.]—**Cleaning Valuable Japanese Lacquers.**—Use a fine Turkey sponge, water about 70°, and white Castile soap.—B.SC., Plymouth.

[64909.]—**Cutters of Wood-Planing Machines.**—"Athenian" should use best cast steel or silver steel, and not the common steel known as spring steel. Good double-shear steel would do.—T. C., Bristol.

[64909.]—**Cutters for Wood-Planing Machine.**—Spring steel is not suitable for machine cutters. I understand there is a special steel for the purpose, not so soft as spring, nor so hard as most cast steel, which latter is apt to fly at the high speeds. They are supplied tempered throughout for flat planing.—W. M. J., Dublin.

[64911.]—**Electric Lighting.**—Theoretically, a dynamo capable of giving 150 to 200c.p. in incandescence lamps, would consume from ⅓ to ½H.P. Practically, it would be well to allow a little more. I know of no water-motor that would give that power with so little pressure as stated. A dynamo for incandescence lighting should be either shunt or compound wound; for arc lighting, series.—S. BOTTONE.

[64911.]—**Electric Lighting.**—You ought to get, under favourable circumstances of conducting your water to the motor, 200c.p., and the bea arrangement will be to use a turbine, the shaft of which is coupled direct to the spindle of a shunt-wound dynamo, or better still, a compound-wound dynamo. We have designed several small installations of this kind, and shall be pleased to give a sketch of one, with the Editor's permission, in next week's issue, where a cottage residence is illuminated by the electric light all the year round at a merely nominal cost for maintenance, the power being derived from the overflow of certain water-cress beds.—FREDERICK WALKER AND HYDE.

[64912.]—**Attractive Power of Selenoid.**—It is impossible to give a definite answer to this query, as the actual result will depend on the diameter of the selenoid, and the number of turns. In some experiments made by me five years ago, I found that a selenoid ½in. internal diameter, wound with eight layers of No. 20 wire 2in. long, gave a pull of 2oz. per ampère. The power decreases as it approaches the middle of the tube.—S. BOTTONE.

[64912.]—**The Power with which a Piece of Iron is Sucked into a Bobbin, &c.**—The force is proportional to the number of ampère-turns on the bobbin, up to a certain point.—W. PERREN-MAYCOCK.

[64913.]—**A Simple Way of Striking Arcs of Large Radius, and Finding the Proper Amount of Spherical Aberration in a Speculum.**—The first part of the query is best answered by referring to the old saw of "Try again." To the second part (if the Editor can find room), I can offer an old illustration of what was called a "spheriometer," and used for testing speculums, mechanically.—W. M. J., Dublin.

[64914.]—**Electrotyping.**—"The Elements of Electro Metallurgy," by A. Smee (Longmans and Co., 1843), is a very practical book on the subject, though perhaps now superseded by more modern works. On page 240 is described a method for obtaining the obverse and reverse of a coin in one operation, which, however, was not successful. Would it not do to make a mould of each side of the medal in thin sheet-lead, such as tea is wrapped in, by careful rubbing, turning up the edge to take the impression of the milling, if any; then, after having deposited the copper to a sufficient thickness, fill the two halves with solder, filing down till each is exactly half the thickness of the original, then fasten together, taking care that the edges meet, and so make a perfect medal? I have been successful in making very fine impressions of coins by the above method, and I hope "Limelight" will be equally so.—CHRONOS.

[64914.]—**Electrotyping.**—I have taken very good electrotypes in the following manner:—Take a strip of tinfoil large enough to cover both sides of the medallion, fold it over in the same way as a sheet of notepaper, and slip the coin into this; wrap the coin and tinfoil up in several layers of stout paper, and screw tightly up in a press; leave them thus for about a quarter of an hour, unscrew the press, and carefully strip the foil from the coin. Make up a solution of copper sulphate, 5oz.; water, 1 pint; sulphuric acid, ½fl.oz.; connect the tinfoil moulds with the zinc end and sheet-copper anode to the carbon end of a small bichromate cell, and hang them about 1½in. apart in the copper sulphate solution. The back of the foil mould must be varnished with sealing-wax or other varnish, and the front covered with blacklead by a soft camel-hair brush. I have not moulded them up as a coin; but with a little ingenuity you could, no doubt, do this—say each side of a sheet of lead, which could be cut off and coloured on the edge.—PRINCIPIA.

[64914.] — **Electrotyping.** — You will find every detail in Sprague's "Electricity." Briefly, all you need do is to get two clean impressions of the medallion, face and obverse, in good white wax, brush up the impressions with a fine camel-hair brush, dipped in fine plumbago, until they shine like a well-polished grate. These are then connected (not together, but one after the other) to the copper wire proceeding from the zinc rod of a quart Daniell battery. The connection is made by warming the copper wire, and thrusting it carefully into the edge of the impression. This point must be well brushed over with plumbago, so as to make a continuous coating between the face of the medallion and the copper wire. (No plumbago should be allowed to get on the back.) The zinc should now be immersed in the porous cell, and the medallion into the outer copper sulphate solution. The acid in the zinc cell should not be stronger than 1 to 10 of water. The sulphate of copper solution should be saturated, and acidulated with a few drops of sulphuric acid to each pint. An electro of each face having been taken thus, the two may be soldered together by placing back to back in a plaster mould, and running some melted type metal or solder between them. The edges can then be filed or turned up true, and coppered with a little sulphate of copper solution.—S. BOTTONE.

[64915.] — **Designing Valve Gearing.** — A work by the late Zerah Colburn, entitled "*Locomotive Engineering,*" in which a "diagram of the slide valve" is very clearly explained by Mr. Maw. The one in the "Practical Engineer" did not, in my opinion, compare with it. It is the A B C of the subject.—W. M. J., Dublin.

[64915.]—**Designing Valve Gearing.**—In designing these, it is necessary to first decide on size of ports and also point of cut-off. Having these particulars, you can calculate or set out amount of lap, and as travel should equal twice the width of port + twice width of lap, you can set off a circle whose diameter is exactly the same as the full travel of valve. "M." will thus see that as all valve travels are comparatively small, the circle can be set off full size, and not to scale; but the same circle can represent for convenience the path of the crank-pin, which will be to same scale. Above will probably enable "M." to understand "Zeuner's" method, which is the most usual. Where a cut-off plate or plates are used, and the cut-off is variable, "Zeuner" gives a diagram for finding the position of plates from edge of port in valve when the cut-off eccentric is in any position (but in advance of main eccentric) up to a point opposite the crank. The diagram requires some study, and I have not time at present to reproduce it; but if "M." can refer to "Ours" in, I think, 1886, I gave a simplified and large diagram containing the essential joints. A single D valve is unsuitable for a greater cut off than ⅝ stroke.—T. C., Bristol.

[64916.]—**Bicycle Rubbers.**—I never had to fix a rubber tire; but if I had to do so, and found the cement sold was rubbish, I should procure some raw indiarubber, and cut it up very small into a quantity of bisulphide of carbon contained in a wide-mouthed bottle, and let it remain several days until all dissolved, giving it an occasional shake. By using above as a thick paste on tire and rubber, previously well cleaned, success would most likely be the result.—T. C., Bristol.

[64918.]—**Closed Circuit Bell-Ringing.**—In reference to this battery, it bears a good name among telephonists, and Mr. Wharton, in his translation of "Hospitalier's Domestic Electricity," page 15, says, "Whatever supply of sulphate of copper is put into the lead tube, it never reaches the zinc.—ASSOC.INST.ELEC.ENGS.

[64918.]—**Closed Circuit Bell-Ringing.**—The cell should be placed where it is not likely to be disturbed, and the zinc (well amalgamated) should not be inserted till the liquids have had plenty of time to settle down. The lead cylinder, once filled with sulphate of copper, would not need replenishing for a good while. The very fact that the cell is on "closed circuit" prevents that ultimate diffusion of solutions which would take place in intermittent working. If the top edge of zinc is hollowed out, and the hollow filled with mercury, the amalgamation will be lasting.—W. PERREN-MAYCOCK.

[64919.]—**Breechloader.**—In answer to "Breechloader's" question, I would advise him to take either one of Holland's "Paradox" ball and shot guns or Lancaster's "Colindian" non-fouling smooth oval bore rifled gun with him. I have never used the latter, but I have the former, and I can speak very highly of its performance. I should think there would be no trouble in procuring the empty cases in America; but he might take 500 or 1,000 with him. There is no trouble in loading them, and the loading implements take up very little room. If he will write to Messrs. Holland, they will give him all particulars.—M.

[64920.]—**Mining.**—Certainly the farmer can claim surface damage, and you have no counter-claim, on account of the water draining through the bed working.—B. SC., Plymouth.

[64922.]—**Engine.**—You have not room to put on more than ¼in. extra lap, as there is not room in the valve-chest. But you cannot cut off at ¼ stroke with a single valve, or anything approaching it, economically. I should put on above lap, and shift eccentric forward to suit, and work at a lower pressure.—T. C., Bristol.

[64922.]—**Engine.**—Steam cannot be cut off at one-fourth of the stroke with a single slide-valve. "A. Z." is in error in stating his eccentric has 2⅜ths throw. The slide-valve has (by the dimensions) 2⅜ths travel and 11/16in. lap, and the steam is cut off at about ⅞ths of the stroke. This is about as much as a single valve can do, as to add more lap would shut the exhaust quite too soon. If he cannot attach a cut-off valve, perhaps the next best thing to do is to have a liner inserted in the cylinder, reducing its bore to about 8¼in. This would permit the full pressure with the present valve, and so avoid throttling, wiredrawing, and condensation.—W. M. J., Dublin.

[64923.]—**Electric Bell Relay.**—Is this a polarised relay or an ordinary iron armature? If the latter, fastening a piece of writing-paper to the armature will soon put matters right. Before doing this, however, reverse the battery connections; this will send a current through the poles of the magnet in an opposite direction, and will for a time destroy the residual magnetism which is the cause of all your trouble. After a while reverse the connections again. I had a bell with bad cores to the electro-magnet that I quite cured by doing as stated above.—ASSOC.INST.ELEC.ENGS.

[64923.]—**Electric Bells.**—Why not put the relay right? The spring should be drawn tighter. The cells, once polarised, will gradually recover if left alone, but certainly not in half an hour. To test for E, disconnect one pole of the battery (leaving the other connected to its leading wires), and inserting a detector, join it to E—i.e., a gas or water pipe. If this shows no deflec., try the other pole of the battery. Of course, this is supposing you have not used E returns. For house work it is preferable to run a naked copper wire for E connections. If house is small do not use E; doing so would save little, and greatly increase the chance of a fault cropping up.—W. PERREN-MAYCOCK.

[64923.]—**Electric Bells.**—The sticking of the armature of your relay to the poles is no doubt due to the iron of your magnets not being as soft as it should be, and can be entirely obviated by gumming a thin piece of paper on the ends of the poles, or by drilling a hole in them and driving in a brass stud (see Fig. 18, p. 425). Clear out the holes in the top of your porous pots, and do not fill the cells too full; this will give them a better chance of recovering themselves. You can localise the fault in your earth wire this way. Having connected the springs of one of the pushes together so that the bell would ring were the circuit in order, fix one end of a coil of wire to your earth, take the other in your hand and work back along the faulty wire, carefully nicking off the insulation here and there, and touching the wire you hold in your hand on the exposed copper till you get the bell to ring. The fault will then be found between the place where the bell rings and the one you previously touched. There is no occasion to make great nicks, and any joints should be uncovered and the wire touched on them first. The exposed places must afterwards be well covered with tape and Chatterton's compound. Provided you fix on to the main water or gas pipe, you will get as good a return as any wire will give you.—F. C. ALLSOP.

[64925.]—**Chromic Acid.**—I have noticed a strong smell as of chlorine upon opening a tin of chromic acid. If you dissolve the acid in hot water, and keep it as a concentrated solution, you will find that when used it will not give off any corrosive fumes.—SM.

[64925.]—**Chromic Acid in Batteries.**—Sullivan's chromic acid is prepared by means of chlorine. A considerable amount of this gas adheres to the acid, and is given off during use. This accounts for the corrosion of the brasses.—S. BOTTONE.

[64927.]—**Leclanche Cells.**—As "Meteor" says, the method of designating the different size cells by their capacity would prevent all mistakes, but the difficulty is, of course, in getting it universally adopted. When I said that the No. 2 cell was the most used, I was referring solely to electric bell work, whereas Preece and Sievewright mean, I take it, that for general purposes (telegraphy, telephony, &c.) the demand for the pint size is the greatest.—F. C. ALLSOP.

[64928.]—**Weight of Porter Governor.**—If "F. A. M." will procure two or three numbers of the "E.M." just two years old (about March [illegible], 1886) he will find some correspondence on this subject between another correspondent and myself, together with a diagram by the former.—T. C., Bristol.

[64929.]—**Sight-Feed Lubricator.**—Has been described but not illustrated. It is simply one form of displacement lubricator, and the old form is as good as the new. Use heavy paraffin oil for lubricating cylinder.—T. C., Bristol.

[64931.]—**Preservation of Slate Roof.**—The stain must be a mineral blue or black, like Prussian blue, or smalts, &c., not vegetable, like indigo, as the lime in the cement kills the vegetable colour.—DERFLA.

[64931.]—**Preservation of Slate Roof.**—I may inform "Celt" that too much water kills Portland cement. It would be no use the way you propose to use it. When dry it would dust off; nor would it be much use to put it on as plaster, as it would soon crack off. A mixture of coal-tar and pitch to a proper consistency put on hot; would preserve the slates if the appearance would be satisfactory.—WM. GRIMSHAW.

[64932.]—**Phosphates of Bran.**—Very little, indeed, of the phosphates contained in bran can be extracted by boiling in water. The phosphates are almost insoluble in water, though they may be held in suspension by gelatinous mediums. The bran decoction does not keep well, and must be made freshly at least twice a week. A very good form of administering phosphates is by boiling down bones in a Papin's digester, which reduces them, in the presence of the gelatine of the bones, into a inous fluid. But why bother about this, bread, fish, eggs, cheese, brains contains dance of phosphates in assimilable form.—S. TONE.

1934.] — **Electrical Machine.**—Two flat ions, stuffed with fine iron wire and flax, red with washleather. Collector should be of No. 6 brass wire, with brass pins for ts. The collectors should embrace the plate both sides. See also my book on "Elect. ruments for Amateurs."—S. BOTTONE.

4935.]—**Musette.**—In reply to "War," the tte is simply a short oboe, and is played with ilar double reed. The principle of fingering d therefore be comparable with this latter inment or the flageolet, but not with that of the onet. I have never seen or heard of the tte being used in any orchestra. From its arance, I should judge its lowest note to be t F, first space in treble clef. Those I have rved in shop-windows have been furnished no keys at all, or else only one or two; in I think the instrument may be regarded as ly a sort of bagpipe chanter. The oboe er descends to B or B-flat below ledger line eble clef, and its range 2½ octaves, or a note wo more with a good player. Perhaps the tte might be made to follow suit; but I doubt At any rate, I do not consider half the faction could be got from mastering the tte as from the legitimate orchestral oboe, its full chromatic scale, with the advantage atter has also in what is termed "standing in key of C." Of the other double-reeded inments we have the Cor Anglais, or tenor oboe, uently used in the string orchestra, with an scribably weird and tender quality solely its ; then the alto-bassoon, now obsolete; next bassoon proper, always present in full bands, ther wind or orchestral, and a most important rument; lastly, the grandfather of the lot— the contra-bassoon, a regular old growler, but ly seen; and this old chap is, moreover, a fearprice. By the bye, can anyone tell me for ain why the clarionet, in the foundation portion s scale, gives a pitch whose gravity properly ngs to a tube double the existing length? I a sort of suspicion that the comparatively t breadth and stiffness of the reed gets a kind alf-victory over the column of air in the tube at is to say, a sort of compromise is come to reby the column of air, instead of having ything its own way, as in the flute and oboe, *c genus*, is forced into allowing the reed to once to its (its column's) every two natural ations. This is, of course, only a surmise, and worth such; but I should much like to know real facts of the case, and the true causes of rture from ordinary rule.—C. R. D., Devon.

4936.]—**Brains.**—Remove the brain as soon as ible after death, by cutting through the atlas axis vertebræ, then insert one blade of a strong ors or bone forceps—according to the animal— gh the foramen magnum; but do not cut until nserted blade is well pressed up against the table of the skull, snip away pieces of the along the middle line alternately left and until the brain is exposed; lift it out care-, bringing with it as much of the cranial nerves pinal cord as you can; put the brain in 70 to r cent. alcohol, or in a mixture of picric and e nitric acids, these are good hardening nts. Start your study of brains with the brain frog—it is, perhaps, the simplest and easiest to get then a fish's, a fowl's, and a rabbit's, the r being a very typical mammalian brain. Kill animals with chloroform, and when dissecting them moistened or pinned down in weak t, and have your razor or knife (a small tables is a capital one for slicing) well moistened spirit too.—P. T. O. S., F.C.S.

4936.]—**Brains.**—You are laying out for yourwork which only men of immense experience at specialty have as yet been able to perform, I would estimate that if you have good ability may be able to harden and study the brains rious animals, as you propose, after ten years' ial study and experience. It is evident from query that you don't know anything of the ect at present. The difficulty lies in catching xact time when the brain is hard enough to with the razor, and at the same time does not ble. I can give you the composition of the ening mixtures used by the great masters on art Deiters and Frey, premising that if ible the brains should be taken from the animal ediately after the moment of death, and cut in ll pieces, say 1in. by ½in. by ¼in., and hung by ads in the hardening fluid. Frey begins with per cent. solution of chromic acid, and ges every day or two into a gradually stronger ion until it reaches 1 per cent., when he ens with bichromate of potash; he begins with per cent. solution rising up to 6 per cent. s puts them in a solution of bichromate ins to the ounce from one to two weeks, then and puts them in chromic acid solution, beginning with two and rising up to three grains to the ounce.—B. SC., Plymouth.

[64937.]—**Earth's Speed.**—If her mean distance from the sun be called 92,000,000 miles, and eccentricity = ε, the area of whole orbit in square miles is $\pi\ 92{,}000{,}000^2\sqrt{1-\varepsilon^2}$. Divide this by the number of seconds in a sidereal year (not a tropical year), and you will have the square miles swept by radius vector in a second. Divide these by half the perihelion distance—namely, $46{,}000{,}000\ (1-\varepsilon)$ —for the miles per second in perihelion, and by half the aphelion distance—namely, $46{,}000{,}000\ (1+\varepsilon)$— for the miles per second in aphelion; both are between 18 and 19.—E. L. G.

[64938.]—**Tempering Turning Chisels.**—Make them black-hot, and temper to a light straw with oil.—COPPER.

[64939.]—**Enamelling Cycles.**—The best thing you can use for enamelling cycles is either Brunswick black or Ardill's enamel—I prefer the latter. —W. D.

[64940.]—**Chloride of Silver Battery.**—I cannot recommend these for lighting lamps. A few cells of Leclanché, though more bulky, are more satisfactory, if only for temporary purposes.—S. BOTTONE.

[64941.]—**Permanent Bubbles and Films.** —According to Prof. S. P. Thompson, permanent films may be made with a mixture of pure resin, 46 parts, and Canada balsam, 54 parts, which gave best results at a temperature of 93° to 95°— (see *Phil. Mag.*, Vol. V. p. 271.) I have blown permanent bubbles with this mixture, using a tobacco pipe in the ordinary way.—J. BROWN, Belfast.

[64942.]—**Model Locomotive.**—It is not absolutely necessary for a model of so light a weight to have springs; so if you do not wish to have a perfect model you need not trouble about them. If you work at 40lb. to 50lb. your boiler will make sufficient steam provided you have a good draught. For this model circular, rails should be about 20ft. diameter; but they are not so good as straight ones, as they increase the friction considerably.—COPPER.

[64943.]—**Battery.**—You should use sulphate of copper (acidulated sat. sol.) with your copper plate vice bichromate.—W. PERREN-MAYCOCK.

[64943.]—**Battery.**—Copper and zinc in bichromate give a very poor current. You should use two carbons to one zinc. Connect these up in series.—S. BOTTONE.

[64943.] — **Battery.**—Try flat carbon plates instead of copper: the local chemical action that is set up by the introduction of copper as an electrode in a chromic-acid solution is sure to render the battery useless. And in order to diminish the internal resistance, the electrodes should both be flat, and as close together as practicable, which is impossible to be atained if you oppose a cylinder to a flat plate or plates. You will do better, as far as constancy is concerned, to place the carbon plates in porous pots with the bichromate solution, and the zinc plates in the outer cell immersed in dilute sulphuric acid, in the proportion of one of acid and eight of water. You may get a small arc with six cells, but you cannot work an automatic lamp with so small an arc.—FREDERICK WALKER AND HYDE.

[64944.]—**Chemical.**—(1) When pure nickel is dissolved in nitric acid it forms nickel nitrate; when German silver, which is composed of copper, zinc, and nickel, is so treated, it forms the respective nitrates of the metals of which it is composed. The pure nickel solution is light green, and the German silver one is dark green. Pour into the suspected solution a solution of potassium ferrocyanide: a light green precipitate indicates nickel, a brown one is copper. Precipitate the solution with potash, wash, and boil with an excess of potash; oxide of zinc will be dissolved, while oxides of copper and nickel remain; wash the precipitate, dissolve in excess of nitric acid, and pass sulphuretted hydrogen—copper sulphide is precipitated, and the nickel remains in the liquid, which may be neutralised with sodium carbonate, and the nickel tested for, thus:—Potash, light green precipitate; potassium ferrocyanide, the same; potassium cyanide, the same, soluble in excess to a brown liquid. Dissolve the copper sulphide in nitric acid, and test thus:—Ammonia, a blue precipitate, soluble in excess to a splendid blue liquid; a strip of bright iron, a deposit of metallic copper; potassium ferrocyanide, a brown precipitate. Neutralise the potash solution with nitric acid, and apply:—Potassium ferricyanide, a buff precipitate; potash, a white precipitate, soluble in excess. If there is any iron in the original metal it will be found in the above nickel solution, and may be detected by potassium ferrocyanide, which will give a blue precipitate; while the tests for nickel will be obscured. (2) No. (3) Yes; potassium nitrate will do so. If you have any difficulty with the above, publish your address, and I will try to help you.—PRINCIPIA.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

64302.	Marionettes, p. 517.
64305.	Iron and Steel, 517.
64309.	Photographing on Wood, 517.
64317.	Photophone, 518.
64323.	Birds' Wings, to Preserve, 518.
64326.	Ozonometer, 518.
64329.	Medical Cotton, 518.
64333.	Dynamos, 518.
64344.	Diatoms Mounted in Zinc Chloride, 518.
64355.	Tracing Work, 519.
64357.	Coloured Patent Leather, 519.
64360.	Harmonic Motion, 519.
64362.	Magic Lantern, 519.
64556.	Rustic Pipes, p. 610.
64572.	Refraction, 611.
64591.	Dynamo, 611.
64615.	Abyssinian Pump Clamp, 612.
64620.	Fehling's Sugar Test, 611.

QUERIES.

[64946.]—**Railway Waggon Springs.**—Will any of our readers oblige by giving a method of tempering the above?—BLACKSMITH

[64947]—**Diamond Cement.**—Will any kind reader inform me how to make this class of cement?—L. BROS.

[64948.]—**Regilding.**—Is there a method of regilding metals with chloride of gold, similar to that for resilvering with nitrate of silver and salt, which I have found effective?—UBI.

[64949.]—**Organ Swell.**—Having purchased a small organ, I desire to make a swell. Will some brother-reader instruct me in the form of the action of louvres and shutters, &c., giving details?—MECHANIC.

[64950.]—**Rudders.**—TO MR. FRANK CAWS, SUNDERLAND.—Would you please oblige me with the formulæ for the strength or diameter of iron rudder heads, having given (1) area of rudder, (2) speed of vessel, (3) horizontal distance of centre of gravity of rudder from fore edge of rudder?—N. A. [We hope Mr. Caws will oblige at less length than usual.—ED.]

[64951.]—**Violin.**—I wish some one could tell me why the lower G on my otherwise excellent instrument (which I have had for about 37 years—in fact, ever since I was a little boy) has latterly an unpleasant sound? There is nothing visible to account for it. The soundpost is just a shade short, I fancy.—F. C.

[64952.]—**To S. Bottone.**—I have a ¼H.P. steam-engine. I want to work a dynamo with it, so as to light a 5c.p. electric lamp for four hours every evening. I should like to know what dynamo I should use and what sized storage cells, and how long I should have to work it every day, so as to light in the evening?—N.

[64953.]—**Small Boiler.**—I want to make a horizontal boiler to work a slide-valve cylinder, 4in. stroke by 2½ bore. Please tell me what size I must make it, and what size the furnace must be. I want to burn coke or charcoal. What sized tubes, and how many of them, I must use? I want to have 100lb. of steam-pressure on. What power should I get from my engine?—T.

[64954.]—**Fire Doors.**—Can any reader tell me what is the best plan on which ventilated fire doors for steam boilers ought to be made, so as to give the best results in smoke consumption and steam production, and to what extent can these two objects be attained by a properly ventilated fire door?—R. UREN.

[64955.]—**Chloride of Zinc.**—We use a good deal of this as a flux for soldering purposes, but when applied to new tin goods (unless cleaned off) it makes them in a dreadful mess. Also forms a sticky insoluble deposit on the hands which can only be removed by paraffin, or strong soda water. Can anyone tell me of a more suitable flux? Also what is the action (chemical or physical) in causing metals to flow more readily, and what are the essential conditions of a good flux.—T. G.

[64956.]—**Faulty Magneto-Machine.** — Will some one kindly assist me to put right a magneto-machine? It is of the usual model standing on three feet under glass shade. Armature coils are perfect, though somewhat thinly insulated with cotton. Where should wire ends make contact with spindle? Magnet seems to have lost much of its power. How can I revive it? Would weakness of magnet account for trouble? I cannot get current at all. To all appearance the machine is perfect.—CANTAB.

[64957.]—**Endless Chain for Raising Water.**—Can any of your readers give me a description of the method of raising water out of a well by means of an endless chain with buckets at intervals, the chain travelling in one direction, and the buckets emptying themselves automatically into a tank at the top?—GWALIA.

[64958.]—**Cleaning Diatoms.**—Will some brother-worker with the microscope kindly state from practical experience how to separate the "flock" from diatoms, as I find in some cases it will not yield to liquor potassæ or sodæ carb, although boiled in strong solution? The frustules are perfectly clean and brilliant after the usual hydrochloric, nitric, and sulphuric-acid treatment; but on putting the deposit on the thin glass cover they congregate in a most annoying manner.—J. J. O.

[64959.]—**To Mr. Lancaster.**—Having purchased one of your sets of lenses for a 2in. [illegible] achromatic telescope, I put them together according [illegible] directions, substituting, however, for the single ey[illegible] lens eyepiece, giving a power of about 6[illegible] scope answers very well indeed for the moon, and I can also separate a few easy doubles, such as Castor and Epsilon Ursæ Majoris, although the coruscations are truly fearful and wonderful; but when I tried it on Jupiter and Saturn there its usefulness ended, for I could make out absolutely nothing. Can you explain this? Also can you refer me to any practical manual on the subject of lens grinding? I have looked in "E. M." for past six years, and cannot find much about it.—LENS.

[64960.]—**Harmonium Pedal Organ.**—Having added a set of pedals with separate soundboard to an Alexandre harmonium about 14 stops, I find that the tone of the reeds is very weak and bad. The reeds are of 8ft. and 16ft. pitch, and the supply of wind is supplied from the ordinary wind chest by means of three indiarubber (tubes about ¾in.). The channels are cut in the soundboard of the same size, as is the case in the reeds of the stops bourdon and cor anglais of the manual department. What is wrong? I think the inside of the box into which the reeds are screwed is a little convex, so that the reeds are bent a little in screwing in their place. The reed board is inclined as in the case of the manual department. Will some reader kindly help a perplexed and annoyed musician?—CLIMAX.

[64961.]—**Hot-Water Fittings.**—Will Frank Caws kindly answer this? My hot-water fittings are as you described last week, only hot supply is taken from top of hot tank, which is placed under kitchen ceiling about 8ft. from boiler. We have often to run off about 6 quarts cold and tepid water before hot, which is a great waste, and am about altering it, and would like to have it right. I read up Notes on Plumbing in back numbers, but found nothing about circulation in branch pipes. A master plumber proposes taking a pipe from sink tap which is about 20ft. from tank, to rising pipe. You say take two pipes. It would be difficult to take another from top part of branches to return pipe. Will do nothing until you answer.—S. S. B.

[64962.]—**Force Draught for Boiler.**—Will any of our engineering friends give me a few particulars as to applying a force draught to a single-flued boiler?—the present natural draught being much dependent upon the changes of the wind. The boiler is situated in a district much resorted to by health seekers, and the black smoke often emitted with the wind in certain quarters is highly objectionable, and it is proposed to try coke as a fuel exclusively. I may also state that the boiler drives a small engine for steam laundry.—J. C. T.

[64963.]—**Water Power.**—There has been a good deal said of late in the "E. M." about turbines and water wheels. Gas, and steam-engines have also been frequently described, but I cannot find anything in any of my back numbers that would assist me in making a water-engine, or that would guide me as to the size or power of such an engine. I have water from ⅝in. pipe. The pressure varies during the day from about 40lb. to 20lb. What power should I be likely to get from such a supply, and what pattern of an engine (simple as possible to make) would be most suitable to drive a dynamo? How much water per H.P. would be consumed?—STIRLINGS-ROAD.

[64964.]—**Hard-Water Well.**—I want to know best procedure to soften 3 or 4gal. of water a day for kettle and drinking use. Should I use ordinary lime from limekiln, slaked or unslaked? If so, how much to a gallon? The well is in the chalk. Must I buy anti-calcaire? What would be best sort of vessel to use? Must the lime or anti-calcaire be simply dropped into the water, or stirred up with it? Must the softened water be drawn off by a siphon to save disturbing sediment? If I put in the 3 or 4gal. every evening will it be softened by the next morning, and must the previous sediment be cleared out first, which, if done daily, would be rather troublesome? The said well water is too hard to be wholesome for drinking.—RUSTICS.

[64965.]—**Halse's Battery and Coil.**—Will Mr. Bottone or some other correspondent kindly give me more information about Halse's battery and coil? Is the battery a Smee or a modification of it? Should the zinc plates be amalgamated? How long should it remain in action at one charging? Is it the best battery for the purpose? Also would not the coil be better if the secondary was wound with finer wire, the primary and secondary being the same size? Is it essential that the silver plates should be coated with platinum? Also, in making chloride-of-silver battery, how much chloride of silver must be put on the silver plates? Must it be coated thickly or simply painted on?—COIL.

[64966.]—**Enema.**—How could I make the whole apparatus necessary for the galvanic enema small enough to carry in the pocket for use at any time? Is the galvanic enema preferable to an enema of glycerine injected with the ordinary syringe? Is continued use of either enema necessary or injurious?—H. A. H.

[64967.]—**Telephone.**—Will any reader kindly advise me as to how much and what number s.c. wire I should wind on end of magnet of small telephone to carry, say, 20yds.? I should like sketch showing how wire is bound on.—TARA.

[64968.] **Old Indiarubber Balls.**—Can anyone give me any information how to inflate rubber balls which have been left over from last year and have got quite soft? The bounce has all gone out of them.—SHOPKEEPER.

[64969.]—**Quick-acting Westinghouse Brake.**—Will any correspondent explain how the new quick action of the Westinghouse brake is obtained, and also say what time it takes to apply over a train of 20 carriages, and has it been tried on any of our English lines yet?—ENGINEMAN.

[64970.]—**Perforated Pulleys.**—I have a 12in. pulley on a dynamo driving at 800 to 1,000 a minute, and main shaft pulley is 40in. diam. There is a lot of slip in spite of all I can do. Shall I gain anything by using perforated pulleys? I run a 10H.P. engine, and belt is about 12yds. long.—C. CALVERT.

[64971.] — **Ordnance Survey Datum.** — To "F.R.A.S."—Would you please tell me for a certainty if all these measurements are taken from the height of the water at the Old Dock gates, Liverpool, at 25ft. of [illegible] the mean would be 12ft. 6in? A "F.R.M.[illegible] ently gave the above information, but on re[illegible] H. James's "Abstracts from the Level[illegible] d Wales," I cannot see 25ft. actually mentioned, although the diagrams in that book from the tide guage used seem to average that height very nearly.—A. I. E. E.

Desigi the late Zei
ive Engineering,"

[64972.]—**Ventilating Church.**—A space of 10,400 cubic feet (40 by 20 by 13) with five windows on one side only, and entry door at one end (with porch placed externally) a ventilating opening in ceiling at one of the corners opposite to the door, and also opposite to the windows, has in addition three zinc tubes of 6in. diam. and 6ft. in height (from floor line) carried through the side walls to the exterior, and passing up centrally between three of the windows interiorly. When seating about 80 persons the air becomes very vitiated, necessitating the opening of the windows, which is undesirable. A stove placed near the door sufficiently warms the space if no windows are open. I had the zinc tubes put in on the advice given in back numbers of "Ours," and am somewhat surprised at their not being more effective and find little or no current through them, even with great differences of temperature between the outside and inside. They are quite smooth internally and curved below and carried through the wall at an obtuse angle favourable to inflow of the air. Would our valued correspondents kindly advise and also explain the inaction of the tubes—understanding that they open out to the east, on to a perfectly free and open yard?—M.

[64973.]—**Motor for Dynamo.**—I have purchased one of Jones' 40c.p. dynamos to run at 2,000 revs. a minute. I want to light three 10c.p. glow lamps with it, and will feel much obliged if some reader will advise me as to whether a small turbine, steam, gas, or hot-air engine would be the cheapest and best for my purpose. Living in a flat in Glasgow, any excessive thumping or vibration would, of course, annoy my neighbours. We are well supplied with water at a good pressure, but besides having to purchase a water meter, the charge for water, would, I expect, cost a lot. If a steam-engine is advisable, would one 1¾in. by 3½in., working at about 60lb. pressure, be sufficient?—ARTHUR CRAIG.

[64974.]—**Battery Connecting.**—Will any of your numerous readers give me the best way to connect 15 1-pint chromic-acid cells of the following dimensions? Two carbons and one zinc, 1½in. by 6in., to be connected up in three rows of five? Also the proper proportion of chromic acid and H_2SO_4 for same, and what c.p. battery lamp could I light? Also I have several broken carbons. Is there any way to cement or join together without altering strength of battery? Would any correspondent kindly give me answers and sketch for above?—LEX.

[64975.]—**Soldering Solutions.**—Will any reader kindly tell me the best kind of soft soldering solution to unite parts of brasswork which have been previously tinned? It must be adapted for use with the soldering iron. All the parts are of very thin metal. Spirits of salts will not answer my purpose, as the instruments when made are to contain a liquid which would become affected by its use. I also wish to know the best method of tinning sheet brass (paper brass), or whether it can be purchased ready done, and if so, where?—ALADDIN.

[64976.]—**Brass Casting at Home.**—Will any kind reader help me in the following? I want to cast some small articles in brass, and for the mould I use plaster of Paris mixed with an equal quantity of powdered gas coke. To this I add water to about the thickness of batter. With this material I make the mould in the usual way, of course, letting the bottom half harden before making the top half, and putting a little grease in where the mould parts, and then letting the whole bake in the oven till it is thoroughly dry. Now my difficulty is when I pour the metal. Although the mould is thoroughly baked, the metal bubbles, and when taken out is full of holes. Is it the grease or the coke in the plaster, or should I put more than one vent hole in besides the pouring hole that causes the metal to bubble, or is moulding sand more practicable for an amateur?—AMATEUR BRASS FOUNDER.

[64977.]—**Watch-Case Bottoms.**—Will some one inform me how to get out of my difficulty? I cannot get my silver or gold to go right when I get a flask run down to case bottoms. It is full of little blisters, and when they come to be engine-turned they have to have new bottoms put in, as the blisters turn up. I was told to try a wedge-shaped flask, but that won't do, because we have flasks from the refiners from London and Birmingham exactly the same size and shape as the one I use, and there is no[illegible] a bit of a blister in them. If you can inform me whet[illegible] it is in the melting or what it is that [illegible] it, I sh[illegible] very thankful.—J. T.

[64978.]—**Electro-Motor.**—Would any of [illegible] electrical friends oblige by giving me [illegible] I made a motor and it is of 4-magnet type [illegible] frame, wound with 12lb. of No. 16 [illegible] each magnet. Armature is of the Siemens class wound with 3lb. of No. 20 d.c.c., and is connected up to a commutator of two sections. The magnets are so arranged as to two N and two S—

N
S

and I found th[illegible] [illegible] [illegible] them up in series with the arm[illegible] [illegible] motor works, but not very fast. But [illegible] [illegible] up so as to divide the current, pa[illegible] [illegible] magnets at o[illegible] [illegible] went faster. [illegible] [illegible] is w[illegible] [illegible] be the best possi[illegible] [illegible] most work with mot[illegible] [illegible] cells, bichromate.—EL[illegible]

[64979.]—**Soldering Joints of No. 1[illegible] Bell) Galvanised Wires in a Coal [illegible]** [illegible] any of your readers kindly inform me how [illegible] be done where nothing but the heat of a la[illegible] [illegible] plied? What class of oil and lamp will be required, [illegible] does it need a soldering tool?—COLLIERY M[illegible]

[64980.] **Electric Bell**—Will some [illegible] readers kindly inform me what are the necessary [illegible] and parts in detail of a one-stroke electric bell, with a 1[illegible]in. or 12in. gong, suitable for colliery signalling [illegible] about trying to make one.—COLLIERY MANAGER.

[64981.]—**Heating and Lighting [illegible] Church.**—Will any of your readers kindly give [illegible] as to whether it would be practical to light a c
cubical area of about 2,500yds.) with electr
to heat the same with warm air gen
furnace of a steam-boiler, which would
steam for driving dynamo engine? Also
exhaust steam pipes around the church to
same, and then return to boiler and be injec
by an exhaust steam injector, the same to
an eye to economy? State the probable
plant required, or what other plan would be
with an eye to the lighting of the churc
proaches. When the heat would not be r
week night meetings without putting th
can secondary lamps be charged with
working to use when needed?—A SUBSCRI

[64982.]—**Plating Dynamo.**—TO MR.
I have made a plating dynamo of
type, of the following dimensions, w
armature:—Pole pieces 4in. thick, b
8in. The wire space on coils of F.M
in section, 6½in. long, 5¼in. wide, 3in. thick
10 layers No. 14. d.c.c., about 70lb. weigh
ance of the four coils in series is 4·9 ohms a
core is made of wire ⅛ thick, with iron t
with 20 sections ⅜in. by ¼in. deep, woun
parallel No. 14 wires, 8ft. in length. Wh
proper speed and F.M.'s connected up in shu
can only get the faintest current. When t
connected up in parallel and in shunt w
fairly good current, but nothing near
80 amps., 5 volts. Will you please say if
better to rewind A. with a No. 6 wire, a
turns or lengths in each coil, or to take off
so as to get more wire on it, 3 No. 14 in
single No. 6, say, instead? As it was in
wound with a 3-16 sq. wire, 3 layers deep,
coil, will you please say if the F.M. is wou
right size wire? I omitted to say the R. of
about.—ANXIOUS.

[64983.]—**Rust in Kitchen Boiler.**
kind reader help me to remedy this evil?
range and heats a large circulating tank at
for house supply. The peculiar fault of our
is it is impregnated with iron, but very cle
Can anything be done to the boiler, and wh
the best pipes, &c., to use in this case, to pre
up as they do now? Can the boiler be lin
thing to prevent this rust boiling up and a
—PROPRIETOR.

[64984.]—**Hydraulic Leather.**—Could
by telling me where I could get good qu
dash valves of hydraulic rams, which requir
powerful stroke for very high lift?—PROPRI

[64985.]—**Spring Water Storage**
have some large galvanised iron tanks, but t
come scaly with rust at the bottom inside.
be the best sort of tank to use to replace?—P

[64986.]—**Electrical.**—I have an engin
ning from 9a.m. till 4p.m. Is it possible for
accumulator to store electricity, so as to lig
at night with, say, four 5c.p. lamps, and one
and what will be the probable cost of plant?

[64987.]—**Tractive Power.**—I inten
model loco., 3ft. long. Boiler 2ft. by 5½in.,
sure 60lb., outside cylinders 2¼ by 1½, 8in. cou
I suppose the weight when in working order
slipping. What is the tractive force on stra
COPPER.

[64988.]—**Fastening Velvet to W**
making a ladies' workbox of fretwork waln
wish to line it with green velvet. Could an
me how I can fasten it inside the box? Wo
fine glue do? I am afraid it would injure t
JACQUARD.

[64989.]—**Soapstone or Steatite.**—C
"ours" inform me how firebricks of this
made? What is the cementing material
common clay or what, and what proporti
are such bricks made?—BOFIN.

[64990.]—**Cycle Spokes.**—Can anyone in
to make double-butted spokes? I have tried to
at steel works and other places, but no one s
[illegible] I require about 300 for a number of
A. F. SH[illegible]

[illegible]—**[illegible] Drills.** [illegible] there
[illegible] merc
[illegible] th
[illegible] wo
[illegible]

[64992.]—**Ballast.**—I have a mound of c
be glad if some of "ours" would tell me how
make it into ballast, such as is used for rail
ments?—CLAY.

[64993.]—**Shooting.**—Can any reader
formation as to a good book on shooting,
expensive?—W. D.

[64994.]—**Glass Beads.**—How are glass
—H.

[64995.] — **Fretsawing Attachmen**
Lathe.—I have a foot lathe, 6in. centres.
inform me how to make a fretsawing appar
from the mandrel?—E. STONEHOUSE.

[64996.]—**Butter Blending.**—Can an
inform me if any work is published on the
information anent creameries and chemi
[illegible]nding will oblige.—ZEMA.

[6499]7.]—**Chemical.**—Will Mr. Grey
[illegible] friend kindly tell me of a simple
[illegible] calomel or any other preparation
[illegible] have for years taken a certain adv
[illegible] in the firm belief that it was pur
[illegible] he other day by a medical man
[illegible] a drug that I have a wholes
an [illegible] if possible, to satisfy myself.
very [illegible] [illegible]yone who will put me
doing so.—A [illegible] [Save trouble and gi
Read Dr. [illegible] articles in the *Weekly T*
—ED. "E. M."]

e English Mechanic
WORLD OF SCIENCE AND ART.
FRIDAY, APRIL 13, 1888.

ROSCOPICAL ADVANCES.—XXXV.

:. ROYSTON-PIGOTT, M.A. Cantab., S., F.R.A.S., Memb. Roy. Coll. icians; Fell. Cambridge Phil. So- ; formerly Fellow of St. Peter's ge, Cambridge.

ches in High-Power Definition—Inference Lines, Circles, and Dots.

RE is no more interesting department. Forming the most exquisite r microscopes, as well as explaining vealing hidden structures, *Interference Circles, and Dots* are worthy of the examination.

·. — There are two black margins efracting round fibre. Take finelyass, or a spider line: these black lines are present, and if the focus be l, often, a very finely-delicate single entral line can be detected above the of the cylindrical lens. If it be al, this line is changed into a black rence dot well elevated.

her form: Vertical cracks in silica ay develop two extremely thin black ence lines as well as silvery ones. f this anon (next article).

transparent refracting ribs on moth tterfly scales also develop interferes of wonderful delicacy.

arching the foci of a small refracting e exposed to a minute but brilliant f sunlight, besides the first interfert, there are foci belonging to each ible colour, inherent to the solar m.

interfering rays crossing each other the axis particularly illustrate the al aberration present, and if purely romatic light be used, there will be oured foci; but for compound deable light there exist at least *seven* t coloured foci arranged along the d amongst these a great number of terference dots can be discovered.

lem.—A fine line of solar light passes a silica spherule 1·40,000th of an inch eter. Find the distance between the us and the focus for blue rays, taking ractive index approximately like that entine.

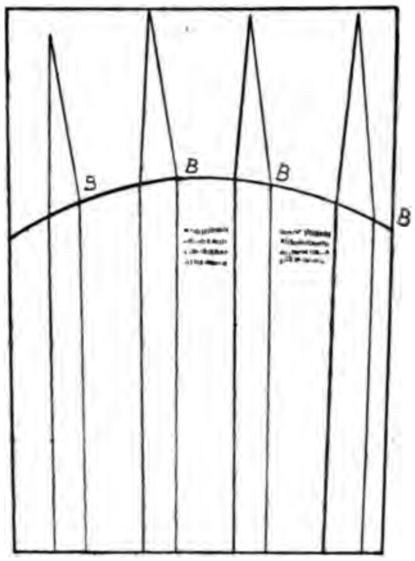
ver.—Distance between red and blue 1-700,000th of an inch (nearly). a microscope which can distinguish torily two different focal planes 00th of an inch apart deserves a very eed of praise. But as there are cerive other focal planes for the rest of lours (orange, yellow, green, blue, it would be interesting to calculate ntervals, and it would be grandly ing to display them.[*]

microscopic lines, however, present ifficulties. Nobert's are exceedingly o the sight. Black margins of ribs, bars, and gossamers are more available. The micrometer spider lines observed were about 1-10,000th of an inch thick, and each exhibited two very thin black margins, and an attenuated central line of light. Two, in Browning's micrometer, were then arranged in very close juxtaposition. A line of light was detected between them 1·230,000th of an inch broad.[*] These threads (nearly 1-10,000th thick) are cylindrical, and expose cylindrical refractions, and are fixed exquisitely parallel.

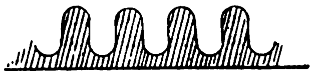
The edge of the membrane joining spikelet to spikelet, in the smallest gnat scales, gives a fine little curving line, consisting of the folded edge of the two membranes forming the sac; this line nearly represents the thickness of one of the membranes.

The full breadth of a rib was 1-50,000th, the little curving border line being placed exactly between these spider lines centrally, so that it appeared half the space between them. The curved margin was found to be nearly 1-40,000th, whilst the black margin of each rib appeared slightly thicker than my coarsest spider line, after being magnified 100 times, or 1-500,00th of an inch nearly.

A figure of a very minute gnat scale is now inserted :—



The ribs cross the terminating membrane at B, B, B, B, exposing their minute spikelets, showing black points; the margins are excessively attenuated. The cross-beading is very distinct with my oil 1-12th. The ribs look cylindrical, and that shape seems necessary to support the spikes. But on one occasion a scale was happily caught standing end on, caught between cover and slide, and presented the following appearance, corrugated on one side and smooth on the other :—



By careful comparison with the terminating curved edge, the cross rouleaux of beading appeared the same size as the edgeline—i.e., about 1-140,000th of an inch. The blue-blackness of the ribs seen in profile arises from total obstruction of the optical rays. None can be transmitted in this direction: they project in relief nearly the same amount as their separation by the corrugated channels. (See figure.)

Still finer lines have been descried by means of the hairs springing from the antennæ of the smallest plumed gnat. These hairs—themselves only 1-100,000 thick — are themselves hairy. They are almost invisible when mounted in Canada balsam.

In this gnat the antennæ were embossed throughout their whole length. Each boss sustained a little forest of minute cilia arranged around the hair cup, and also discoverable in its interior where there was a rent. These hairs required the finest microscopic manipulation, and, by gauge measurement, were evidently less than the millionth of an inch thick. The whole of the surface bristles with these minutiæ, and are plainer near the base of the antennæ. The large hairs extend over the whole of the antennæ, and are a most beautiful spectacle.

Mathematical lines of surprising tenuity can occasionally be detected at the line of close flexure of many objects—such as scales, gold leaf. In goldbeater's skin it is easy to measure absolute thickness as seen edgeways, and comparing this with the thickness of the black line of flexure, it appeared about one-third thicker.

In the next article attention will be drawn to the amazing lines discoverable in Mr. Slack's colloid silica films. There are black shadow lines, silvery lines, and the finest interference lines imaginable, some even baffling very celebrated glasses.

(*To be continued.*)

REVIEWS.

My Life and Balloon Experiences. By HENRY COXWELL. London: W. H. Allen and Co.

THIS is an autobiography of a well-known aëronaut, which gives a good deal more than the experiences of Mr. Coxwell in ballooning. It is a chatty, interesting volume which one reads with pleasure, and contains a great deal of valuable information, for it is evident that ballooning will play an important part in future wars. We will not pretend to give an account of the contents of the book, but will recommend all interested in ballooning to read it, while those who have no inclination for aëronautics will still be amused by reading some of the experiences of Mr. Coxwell. The author does not "speak disparagingly" of "bullock's skin" as a material for balloons, but he expresses the opinion that, all things considered, a certain quality of silk is more reliable, and, if heavier than skin, is more readily repaired. It also resists the shrivelling effects of a hot atmosphere, and is not so liable to be attacked by insects. Mr. Coxwell says that the use of skin is not new, because he saw and handled, half-a-century ago, a huge balloon made of "similar animal substance." In England preference is shewn for exceedingly small bullock's-skin balloons; in France they are cigar or cannon-shaped, with "steering" gear; while in Germany they are medium size and of spherical shape, made of silk by preference, which Mr. Coxwell thinks superior to the calico or muslin balloons in store at Chatham or Lidsing. It should be stated that the book is not confined to Mr. Coxwell's experiences, for it contains a variety of useful notes on ballooning, and is interesting from the first page to the last. A photograph of the author forms an appropriate frontispiece.

The Amazon Provinces of Peru. By H. GUILLAUME, F.R.G.S. London: Wyman and Sons.

THIS work is from the pen of the Consul-General for Peru in Southampton, and therefore its statements would be taken with caution by a man of the world, especially as its object is to point out the advantages of Peru as a field for European emigration It is possible, however, to overdo "caution, and after reading the information which Mı

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sidereal focus of a glass sphere when μ is the rendex measured from its centre, and r the radius ., where μ may be the index of any part of the l) . The distance between the foci of the red and y is therefore for turpentine $d = \frac{\mu' \cdot r}{2 \cdot (\mu' - 1)}$ $\frac{}{1)} = \frac{r}{2}\left(\frac{\mu'}{\mu' - 1} - \frac{\mu}{\mu - 1}\right)$, which has an index ly the same as silica. It is quite possible then xtremely fine glass may differentiate these two es. Mr. Swift has privileged me to select one r surprisingly good oil 1-12ths; and on suitable hows with 2,000 diameters convex beading lying er membrane, either pale blue or ruby, accord- focal plane, under the lightest possible touch of ing wheel, measuring depths of focus 230,000th to each division.

[*] The spider lines in the micrometer were fixed below the stage, and subjected to a tolerably high magnifying power.

Guillaume has collected, we can recommend his work to those who wish to know something of the Amazon Provinces of Peru. It is full of information, and is, in fact, a "statistical and geographical review of the country and its resources," with maps and illustrations, which serve to give a better idea of the character of the country than volumes of text. The author has, however, compiled a great deal of useful information from official sources, and has honestly endeavoured to set forth an unbiased account of the country and the resources of its vast uncultivated regions. The basin of the Amazon has often been described by travellers who have visited portions of it, but at present it is still comparatively an unknown, and certainly unworked, territory, and we commend to explorers, merchants, and others this work by Mr. Guillaume, because, from internal evidence, we believe it to be an honest attempt to describe the country and its resources, while pointing out its disadvantages and the difficulties which will have to be overcome in opening it up, not to civilisation, but to commerce. Peru has made rapid strides of late, and emigrants and capitalists may peruse this volume with interest, and probably with advantage.

Practical Education. By CHARLES G. LELAND. London: Whittaker and Co.

THE work of education should progress apace nowadays, when so many minds are given to it, but the fact is that those who have the direction of national education are not agreed as to the methods to be adopted. Years—almost centuries—ago the Jesuits settled a system of education which has produced all that could perhaps be desired, by the simple process of encouraging the "bent of the mind"; but Mr. Leland deals with generalities, and his object is to treat of the development of memory, the increase of the faculty of quick perception, and the training of the constructive bias which is apparently latent in every human being. He believes that every human being possesses a memory which may be easily increased to what would seem to most persons a miraculous degree—that is true only of some individuals; he thinks that quickness of perception may be brought forth to "an astonishing degree in every mind"; that is, a faculty of visual perception, or eye memory; and also a faculty by which children of from eight years of age can be taught original design. Mr. Leland, as "late director of the public industrial art school of Philadelphia," has naturally much experience; he has also much to say that is worth reading; but he is mistaken if he thinks that children, or even grown-up people, can be "taught" original design. Speaking of thoroughness in education, he is evidently aware that there are children who can "learn a lesson in ten minutes and forget in five," while there are others who can conjugate a Latin verb in "due order" without a mistake, and yet know really nothing about it; but, knowing this, it is singular that he should think apparently that education is very easy, and that it is simply a development of "mental faculties," which may or may not exist. The "very great artist" to whom he refers, who said that he "began to draw at fourteen years of age, and every day of my life I realise the fact that I should draw twice as well if I had begun at seven," simply talked very great nonsense instead of a "great truth," as Mr. Leland has it. Much can be done by education; but the raw material must be present—cramming is useless. We can quite believe that "Red Indians were the quickest pupils to learn" that Mr. Leland ever had, for the simple reason that they inherited the faculty of observation; but it does not prove all children would be well educated on his system.

We have also received *Unfinished Worlds: a Study in Astronomy*, by S. H. PARKES, F.R.A.S., F.L.S. (London: Hodder and Stoughton), the second edition of a work containing "thoughts" which the author trusts may be "useful in counteracting to some extent the materialistic tendencies of much modern scientific teaching." If modern scientific teaching is not true, so much the worse for that, and Mr. Parkes perhaps does well in showing how he "beats his music out"; at the same time, we could not recommend this work to a student desirous of gaining a knowledge of astronomy.——*My Telescope*, by A QUEKETT CLUBMAN (London: Roper and Drowley), is like the author's "My Microscope"—an unpretentious little work which can be recommended. It contains a great deal of information in a few words.——*A Treatise on Mine Surveying*, by BENNETT H. BROUGH (London: C. Griffin and Co.), is a practical manual which will be welcomed by teachers and students alike, as it undoubtedly "supplies a want," to quote a rather hackneyed phrase.——*Elementary Chemistry*, by W. S. FURNEAUX (London: Longmans), and *Elementary Physiography*, by JOHN THORNTON (London: Longmans), are two of the "Elementary Science Manuals" issued by the publishers.——*A Treatise on Photography*, by CAPT. W. DE WIVELESLIE ABNEY, R.E., F.R.S. (London: Longmans), is the fifth edition, revised and enlarged, of a well-known manual of the art.——*The Story of Creation*, by EDWARD CLODD (London: Longmans), is a work that may be recommended to those who wish to read a "plain account of evolution," and especially to those who talk and write about Darwinism and evolution without knowledge. It is, in the words of the author, "an attempt to explain matters of abiding interest and deep significance in as simple and untechnical a style as possible."——*A Treatise on Mathematical Instruments*, by J. F. HEATHER, M.A. (London: Crosby Lockwood and Son), is the fourteenth edition of one of the best known works of the late Mr. Heather. For its size it is the best work of its kind. This new edition has been revised by Mr. A. T. Walmisley, M.I.C.E.——*Prosperity or Pauperism*, edited by the EARL OF MEATH (London: Longmans), is a collection of papers by various authors on the national system of education, and is a work which should find its way into every library, public or private, frequented by thoughtful men.——*Specifications Relating to Velocipedes*, by R. E. PHILLIPS (London: Iliffe and Son), is a continuation of the "Abridgments" prepared by Mr. Phillips, which have been found of great use to many makers and intending patentees.——*Sell's Dictionary of the World's Press* (London: Henry Sell) is a wonderful production for the money. It is as useful as it is wonderful. Besides being a directory of the Press, it contains much matter of interest, especially to advertisers.——*The Pocket-book of Mensuration and Gauging*, by J. B. MANT (London: Crosby Lockwood and Son), is intended for the use of revenue officers, brewers, spirit merchants, &c., and is an authoritative guide on the subjects it treats.——*The Watchmaker's Handbook*, translated from Saunier by J. TRIPPLIN and E. RIGG (London: Crosby Lockwood and Son), is the second edition, revised, with appendix, of a well-known practical treatise on watchmaking.

We have also received Watts' *Dictionary of Chemistry*, Vol. I. (London: Longmans); *The Fundamental Principles of Chemistry*, by ROBERT GALLOWAY (London: Longmans); *The Testing of Materials of Construction*, by W. C. UNWIN, F.R.S. (London: Longmans); *Standards of Length* (Hartford, Conn.: The PRATT and WHITNEY Co.); *Granites and our Granite Industries*, by G. F. HARRIS (London: Crosby Lockwood and Son).

ON THE "E.M." AND OTHER TELEPHONES.*

By S. R. BOTTONE.

§ 3. EVEN this was but an application of phenomenon which had previous been observed, for Robert Hooke, F.R.S., in work of his published in 1666, observes: "And though some famous Authors ha affirmed it impossible to hear through t thinnest plate of Muscovy Glass, yet I kno a Way, by which it is easy to hear one spe through a Wall a Yard thick. It has not y been thoroughly examined how far Ot cousticons may be improved, nor what oth Wayes there may be of quickning our hearin or conveying Sound through other Bodies th through the Air; for that is not the or Medium. I can assure the Reader that I ha by the aid of a distended Wire, propagated t Sound to a very considerable distance in instant, or with as seemingly quick a Moti as that of Light—at least, incomparabl swifter then that, which at the same time w propagated through Air; and this, not only a straight line, or direct, but in one bended many Angles."

Belonging to this same class of sound-tra mitters are the so-called "mechanical" te phones, consisting, as shown in Fig. 1, of t

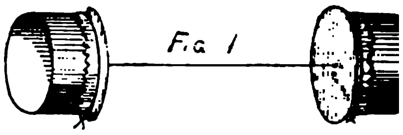
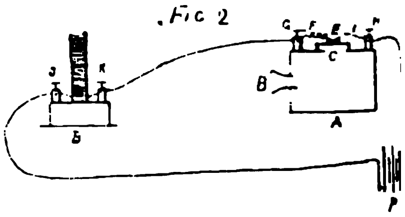


Fig 1

tin or cardboard cylinders, with a membrane such as parchment or bladder—stretch tightly over one end of each. The two dru thus produced are connected together at th centres by means of a tight string, which mu not rest on any other object. Speaking in one of the drums sets the membrane of th drum into vibration, and the vibrations th set up are transmitted by the string in purely mechanical manner to the drumhe at the farther extremity of the line, so th a listener actually hears the spoken wo or sounds reproduced by the vibrations set in this second drum-head, by the alternate pu and relaxations of the connecting line. T Ceylonese have had this device in common for many years as a practical far-speaking strument; but these telephones, or "f speakers," depend in their action upon transmission of the actual vibrations mech nically along a wire, a rod, or a string, and no case could the sounds transmitted be v loud, since the "amplitude" of vibrati (owing to the comparatively small size of transmitting line) must necessarily be sm Another, and great, defect in this kind of te phone is the necessity of keeping the tra mitting line tense, and out of contact fr any body which might impede the freedom its vibrations.

§ 4. *Reiss' Telephone.*—Page in America, a Delezenne in France, demonstrated that at t instant of sending a current of electrici round a bar of iron (as may be done by coili insulated copper wire around the bar, a

Fig 2



transmitting a current through this coil), musical note is produced, a similar note be evolved when the current is interrupted. Fr a series of carefully-conducted experiments De la Rive and Wertheim, we are in a posit to assert that these sounds are due to vibrati set up in the particles of the iron itself, ow to alternate contractions and elongations the bar at the time of making and br

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ntact with the source of electricity.
' following upon the above discovery
ıe announcement, by Philip Reiss, in
f a musical telephone, with a transmitter
ing of a tense membrane as a contact-
r, and coiled iron bar as a receiver. The
action of Reiss's instrument will be
tood by reference to Fig. 2, in which A
ents the transmitting instrument, B the
ng. In the transmitter (which is shown
ion) we have a square box looking some-
like a photographic camera. Instead of
s, however, there is a bell-shaped tube
ich leads to the interior of the box. Into
he operator sings, whistles, or plays,
ts in vibration a membrane, C, tightly
ed over a circular opening at E. To
tre of this membrane is fastened a little
ic plate, E, connected by a light springy
', to the binding-screw G. The opposite
g-screw H carries an adjustable stylet, I,
can be made to touch lightly on the
of the metallic plate E. Now, it is
t that if this membrane C be thrown
bration, the stylet I will sometimes be
tact with the central metal plate E, and
rs not.

ill be equally evident that if we connect
poles of a battery P, one with the
g-screw at H, and the other with the
g-screw J of the coiled iron bar, of the
ng instrument B; the binding-screws K
being also metallically connected, we
et a flow of electricity around the coiled
B so long as the stylet presses on the
piece E, while the current will be inter-
whenever, by the vibration of the mem-
the centre piece is out of contact with
let I. Hence, the coiled iron bar at B
produce exactly the vibrations set up in
ox A, and consequently emit similar
, which will be strengthened by the
nce of the hollow box below.

RIDE OF ZINC DIRECT FROM THE ORE.

ETHOD of producing chloride of zinc
direct from the ore and using it for coat-
tals by the galvanic process has been re-
patented by Mr. J. Lea and Mr. H. R.
ond. The object of the invention is to
upon zinc ore (calamine) in a direct
r by hydrochloric acid or an aqueous
n of chlorine, thus producing a solution
ride of zinc. The solution of chloride
so produced is submitted to electrolysis,
lorine being evolved and the zinc
ed. The chlorine thus formed can be
or operating upon a fresh quantity of
ne, or for making chloride of lime or for
ses to which it is applicable. The zinc
posited may be upon metal as a coating,
les in zinc may be moulded by deposi-
The patentees are aware that zinc has
eposited and chlorine evolved, the
e being collected for making chloride of
ut in those processes zinc as a metal has
onsumed or dissolved for the purpose.
ing to this invention the zinc ore is
in a direct manner by hydrochloric acid
uce chloride of zinc.

CHING WITH PEROXIDE OF HYDROGEN.

Chemical Trade Journal has been favoured
y Messrs. Königswürter and Ebell, of
, Hanover, with the following directions
aching with peroxide of hydrogen. For
, to bleach sponges:—
he sponges are plunged into a mixture of 5
ydrochloric acid of 21° B. and 100 parts
nd allowed to remain therein for twelve to
four hours. By this means the carbonate
as well as the oxide of iron are removed.
vent of a single treatment in this manner
icing, a repetition of the same should be
Sponges which have red spots must be
with a stronger acid mixture, consisting of
of hydrochloric acid and 100 parts water.
on the sponges must be well squeezed out
hed for some time in clean water until the
been removed.
'en litres of our peroxide of hydrogen are
a vessel made of wood, glass, or earthen-
th 225 grammes of spirits of ammonia of
The sponges cleaned, according to prepara-
tion II. are plunged into this bath and pressed together either by wood or glass rods. Temperature of the bath, 20° C. The duration of the process depends upon the quality of the sponges, averaging about forty-eight hours. During the process of bleaching the sponges must be repeatedly squeezed and stirred. If continuous bleaching is carried out it is then desirable to adopt a series of three to four baths, and to utilise these systematically.

III.—The bleached sponges are pressed out and dried in a current of air—when practicable in sunlight.

Bleaching Wool with Hydrogen Peroxide.

I.—By means of repeated washing in soap and water and diluted ammonia, the wool or the woollen fabric becomes freed from the dirt and grease attached thereto. The chemicals used in washing should be most carefully removed by means of soft water, free from lime.

II.—In a wooden or earthen vessel (not a metal one), mix 10 litres of our hydrogen peroxide with 200 grammes of spirits of ammonia 20° B. (0·985 specific gravity); the cleaned wool should be plunged firmly and allowed to remain therein for the space of ten hours. During this time the bleach bath must be placed in a room heated to 20° Celsius. After completion of the process, the bleached wool or textile is passed through a wringing machine, by which means of treatment the superfluous bleach bath becomes removed, after which the moderately moist material is dried in a current of air of 15° to 17° C. If continuous bleaching takes place, it then becomes desirable to arrange a series of bleach baths, which are so systematically utilised that the unbleached article is placed in the bath which has been utilised the longest, so that after a few hours, having passed through the wringing machine, it reaches the second, the better bath, continuing until the bleaching process has been completed in the strongest bleach bath.

Another Method.—Previous treatment of the wool or the woollen fabric as mentioned before. The bleach bath is prepared from 10 litres of peroxide of hydrogen and 200 grammes of spirits of ammonia. The textile is plunged into the fluid and completely saturated with it, then pressed out and dried in a current of air at a temperature of 15° to 20° Celsius, or even dried in the open in sunlight. This process must be frequently repeated.

III.—The dried materials are again subjected to a process of washing, adding to the soap solution a blueing element, such as methyl-violet, afterwards drying under the conditions well known for woollen goods. We urgently request that the bleaching process should be determined by periodical analytical testing or fixing of the hydrogen peroxide contents of the bleach baths, for which purpose we furnish special instructions.

TRANSFEROTYPE.*

I HAVE compiled a short paper, which, if uninteresting as a subject for raising discussion, is the first paper, I think, which has been given before any society treating of "Transferotypes," as it has been thought fit to style them. I make no attempt to support the title chosen by the manufacturers as being specially suited to this class of product, for when employed as *glacé* prints no transfer is made. Again, transfers (possibly collodion transfers) and single or double transfer papers have each and all become very familiar to the photographic ear. It can hardly, one would think, be of advantage to associate this useful process with the ferrotype, now dying a lingering death after a long and arduous struggle for a position in commercial photography which it was never permitted to attain. No, there is not any connection between any of the processes named and the so-called "Transferotype."

Briefly stated, this latter style of photographic production is a positive obtained by the gelatino-bromide process, and I think we may presume that a stoutly made and good quality paper has received a coating of soluble gelatine by way of substratum, and upon the paper so prepared is spread a less soluble and perhaps a thinner layer of sensitive emulsion composed of silver bromide alone, or mixed with chloride or other haloids suspended in nearly colourless gelatine. Precise details and proportions I do not propose to enter upon, the formulæ being a trade secret, and of little use to any but those able to coat large quantities of paper successfully. We may as well, for all practical purposes, rest content with the assumption that an outline of preparation has been touched upon, rather meagrely, it is true, and that if not absolutely correct, sufficient has at all events been mentioned to indicate to photographers curious to know more of the process than that of name, what is likely to be the nature of the manipulations they would have to encounter in practice. Now these are very simple, and, like printing by development on other silver bromide papers, need but a single trial to convince even the tiro how easy photography is, and what an astonishing result can be secured with a slight expenditure of labour and wonderfully little experience. As I proceed I hope to illustrate this statement by demonstrating the practicability of the process for decorative purposes.

The paper I have here has been prepared by the Eastman Dry Plate and Film Company, of Rochester, N.Y., and a developed image thereon can be utilised in various ways. It may be transferred from its paper support to almost any flexible or rigid base, as, for instance, polished or ground glass, porcelain, wood, prepared canvas, ivory, or, indeed, any substance not appreciably affected by hot water used in the stripping process. Metallic surfaces carefully polished, silver, gold, and other ornaments, are well suited to receive the transfer, and need not of necessity yield images lacking vigour from an absence of underlying whiteness to give power to the lights. It is, of course, understood that direct contact printing or reproduction by means of the camera are each available, but to-night we will, for convenience, adopt the easiest (the former), and expose a piece of paper under a negative for one minute at a distance of 4ft. from the gas burner. This done, we shall, after soaking the paper for a few seconds in cold water to flatten and soften it, develop an image thereon by any favourite developer, and as soon as sufficient detail for our purpose is visible in the lights of the picture, further developing action is stayed, and the usual processes of fixing and washing follow. Alum clearing solutions after development and fixing have to be avoided in consequence of the tanning action alum has upon gelatine, and if this were to be permitted at either of these stages the soluble gelatine substratum might prove to be insoluble, and remain most tenaciously on its paper support. An exposure is now made of one minute to the gas jets, and we will proceed to develop in the dark room, but before doing so will, with your permission, finish the remainder of this communication.

Development.—Alkaline carbonates in conjunction with sodium. Sulphite and pyrogallol may be used if preferred, but a blacker image results from ferrous oxalate. The formula recommended by the manufacturers is composed as follows:—

No. 1.

Oxalate of potash	1lb.
Hot water	48oz.
Acetic acid	3 drachms.

No. 2.

Ferrous sulphate	1lb.
Hot water	32oz.
Acetic acid	½ drachm.

No. 3

Potassium bromide	1oz.
Water	32oz.

These solutions are stocked separately, and mixed in the following proportions immediately before use, and in the order recited:

No. 1	3oz.
No. 2	½oz.
No. 3	15 minims.

After exposure the print is soaked in a dish of cold water until flat; the water is replaced by developer, and the action watched until the shadows are judged to be sufficiently strong in depth, when the developing solution is quickly replaced (without a preliminary washing) with water acidified as follows:—

Acetic acid	1 drachm.
Water	32oz.

It is a good plan to change this solution once or twice, after which the prints are fixed in sodium hyposulphate, washed for an hour or so in running water, and are then ready for transfer to some other surface. This may be opal, or, indeed, almost any substance unaffected by hot water; hence if we mount an image on a wood block, it is of the greatest possible use to an engraver; if on clear glass we get a transparency well suited for the lantern; or by similar means positives suitable for negative reproduction or window decoration can be made, the difference of manipulation being merely one of varying the length of exposure and development. Plaques, tiles, enamel plates, all kinds of chinaware, &c., can without any difficulty be thus pictorially ornamented by photography: so also may gold, silver, or many other surfaces, provided such are previously cleansed from grease. Even surfaces which under ordinary circumstances might be expected to repel the gelatino film as the process of drying proceeded, can by the employment of a gelatine substratum rendered partially insoluble with chrome alum be rendered amenable to our purpose.

Perhaps some of our members now present may object to the process, on the score of the image being reversed to that of positives by some other processes from the same negatives. To any such, I beg leave to remark that there are means by which such a difficulty, if difficulty it be, can most assuredly be overcome. I will not say much in favour of a reversing mirror, on the ground that we may assume the negatives have previously been taken in the ordinary manner for other purposes; therefore, any such suggestion must necessarily be out of place, and for the like reason, it would be idle to suggest that exposures be made on sensitive plates, reversed in the dark slide, as recently advocated by my friend, H. J. Burton, for correcting revised images in working that very simple and beautiful process, that of carbon by single transfer. Not only can we utilise single transfer paper in the present instance, however, to gain our ends, but autotype flexible support also, and it is extremely probable that the manufactures of the Eastman Company "Transferotype" may now hear this fact for the first time. A developed, fixed, and washed "Transferotype" can be laid down on a waxed and collodionised glass plate, and, if stripping has taken place, single transfer papers may afterwards be squeegeed thereon, and when dry will leave the glass with a high polish, a *glacé* print, in fact, with a fresh backing; so also may a preliminary mounting on flexible support be effected, and if the ordinary manipulations advised for the working of this special paper in the carbon process be adhered to, a gelatino-bromide positive by double transfer will be the result.

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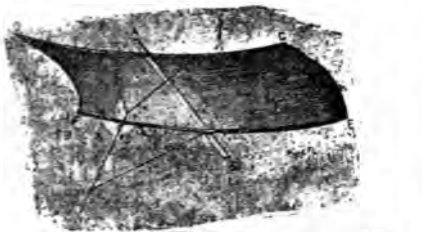
* By W. M. ASHMAN, a communication to the London and Provincial Photographic Association.

Personally, I see no necessity for re-reversing an image, and am quite content with the first transfer, which is effected in the following manner:—The print, well washed, is squeezed upon whatever surface has been chosen for its reception, said surface being cleaned or otherwise prepared previously, if necessary. Pressure is then brought to bear upon the two surfaces, which, if flat, is best effected by placing under a heavy weight. In any case a wait is necessary before further progress can be made, and the period of waiting may be any time between half an hour and half a day. Contact fully established, the object to be embellished and the adhering transferotype print are subjected to water of not less than 140° Fahr., or more than 160° Fahr. Pretty soon the soluble gelatine substratum will give way, and the paper support can be removed without injuring the positive image which lies on the surface of the object intended. Washing in slightly warm water and hardening in alum are now admissible, after which a final washing is given, and the print may be dried and further treated by painting, varnishing, &c.

CHINESE KITES.

THE art of constructing kites is much cultivated in the East, and the Chinese, who have at hand the bamboo, India paper, and thin silk, excel in the manufacture of very ingenious devices of varied forms. One of our correspondents in China, M. Huchet, at present in Paris, has had the kindness to have made for our purposes, by a skilful Chinese manufacturer, a series of models representing the different types of kites used everywhere in China, Annam, and Tonkin, and which the same gentleman has been obliging enough to bring to us in person.



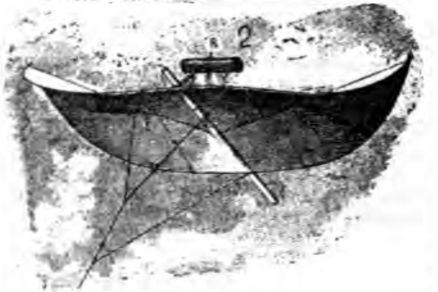
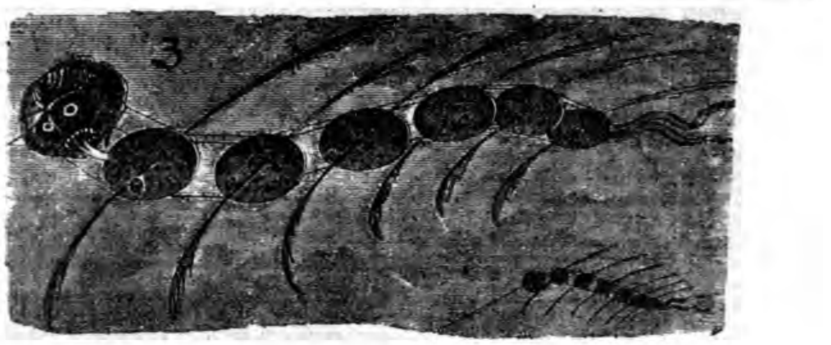


Fig. 1 represents the simplest form of these kites. Its frame is formed solely of a stiff bamboo stick, A B, and two slightly curved side rods, C D and E F. To this frame is pasted a sheet of paper, which is somewhat loose at the extremities, C E *and D F, where, under* the action of the wind,



pockets are formed that keep the affair bellied and in an excellent position of equilibrium. Our engravings shows the mode of attaching the strings that serve to fix it. Kites of this kind are usually about 3ft. in width.

Fig. 2 shows the appearance of the musical kite, so called because it is provided with a bamboo resonator, R, containing three apertures, one in the centre and one at each extremity. When the kite is flying, the air, in rushing into the resonator, produces a somewhat intense and plaintive sound, which can be heard to a great distance. This kite is somewhat like the preceding, but the transverse rods of its frame are connected at the extremities and give the kite the aspect of two bird's wings affixed to a central axis. This kite sometimes reaches large dimensions, say, 10ft. in width. There are often three or four resonators placed one above another over the kite, and in this case a very pronounced grave sound is produced. M. Huchet informs us that the musical kite is very common in China and Tonkin. Hundreds of them are sometimes seen hovering in the air in the vicinity of Hanoi. This kite is the object of certain superstitious beliefs, and is thought to charm evil spirits away. To this effect, it is often, during the prevalence of winds, tied to the roofs of houses, where, during the whole night, it emits plaintive murmurs after the manner of Æolian harps. In the bird kite, the thin paper attached to the wings moves under the action of the wind and stimulates the flapping of the wings. This kite is sometimes 3ft. in length.

The most curious style of Chinese kites is the dragon kite, shown in Fig. 3. It consists of a series of small elliptic, very light discs formed of a bamboo frame covered with India paper. These discs are connected by two cords that keep them equidistant. A transverse bamboo rod is fixed in the long axis of the ellipse, and extends a little beyond each disc. To each extremity of this is fixed a sprig of grass, that forms a balance on each side. The surface of the foremost disc is slightly convex, and a fantastic face is drawn upon it, having two eyes made of small mirrors. The discs gradually decrease in size from head to tail, and are inclined about 45° in the wind. As a whole, they assume an undulatory form, and give the kite the appearance of a crawling serpent. The rear disc is provided with two little streamers that form the tail of the kite. It requires great skill to raise this device.—*La Nature.*

TO MOULD BEVEL WHEELS WITHOUT A FULL PATTERN.*

THE spindle and centre can be used to great advantage in the production of bevel wheels, but it requires more than ordinary care on the part of both pattern-maker and moulder to make the plan a success. But if such care be exercised there is nothing to prevent as good work being made this way as can be got from the whole pattern. I propose to show three methods of moulding a bevel wheel by the aid of the spindle, each of which has claims for precedence, according to the form of wheel desired. To illustrate this article I have chosen an ordinary coarse-pitched wheel, about 3ft. in diameter, the plan and elevation of which is seen at Figs. 1 and 2. I do not purpose going into all the primary instructions for moulding such a wheel, as I take it for granted that any moulder who may be intrusted with this class of work will know what preparations are needed to insure a good casting; suffice it to say that the centre, when set down in the floor, must be low enough to allow of the point of tooth marked A, Fig. 2, coming level with the floor of the shop. Care is needed in setting down the centre, as the spindle must be absolutely plumb before a start is made. I would also remind the moulder of the advisability of putting in a good cinder bed (the use of which will be seen presently).

As I intend these instructions to serve for castings other than wheels, I shall be particular to give the reasons "why," in all cases where it will be advantageous to do so. It has been suggested that A, Fig. 2, is the starting point or joint; all above this point must come into the cope, and necessarily all below it will be in the floor. I speak now of the outer surfaces; the form of the wheel will determine what disposition we shall make of

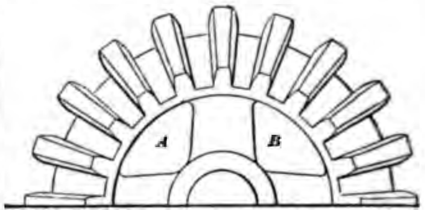


Fig. 1

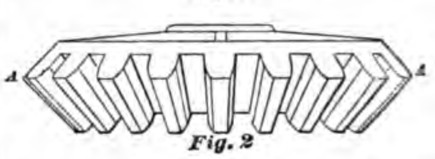


Fig. 2

the inner surface, or arm cores; whether we shall lift them away on plates, use dry sand cores, or carry them in the cope. To better understand the several modes of procedure we will make our wheel by all the methods, beginning with the first mentioned—viz., lifting them away on plates. Fig. 3 will explain the matter. Point A corresponds

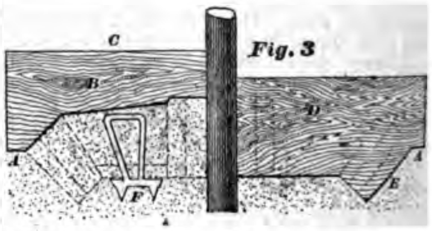


Fig. 3

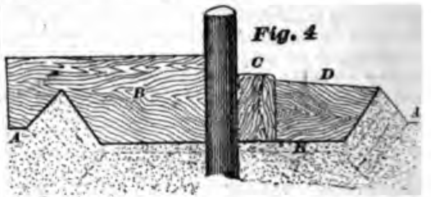


Fig. 4

with A, Fig. 2, and, as before stated, is the joint. B is a sweep attached to the spindle, and is intended to strike the exact form of the back of wheel; its edge is made to correspond with the top face of elevation, Fig. 2. This bed must be made hard and true, and in order to insure accuracy let all the sweeps be made with the top edge C at exact right angles to the spindle, so that a square resting thereon, and brought up to the spindle, will test their correctness.

You now have a true model of the back of the wheel, which must be prepared for parting and the cope rammed over it. An important item is to stake the box well before lifting it away, and take such pains as will preserve them and the joint from injury, whilst the rest of the mould is being made. The portion of mould above A has been obtained by striking a model and taking its impression as you would from a pattern; but the position below A will be obtained direct from the sweep D. The lower edge of this sweep corresponds with all the surfaces below the point A.

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* By S. BOLLAND, in the *American Machinist.*

The broken lines seen on this figure represent a section of the wheel cut across the centre, and will aid the understanding if carefully examined. I need not say that much precaution is needed in the preparation of this part of the mould, for accuracy as well as solidity. In making this sweep it is well to have the surface E (which forms the bed for the teeth) made a little slack; this admits of the segment, with which the teeth are to be formed, being firmly set down in place. When the mould is swept, mark off the arms and set on the core box; also put back sweep B and bring it into position at joint A. This will not only test the core box, but will sweep-off the top of the cores exact with the impression taken in the cope. At F, Fig. 3, I have shown the lifting plate in position. By referring to Fig. 1, at A and B, it will be seen that quite a large plate can be used in this case, thus enabling the moulder to make a safe core.

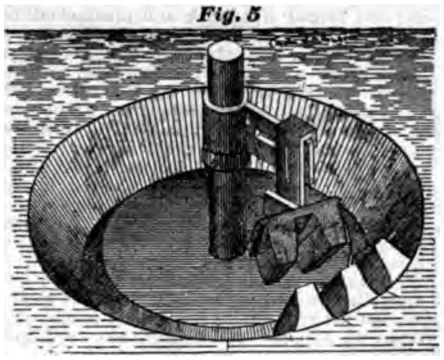
When the wheel is large in diameter and very deep, this plan is the best, as the cores fit the places from whence they are taken with absolute certainty—something which cannot be said for dry sand cores in hardly any case. It must be remembered, also, that there is no shipping of cores in and out of the oven. Should this wheel be made with dry sand cores, the only deviation from the instructions given would be that, as soon as the bottom part of the mould was swept, the teeth could be proceeded with at once, and the cores placed to thickness after the mould was finished. In setting in dry sand cores it is well to have swept B, Fig. 3, in position, so that they can be proved for depth, &c.

To carry the cores in the cope, it will be necessary to change the cope sweep, and instead of a core box to form the arms and hub, these must be made as patterns, in the readiest way that suggests itself to the pattern-maker. Fig. 4 will explain this method, as in Fig. 3 the broken lines show the lower surfaces of the mould; the point A is still the joint, but it will be observed that the bottom edge of sweep B follows the line of thickness down the rim and along the arm. When this has been swept out the hub and arm patterns can be set in position, as shown at C and D, Fig. 4. The ramming of this cope will not be as simple as in the former case, on account of the cores requiring to be secured to the cope by gaggers and chucks, or grates bedded on the bottom and bolted up before the cope is lifted. When lifted off, the mould can be proceeded with as directed for Fig. 3. In this case cores the thickness of the web E, Fig. 4, and in the form of spaces A and B, Fig. 1, must be set into place after the mould is finished. For all shallow wheels, large or small, this plan is the best.

We now come to the all-important part of wheel moulding—to wit, the teeth; and before entering on a description of the actual working of the methods herein suggested, it will be well to mention some of the evils we are accustomed to meet with in this line of work, such as swelled teeth, scabbed teeth, and wheels which evidence carelessness on the part of either pattern maker or moulder, or both, from the fact of their being narrow and wide teeth all round the wheel. To make good sound teeth sand must be used on which reliance can be placed—something which has stood the test. When satisfied on this point, be sure to have it thoroughly mixed with the requisite quantity of sea coal, and not over-damp. Before commencing to ram a tooth, thrust a vent rod through the middle of the space down into the cinder bed below; ram a little at a time, firmly but not too rashly, with a rammer made of wood; the bottom and all along the edge require special attention, otherwise soft places will be found. It is then that the work of destruction begins if the tools are resorted to. Better destroy the tooth and make it over again than to waste time in finishing and have bad teeth after all. By ramming the tooth with the vent rod in place, you are sure that all sides are equally benefited; the wire can be withdrawn when the top is reached and the hole plugged. This relieves all anxiety about the iron entering the vent if there should be any fin or clearance when the cope comes on. To secure correctness in spacing, take the time necessary to do it right. If the segment should happen a little under or over, don't imagine that you can bring it all right by making a little allowance either way as you go round, only to find yourself mistaken at the last move, and, rather than destroy what is done, shave off a little, or divide the difference, as the case may be, but try it again until is right.

Fig. 5 is an isometrical view of the mould when swept as directed. The spindle is 3in. in diameter, turned all its length. The arm is bored to fit snugly, and planed along the top side to a right-angle with the bore. It is made to run loose on the spindle, and rests on a collar held in place by a set screw. Instead of securing the segment to the arm proper, I have shown an attachment (which can be adjusted to the segment by the pattern-maker), the top inner surface of which is planed, and, as is seen, rests on the trued surface of the arm. The planed surfaces allow of an easy adjustment of the segment without fear of altering the angle to which it was originally set. This arrangement admits of a set-screw being fitted on the top, by which means the segment can be lifted clear of the bed (when it is being tried around for the number of teeth) much quicker and without help.

Fig. 5



The bracket seen on the back of the segment not only serves to secure it to the arm, but must be planed, so that when it is correct to the spirit-level the face of the tooth will be at the angle required. When the segment is set correctly, put a bolt through the slot shown and screw fast; then lower the whole down into place, and mark opposite the lines on centre of teeth all round to the starting point. Should it be found to come a little under or over the number of teeth required, increase or decrease the diameter to suit the case; but be sure you are correct before commencing to ram the teeth, and take care to be exactly opposite the mark each move. The view shows three teeth rammed and the segment lifted clear of the last tooth; but it is not intended that the collar on which the arm rests shall be disturbed after it is once set until all the teeth are made. When the teeth are finished, take a segment or half-circle which fits the spindle and extends to the diameter of the core, and bed it round the spindle to form a seating in which to rest the core. Should a washer be required on the face or bottom side, similar to the one shown on the top, it can be done the same way. If proper care has been exercised on all the details of the job it will be found, when closing the mould, that everything will find its place as surely as would have been the case if a full pattern had been used.

QUICK RETURN MOTIONS.

By Prof. A. T. WOODS.*

BY the term "quick return motion" is meant the mechanism by means of which the back stroke of a sliding piece is made in less time than the forward stroke. The most common applications of such motions are to planers and shapers. In the former the quick return is generally accomplished by the use of driving pulleys of different sizes for the forward and back strokes, or by means of intermediate gearing. In the latter some form of slotted crank is frequently used, and it is this form which we propose to investigate.

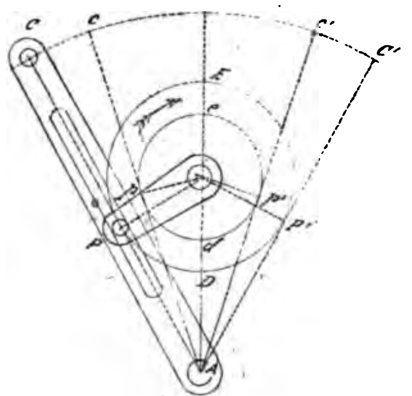


FIG. 1

Fig. 1 illustrates the simplest form of the slotted crank motion. P B is the driving-crank, which revolves at a uniform speed about the centre B, and carries a pin P, which slides in a slot in the arm C P A. This slotted arm swings about the fixed centre A as the pin P slides up and down in the slot during the revolution of P B. Supposing this mechanism to be part of a shaper, the sliding head which carries the cutting tool would be driven by means of a short connecting-rod from C. An examination of the figure will make it clear that when the crank P B is at right angles to the centre line of the slot, as at P B and P′ B, the slotted arm can be moved no further, and that the distance C C′ is therefore the travel or length of stroke of the sliding head and cutting tool. Supposing C C′ to be the forward or cutting stroke, and that the crank revolves in the direction shown by the arrow, it will be seen that the pin P moves through the arc of a circle P E P′, while the tool moves from C to C′, and that P moves through the arc P′ D P, while the tool moves back from C′ to C. Therefore, if, as we have assumed, the crank P B revolves at a uniform speed, we may represent the time of the forward stroke by the length of the arc P E P′, and that of the back stroke by the length of P′ D P. In the figure P E P′ is two-thirds of the circumference, and P′ D P is one-third of the circumference, and, therefore, the back stroke will be made in one-half the time of the forward stroke. Or, to illustrate still further, if the crank P B makes a revolution in three seconds, or twenty revolutions per minute, the time of the forward stroke will be two seconds, and that of the back stroke one second.

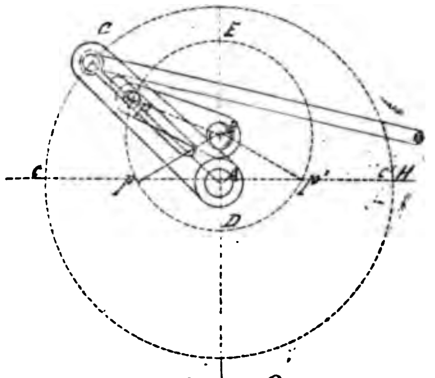
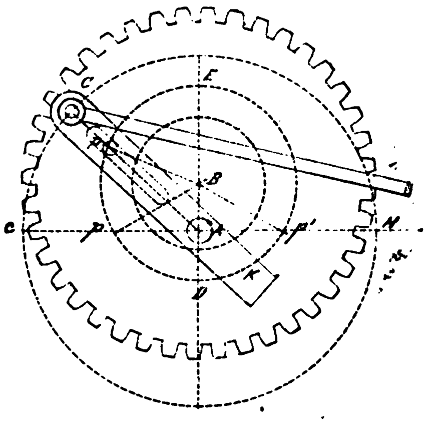


FIG. 2

We will now consider the effects of changing the proportion of the parts in Fig. 1. If the crank P B be shortened to *p* B, for example, it is clear that the travel of the tool will be reduced to *c c′*. Also that the angle *p d p′*, through which the crank *p* B moves during the back stroke, is greater than the angle P D P′, and, therefore, the back stroke will take more time than before. And, as the angle *p e p′* is less than P E P′, the forward stroke will take less time. Thus, by shortening the crank P B, the times of the two strokes are made more nearly equal, or the quick return is less marked. It will be seen that a similar effect will be produced by lowering the centre A and leaving the crank P B as at first.

FIG. 3



Now suppose the centre A to be raised until it is inside the point D, or between B and D. We will then have an arrangement like Fig. 2, which is lettered similarly to Fig. 1. Suppose the crank P B to revolve exactly as before, the slotted arm A C will now make complete revolutions instead of swinging back and forth, as in Fig. 1. The sliding head will now be driven in the direction A H, by means of a connecting rod from C, and the en- of the strokes will occur when A C is on the d centres *c* and *c′* and the pin P at *p* and *p′*. Dur the forward stroke, P moves through the arc p E p', and during the back stroke through p' D p, so that the lengths of these arcs will represent the time required for each stroke, exactly as before.

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* From the *American Machinist.*

In Fig. 2 these arcs are of the same lengths as P E P' and P' D P in Fig. 1, and hence the back stroke is made in half of the time of the forward stroke.

To lay out such a motion as this, we first divide the circle in which P moves into three equal parts, beginning at E on the diameter which passes through A and B. E, p' and p are the three points of division. Then draw a line through p at right angles to A B. This will be the centre line of motion of the wrist pin or the end of the connecting rod which is attached to the sliding-head, and the point A where this centre line cuts the line E B will be the centre about which A C is to turn. The proportion of 2 to 1 has been assumed for convenience, but any other proportion can, of course, be taken. For example—if we wish the proportion to be as 5 to 3, the circle must be divided into $5 + 3 = 8$ equal parts and the points p and p' located so that p D p' = 3 parts and p E p' = 5 parts.

It is evident that the arrangement shown in Fig. 2 is not a practical construction, as the parts would conflict. Fig. 3 illustrates the practical form of the same motion, and in this shape it is familiar as the Whitworth quick return motion. The letters represent the same parts as in Fig. 2. The spur gear shown is a plate wheel driven by a pinion, not shown, and turns about a large fixed journal shown by the full line circle. The arm A C turns about a pin A set in the end of this journal or shaft. The pin P is fixed in the face of the plate wheel and slides in a slot in the arm A C. By comparing Figs. 2 and 3 it will be clear that the principle of the motions is exactly the same, and referring to Fig. 1 we find the same principle—viz., the unequal arcs passed over by the driving pin during the forward and back stroke of the sliding head. A variation in the construction of the Whitworth motion can be made by placing the pin P at K and slotting that end of the arm A C so that B will be between C and P, instead of being on one side, as in Fig. 3. When this change is made, the pin P or K must be revolved in the opposite direction to that shown by the arrow, supposing the tool to be to the right of the figure, as before.

It would seem at first sight that such arrangements as these would produce a rapidly-changing speed of the cutting tool which would make them undesirable for shaping machines; but investigation will show that the speed is remarkably uniform throughout the greater part of the stroke. To illustrate this, in Fig. 4, let A B represent the length of the arc P E P', or the distance through which P moves during the forward stroke. Divide this into, say, eight equal parts, which, as P revolves at a constant speed, will represent equal intervals of time, and at the middle of each division draw lines perpendicular to A B. On these lines lay off the distance travelled by the tool during each eighth of the arc as found from a drawing. Then a curve drawn through points found in this way will be shaped like that shown by a full line. If the speed of the tool was the same at all parts of the stroke, the curve would be a straight line parallel to A B, and the difference between it and a straight line will represent graphically how much variation there is in the actual speed. It is evident that, for the greater part of the stroke, the curve is nearly parallel to A B, and, therefore, that the speed of the tool is nearly constant during the time that it is cutting.

The curve shown by dashes represents in the same way the motion derived from the simple crank, the effect of the connecting-rod being neglected. A short rod would change this curve to that shown by a dotted line, the effect being to decrease the speed during the first half-stroke and to increase it during the last half. These curves clearly show how much more uniform the speed of the tool in these quick return motion is than that of a crosshead or piston as usually connected to a crank which revolves at a constant speed. The connecting-rod produces similar effects in the quick return motions, and is more marked in the forms of Figs. 2 and 3 than in that of Fig. 1; but with ordinary proportions it is not sufficient to be readily shown on a figure of this size.

HAMMERSMITH INDUSTRIAL EXHIBITION SOCIETY.

THE Industrial Exhibition opened at the Flora-gardens Board School, Hammersmith, last Tuesday week, is the second of the Society, and, although not large, is encouraging. All kinds of handiwork are to be seen, from needle-work to models of buildings and ships, including a loan collection of pictures, embroidery, needlework, and other art works. Referring to the chief object of the Society—the competitive exhibits in the lower rooms—we notice a collection of models of houses and churches displaying undoubted ingenuity in the manipulation of various materials, like cardboard, cork, shells, &c., but, as we have always thought, undesirable objects of the skill and immense labour often bestowed upon them. More useful and profitable as examples of artistic handiwork are the hand-painted terracotta plaques and the turned woodwork and ornamental fretwork, and the large collection of needlework, including every kind of children's wearing apparel, knitted counterpanes, and embroidered quilts. A knitted counterpane takes the first prize, worked to a panelled pattern. Specimens of Kindergarten work are also shown. Technical drawings also form a part of the exhibits, and amongst these we notice an elevation of a block of flats, with the bays shown in perspective, and a design in rather puerile Gothic of a library, reading-room, and school. Here we find the need of instruction in technical drawing. The elevation of the block of flats, partly geometrical and partly perspective, is an instance of misdirected labour; the school design is accompanied by sections which show the student has mastered the technical points of construction, but has not succeeded so well in the elevations.

USEFUL AND SCIENTIFIC NOTES.

Effect of Cooking on the Digestibility of Starch.—In a graduation dissertation for the degree of M.D. in the Military Medical Academy of St. Petersburg, Dr. N. Butiagin gives an account of some experiments he has been carrying out with the view of determining the effect of cooking on the digestibility of starch foods. He found that the activity of the saliva does not differ much amongst healthy persons, but that when people are badly nourished and weak, and especially when in addition to this they are suffering from disease of any kind, their saliva has a very perceptibly diminished power of dissolving starch. When starchy substances are subjected to prolonged cooking they become more easily digestible, and in this way compensation can be provided for the inactivity of the saliva of weakly persons. Thus, rice and peas were found to require three hours' cooking in order to render them as easily digested in the saliva of a badly nourished, nervous, hysterical woman (which had previously been found to possess only 88 per cent. of the normal activity), as they were with a single hour's cooking by the saliva of healthy persons; and generally it was found that in the case of weakly or diseased persons starchy food must be cooked twice or thrice as long as in the case of healthy persons in order that it might be equally acted upon. Again, when starch has been cooked for a long time there is less difference between the effect of healthy and unhealthy saliva upon it; this is specially remarkable in the case of millet—which after one hour's cooking showed a difference of 12·89 per cent. in favour of the saliva of healthy as against that of diseased persons, but after three hours' cooking a difference of 5·77 per cent. only.—*Lancet.*

Nickel Plating Solution.—According to the *Bulletin Internationale de l'Electricite*, the following solution is employed for nickel plating by several firms in Hainault. It is said to give a thick coating of nickel firmly and rapidly deposited. The composition of the bath is as follows:

Sulphate of nickel..................	1lb.
Neutral tartrate of ammonia ...	11·6oz.
Tannic acid with ether............	0·8oz.
Water	16 pints.

The neutral tartrate of ammonia is obtained by saturating tartaric acid solution with ammonia. The nickel sulphate to be added must be carefully neutralised. This having been done, the whole is dissolved in rather more than three pints of water, and boiled for about a quarter of an hour. Sufficient water is then added to make about sixteen pints of solution, and the whole is finally filtered. The deposit obtained is said to be white, soft, and homogeneous. It has no roughness of surface and will not scale off, provided the plates have been thoroughly cleaned. By this method good nickel deposits can be obtained on either the rough or prepared casting, and at a net cost which, it is said, barely exceeds that of copper plating.

Gas from Petroleum.—In Glasgow, a committee of the town council has been appointed to inquire into the question of the production of gas from petroleum, and experiments are now being made. There is little doubt now that the gas companies are likely to have a competition with the electric light as far as illuminants are concerned, and they may best meet it either by endeavouring to cheapen the cost of the production of gas, or by themselves commencing to supply electricity for lighting purposes—or by both courses—so that the economical use of both gas and electricity might be fostered (!)—*The Chemical Trade Journal.*

SCIENTIFIC SOCIETIES.

EAST LONDON MICROSCOPICAL SOCIETY.

THE ordinary meeting of this Society was held at the Bow and Bromley Institute on Thursday, the 5th inst. The chair was taken by the president, E. J. Lyndall, Esq., and there was a good gathering of members and a fair show of microscopes.

Mr. Ellsworth read an interesting entomological paper entitled "A Ramble on the Surrey Hills," and he was followed by Mr. John Goodfellow, Prof. of Physiology and Hygiene to the Institute, who read a short paper on "The Chemical and Physiological Effects on the Body of Extract of Meat when taken as a Food." The reader of the paper remarked that he had undertaken the experiments during a little leisure time he had in order to satisfy himself on a much-debated question. All the analysing had been confirmed independently by two or three of his colleagues, and might be taken as correct. The composition of the extract was water 20 per cent.; extractives (creatin, creatinine, xanthine, &c.), 56 per cent.; inorganic salts (chiefly potash salts), 23 per cent., with a probable error of 1 per cent. There were mere traces of albumen and gelatine. It was thus apparent that the extract had no nourishing properties as far as organic food went; but that the extract had a certain restorative effect was well known, and he had performed a series of experiments on himself in order to elucidate, if possible, on what these properties depended. The experiments need not be detailed here; suffice it to say, they were carried out carefully, and the urine systematically examined, while the pulse tracings were taken with a sphygmograph. Briefly, the conclusions at which Mr. Goodfellow arrived at were:—

1. That the extract had no nutritive value.
2. That it acted as a stimulant to the nervous and vascular system, increasing the rate of the heart's beat.
3. That it increased the metabolism of the body without supplying the necessary food to recoup the tissues for their increased activity.
4. That the amount of urea excreted was slightly increased, and thus extra work thrown on the liver and kidneys.
5. The stimulation was followed by a corresponding depression.

He explained these effects as follows:—

1. The inorganic salts were the agents producing the stimulation and the increased metabolism of the tissues.
2. The increased urea was derived from (*a*) increased metabolism (slightly); (*b*) from the extractives being converted into urea in the body (largely).

The discussion which followed by Mr. Smart, M.P.S., Messrs. Love, Day, and Jaques tended to confirm Mr. Goodfellow's researches.

A New Insulating Process.—Messrs. Weber and Schefbauer's method of insulating conductors is as follows: Two or more copper conductors are placed parallel to one another at a convenient distance, and are covered with several layers of paper tapes which have been passed through a bath of ammoniacal oxide of copper. The paper covering thus obtains an outer coating of cellulose, and by passing the core through rollers of the proper shape, the cellulose on one spiral combines with the neighbouring spirals, forming a solid mass. During the passage through the rollers the conductors are carefully guided, so that they cannot come into contact. The core is again passed through the bath, the cellulose, to a certain depth, being thus detached, and it is then taken through rollers heated by steam and exercising considerable pressure; the core comes out dry, and with a smooth surface. A bath in boiling linseed oil is then given, the core being heated so as to allow the paper to thoroughly absorb the oil; finally the rollers are again employed so as to expel any excess of oil.

THE report of Mr. Cautley, the acting consul at Trieste, on the forests of Austria, just issued by the Foreign Office, says that perhaps Austria has a larger proportion of forest in comparison with its area than has any other country. The woods cover about 3,500,000 acres, of which 80 per cent. is timber forest, and the remainder of young growth. The Government and the large landowners own 69 per cent. of the total forest area, the parish authorities 20 per cent., the clergy 9½ per cent., and peasants about 1½ per cent. The forests are, in fact, the principal source of wealth to Austria, and, calculating the cubic contents of all the timber, and reckoning each cubic foot at nine-tenths of a penny, the wealth of the whole country in this respect may be set down at close on £40,000,000 sterling. The yearly increase in the value of the forests is said to be over half a million sterling.

ƆCIENTIFIC NEWS.

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ɪ Dun Echt Circular No. 154 we learn ːt Dr. L. Becker has computed parabolic s of Comet Sawerthal from observations t the Cape on Feb. 18, at Palermo on .3, and at Strassburg on March 27. He = 1888 March 16·96412 G.M.T.; π − ☊ 45·1″; ☊ 245° 30′ 40·2″; *i* 42° 17′ 47·4″; 9·844562. Unless there is some cone error in the observations, it may be ıferred that the true orbit is elliptical. .emeris for Greenwich midnight reads—

	R.A.			N. Dec.	
April 14	22h.	41m.	6s.	15°	54′
16	22	46	40	17	27·8
18	22	52	8	18	57·3
20	22	57	31	20	22·7

ıet was observed by Prof. Ricco at ı in the middle of March, when it was ı 6 mag. star 27 Capricorni, to which its was about equal in brightness; the wide, spreading, and directed towards .W.

a purely personal matter, but it may some of our readers, and possibly preistakes, if we mention that Mr. E. Her Majesty's Astronomer at Durban, has changed his name to Edmund Nevill, in accordance with certain pro.n the will of the late Neville Nevill, of ches del Norte, Colorado.

'alisa, of Vienna, discovered another ·lanet on April 3. It is No. 274, and ;2nd discovered by the distinguished :.

ɾev. T. E. Espin, in Wolsingham Ob·y Circular No. 19, writes:—The star 40° 2694 R.A. 13h. 24m. 43·2s. Decl. + (1855) Mag. 9·2, was observed here on ;hts of April 6, 8, as 7·3 and 7·7. It :herefore, variable. The spectroscope fine III. type spectrum.

eath is announced of Dr. Rudolf Engel·f Leipzig, the well-known publisher of c works, and amateur astronomer.

anchon, the director of the Jardin des at Montpellier, is dead.

'hos. Lister, of Barnsley, a well-known ist, died the other week in his seventy·ear. He was also a poet, and for some ıstmaster of Barnsley. He frequently ıted papers to meetings of the British :ion, his last being in 1882, "On the ıtion of Yorkshire Spring Migrants."

. G. Baker, F.R.S., F.L.S., will deliver a ɔf twelve lectures on Botany at the of the Apothecaries' Society, Chelsea, rdays during May, June, and July, at Tickets can be obtained from the ıf the Society.

ıeteorological observations made during der the superintendence of Mr. Cuth- Peek, M.A., at Rousdon Observatory, .egis, have been issued. The observaı evaporation carried out at Rousdon special interest.

Cruls, the Director of the Imperial tory at Rio de Janeiro, has made an to all meteorological observers for ce in the compilation of a "Universal logical Dictionary," which is intended rise, in a methodical form, the principal logical elements from as many stations ible over the whole globe. The data or are the mean monthly and yearly .tures, together with the monthly and minima, and the dates of the absolute extremes; the relative huamount of cloud, rainfall, number of rain, thunderstorms, and frost, and the ıt wind, in each month; the mean ıeight of the barometer, and its mean ɔscillation.

important changes in the working of lian Meteorological Department are ı be made, the object being to concenmuch as possible the energies of the ıent on the rapid transmission to head·ı of information regarding current in the state of the weather, and the ıication of that information to the ı an intelligible form.

ɘcent meeting of the Sheffield Medico-Chirurgical Society, Mr. Pye-Smith read a paper on Clothing, in which he stated that the two main objects of clothing were protection from violence and from extremes of weather, and preservation of the natural warmth of the body. Good clothing should accomplish these objects without injury to the body, without interference with its proper movements, without special danger or inconvenience, without needless interference with social distinctions, and without offence to modesty and good taste. Fabrics manufactured from the wool of animals were greatly to be preferred for garments to those made from cotton or other vegetable fibre; woollen goods compared favourably with those of cotton in respect to the following qualities:—Conduction of heat, absorption of moisture, porosity, weight, cleanliness, natural colouring, inflammability, strength, softness, flexibility, elasticity, and durability. Their roughness of surface was advantageous, except in the rare cases in which even the finest varieties caused unbearable irritation of the skin. Their shrinking in washing could be prevented by care, and their greater cost was held to be much more than compensated by their greater healthiness. The various articles of male attire were then passed in review, and special stress was laid on the value of socks with separate compartments for each toe, as a preventive to corns and deformity of the toes, and as contributing to their warmth, cleanliness, and natural development. Remarks were made on evening dress and outdoor clothing, and the opinion was expressed that the commonest faults in clothing were the use of cotton instead of wool, and the undue tightness of garments for the chest, waist, and feet.

The British Consul at Barcelona thinks that ramie fibre is destined to play an important part in conjunction with wool and silk, and also with cotton; but he does not think it can be substituted altogether for cotton. Thread and string made from it will be stronger and more lasting than cotton, and have a flexibility difficult to obtain from either flax or hemp. It is said that even now much of the thread that is sold in England as silk is made from ramie. There is no difficulty in colouring it; indigo is best for blue, saffron for rose, the castor-oil plant for orange-brown, and turmeric for yellow. It also preserves the colour better than other fibres. Senor Obiols, Professor of Agriculture at Barcelona, declares that ramie is a most valuable industrial fibre: thread can be made from it to imitate cotton, with the advantage of greater strength and durability; all kinds of linen, stuffs for trousers, shirts, sails, sackcloths, cordage, &c., can be made of it, as well as lawns and fine lace. He thinks its cultivation will throw that of wine into the shade in parts of Spain; it produces three harvests a year, and it will become popular, as it requires a *minimum* of labour. Moreover, machines are already in use which are able to decorticate it on a profitable scale.

The projected competition for the prize for the safest paraffin-oil lamp exhibited at the St. Petersburg Exhibition has fallen through, as the Imperial Russian Technical Society has now altered the conditions, and intends giving the prizes of 2,500 and 1,000 roubles respectively, only to lamps burning heavy oil, whether they are safe or not. Sir Frederick Abel has pointed out that heavy oils may be more dangerous than those of a lighter character. The Imperial Technical Society, however, has made the alteration mainly with the view to promote the production of lamps calculated to burn the heavy oils now wasted at Baku. It seems that the lamps we have been using so long in England are regarded on the Continent as quite out of date; foreigners universally displaying a preference for the circular wicks that give twice the light with a greater economy of power. However, as regards safety, Birmingham, in the opinion of Russian experts, has come off first, and would undoubtedly have obtained the prize if safety had remained the chief condition.

The system of train telegraphy introduced by the Consolidated Railway Telegraph Co. (see page 221, Vol. XLVI.) has had an excellent opportunity during the recent snowstorms in America of proving its value. On the Lehigh Valley Railroad during the past winter the snowed-up trains kept up constant communication with the terminus, and being thus able to define their position and explain their condition, were materially helped in a very trying season.

In a recently-issued number of the *Transactions* of the American Society of Engineers, Mr. C. H. Haswell describes some experiments with a steam-engine, with an attachment in which bisulphide of carbon is used. "Reviewing," he says, "the elements submitted, it is presented that by the use of the vapour of bisulphide of carbon in a vessel connected to an ordinary steam-boiler and engine, condensing or non-condensing, an elastic vapour can be attained greatly in excess both in pressure and volume of that of the steam that generated it; and, as an evident and infallible consequence, both increased power and economy of fuel are attained with less boiler surface and consequent wear." All which it may be observed had been discovered years ago, and been worked at in America. Faraday and Brunel tried the plan with carbonic acid, and with ammonia also, we believe; but although workmanship is much more accurate nowadays, an engine driven by bisulphide of carbon would certainly need to be in the open air.

USEFUL AND SCIENTIFIC NOTES.

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Chloride of Nitrogen.—Dr. Gattermann, whose venturesome experiments have had so successful an issue, has not got off with impunity. It is regrettable to learn that he must give up for a time all further work upon this explosive, his eyes and nerves having been grievously injured by his recent experiments. Yet he has been more fortunate than his predecessors in the same work. Those familiar with the lives of Davy and Faraday are not likely to forget the serious accidents that happened to them when experimenting with chloride of nitrogen. Much less is it likely to be forgotten that the discovery of this dangerous body in 1811 by Dulong cost that distinguished chemist one of his eyes and three of his fingers, doing him much bodily harm besides. The substance has been usually prepared by leading chlorine into a warm solution of salammoniac. In laboratories the explosion of a tiny drop of the liquid is secured by touching it with a feather moistened with turpentine and attached to the end of a long wand such as a fishing-rod. Its suppleness saves the arm from the shock.—*Chemical Trade Journal.*

THE *Economiste Français* estimates the loss suffered by French wine growers through the phylloxera at 10,000,000,000f., or double the amount of the war indemnity of 1871. This loss is considered to be the principal cause of the commercial and agricultural crisis through which France has passed in recent years, while it has also reacted unfavourably upon the revenue of the railway companies. The sum total given above is calculated as follows:—Totally destroyed, 1,000,000 hectares of vineyards; partly destroyed, 664,511 hectares, the loss on which is equal to the entire destruction of 200,000 hectares. Reckoning the hectare at 6,000f., this gives a loss of 7,200,000,000f. To this must be added the deficit in the wine harvest, which may be approximately estimated by the quantity of inferior wine and raisins imported, and which in the thirteen years from 1875 to 1887 amounted to 2,800,000,000f.

THE French Consul at Bilbao states in a recent report that the pilchard or sardine fishery on the Atlantic shores of the northern portion of Spain proved in 1887 a most disastrous failure. During the three months of June, July, and August, which are generally the most abundant in the year, nothing was caught but sardines far too large for the boxes commonly used in the trade. The amount taken in 1886 was 1,650 tons, and during the corresponding months in 1887 it was only 790 tons. This large falling off is supposed to be due to the fact that the fish do not find the food they require on this coast—formerly one of their favourite habitats. Perhaps in a large measure it is owing to their having been driven away by the reckless system of fishing which has been adopted in the past.

THE coming exhibition of the Graphic Arts which is to be opened in Leipzig on the 28th inst., will be divided into seven departments—viz., (1) The publishing of books and newspapers art works, maps, music, &c.; (2) Printing processes, including type-casting, electrotyping, and inks; (3) Paper; (4) Bookbinding; (5) Photochemical reproductions and etchings; (6) Drawings for illustrations. A feature is to be an exhaustive collection of the periodicals, in all languages, that relate to the various trades. Upwards of one hundred have already been sent in.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, *332, Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

*** *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

THE CAPE TOWN COMET.

[28607.]—GOOD observations were obtained this morning of the comet discovered at Cape Town on Feb. 18. It was this morning situated in the head of Aquarius, R.A. 21 hours 40 minutes, decl. south 5° 15'. The comet was just visible to the naked eye when its position was known. In the telescope it was really a fine object, with a bright elongated nucleus, and a broad tail about 1° in length. **William R. Brooks, F.R.A.S.**

Red House Observatory, Phelps,
N.Y., U.S.A., March 25.

SMALL STARS IN THE TRAPEZIUM OF ORION.

[28608.]—UNE discussion ayant surgé dans votre intéressant journal sur la visibilité et la variabilité possible des petites étoiles du Trapèze de la nébuleuse d'Orion, j'ai voulu m'assurer si je les voyais encore aussi bien qu'en hiver 1886-1887; à cette époque, en effet, mon huit pouces de Grubb me les montrait admirablement, et je les ai fait voir à plusieurs personnes; il s'agit de la 5^e et de la 6^e étoile. Or, le 1 avril, 1888, vers 8h. 45m. Orion se trouvant près de l'horizon, la lunette étant presqu' horizontale, armée du grossissement de 150 fois, j'ai parfaitement vu la 5^e étoile, aussi bien que l'hiver passé en égard à ces conditions défavorables; la 6^e étoile ne se montrait que par moments, avec difficulté, pour les mêmes motifs. Il faut être très circonspect quant à la question de variabilité. Il m'est arrive de les voir parfaitement, puis, après avoir changé légèrement la mise au point, de ne plus retrouver la position de l'oculaire la plus favorable à leur visibilité.

Louvain. **Dr. F. Terby.**

ILLUMINATION OF THE ECLIPSED MOON.

[28609.]—PERHAPS you will allow me to answer through your columns some inquiries which I have received on this subject, as well as a question which is asked by Dr. Burder in your last number (p. 123).

I know of no photometric measurements which will enable us to compare with numerical accuracy the brightness of the corona from one eclipse to another; but there is evidence which renders it probable that there is a variation in brightness from eclipse to eclipse. The total light given by the corona is usually much over-estimated. The evidence of several reliable observers tends to show that the corona and solar prominences do not cast a shadow. That is, the light derived from the corona and the brilliant ring about the dark moon is overpowered during a solar eclipse by the light derived from the clouds seen on the horizon outside the region of totality, which are lit up by the thin crescent of the disappearing or reappearing sun.

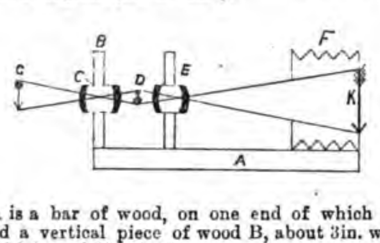
A lunar observer, if he saw the corona, would never see as much as half of it at once, for more than half the corona would be hidden behind the disc of the earth, which, as seen from the moon, is about two degrees in diameter; and although an observer on the moon (thanks to the want of a lunar atmosphere) would probably see the uneclipsed part of the corona somewhat brighter than it would appear to a terrestrial observer, he would be dazzled by a brilliant arc of light, due to the transmitted rays from the whole body of the sun, along the earth's limb immediately below the uneclipsed part of the corona. A little consideration will show that this arc of refracted sunlight would give much more illumination to drown the coronal light than is given by the clouds around the region of totality during a terrestrial solar eclipse, which clouds are only illuminated by the thin solar crescent, and the light from them is sieved through 40 or 50 miles of the lower atmosphere after dispersion by the cloud particles before it reaches the station of the observer within the region of total shadow. To a lunar observer just within the region of total shadow the arc of light would appear about half a degree long. The light from the upper limb of the sun would be hardly refracted in the higher parts of the earth's atmosphere, and the light from the lower limb of the sun would have passed through the earth's atmosphere at an altitude where it suffered a refraction of about half a degree. It is possible to make a rough estimate as to the region in the earth's atmosphere through which light so refracted must pass, and we shall see that the region is so elevated that almost all the sun's light would be transmitted above the level at which clouds usually float.

A solar ray grazing the earth's surface at a part of the earth's limb where there were no clouds, would be bent inwards from its original course by double the amount of the horizontal refraction (33')—*i.e.*, by 1° 6', because on passing out of the atmosphere it undergoes a bending equal in amount, and in the same directions, as it undergoes on entering the atmosphere. We know that at a height of about two and a half miles above the sea-level the barometric pressure is reduced to about one-half, and leaving out of account the effect of the colder temperature; the horizontal refraction would also be reduced by one-half. We may, therefore, feel certain that none of the light which reaches a point on the moon's surface just within the region of total shadow has passed through the earth's atmosphere at an altitude lower than two and a half miles above sea-level, and the greater part of the solar light must pass at a much greater altitude, where no clouds float. The differences in the colour and brightness of the eclipsed moon from lunar eclipse to eclipse must, therefore, be due to differences in the transparency of this upper atmosphere. The observations show that the difference from eclipse to eclipse is very great, and that the whole ring of atmosphere around the earth's limb is similarly affected, for one portion of the eclipsed moon is not blue while another portion is red; but the whole moon appears either red or bluish, or it is nearly invisible. There is no radial distribution of colour, as there would be if very local causes, such as storms on the earth's surface, affected the transparency or colour of the upper air. I am inclined to attribute the differences from eclipse to eclipse to differences in the dust-laden character of the upper air, rather than to differences in the gaseous constitution of the atmosphere or to aqueous vapour. If the variation of colour were due to differences in the amount of aqueous vapour, we should expect a marked difference in the colour of the light refracted at the Equatoreal and Polar regions; but there is no evidence of such a difference. A Krakatoa explosion does not occur every few years, and unless dust from Equatorial desert regions is carried up into the upper half of the atmosphere by ascending currents of warm air, we must look to causes outside the earth for changes in the clearness or dustiness of the upper air. As, for example, that the earth sometimes passes through a region rich in meteoric dust, and sometimes through regions where meteoric matter is more sparsely distributed.

A. Cowper Ranyard.

LUNAR PHOTOGRAPHY.

[28610.]—SOME years ago, with the kind assistance of the "Optical Bricklayer," I ground and polished an 8in. speculum, which I mounted in a roughly equatorial manner. The speculum, being a first attempt, was not very good, and I have not since had the opportunity of making another; the stand also was not very steady. I thought I should like to photograph the recent eclipse of the moon, and as the telescope was no use for the purpose, the method employed may interest your readers. In order to make the description clearer, I have prepared a diagram (not to scale).



A is a bar of wood, on one end of which was fixed a vertical piece of wood B, about 3in. wide, 6in. high, and ¾in. thick.

To B was attached a 6in. Dallmeyer, rapid rectilinear, C. This gave an image of the moon at D ·05in. diameter; 10·8in. behind C a 4in. Ross portable symmetrical lens E was fixed in a similar manner to the Dallmeyer, care being taken that the two lenses were truly centred.

The Ross lens, being 4·8in. behind the image from the Dallmeyer, gave an enlarged image ·25in. diameter, 24in. behind E. This was received on the sensitive plate in the camera F. The focussing-screw of the camera was used to get the exact focus. The whole was strapped on to the telescope tube, and one portion of the moon's surface was kept, by means of the tangent screw, on cross hairs in the large telescope.

Exposures were given varying from twenty to sixty seconds as the eclipse progressed, and the results were fairly satisfactory. The methods would be more satisfactory on a steady telescope, and might, I think, be used with success by owners of refractors not corrected for photography.

In the figure, G represents the moon, D the first image, and K the final image.

98, Chapel-road, Sale. **D. E. Benson.**

HEAT ON THE MOON'S SURFACE.

[28611.]—IN the remarks by "E. T. C." (letter 28585), he says:—"The statement that these apparent craters may be nothing more than masses of ice is not worth a moment's consideration:" also, "as the moon must necessarily be exposed to a very high temperature for several days when near the full." Now, in regard to this statement about the heat on the moon's surface (which is in all the textbooks), would "E. T. C." give an explanation as to how it is possible for the surface of the moon to receive any heat when there is no atmosphere, as, along with others, I have always understood that the intense cold and everlasting snow above the "snow line" on our earth is caused by the thinness or increasing rarity of the earth's atmosphere, and that although space from the sun to the orbit of Neptune (not to go any farther) is filled with light and heat, neither the one nor the other is seen or felt, except when in contact with the atmospheres of the planets? If this is so, how, then, can the surface of the moon (where there is no atmosphere) receive any heat as heat any more than space? **Dens.**

THE GLACIAL PERIOD AND THE MOON'S WATER.

[28612.]—AS circumstances compel me to be absent from England three out of four weeks, there is no use occupying your columns with inconstant replies; but perhaps I may intrude to say a few concluding words. In reply to my letter (28499), "F.R.A.S." recommends me (28527) to study the elements of the planetoid orbits in some recent work on astronomy. I have done so, and fail to find any conclusive proof that the asteroids are not the remains of a burst planet. I do not contend that they are, but simply that they might be. The force of steam, which will move a train or upheave the Andes, would in certain circumstances burst our earth or the planet Mars. Tidal steam would have an extra factor in its account. On the other hand, cold might be sufficiently powerful to burst a planet, or, say, the moon, if its waters were imprisoned and subjected to its influence. In the Middle Ages it was a common experiment to burst spheres made of copper or other metal by freezing water in their interior. In the same manner Huyghens burst iron cameras. Major Williams, during a severe Quebec winter, filled a mortar with water and closed it by driving a plug of wood into its muzzle. He exposed it to a temperature of 50° below the freezing point of Fahrenheit's scale, when the metal resisted the strain, but the plug gave way and was projected about 400ft. The meteorites probably come from many sources, and there are many sources in space from which water might reach us. Whether from the lunar surface, the asteroids, or a hydrogen comet is not of much consequence. I contend that the Glacial period was due to an immense addition of water to our atmosphere from somewhere outside our own earth, and that it fell north and south of the tropics as snow. From among a host of examples I may point to the evidence that the river St. Lawrence originally entered the ocean between Cape Breton Island and Newfoundland, The Gulf of St. Lawrence expands rapidly with several openings to the sea, but any good nautical chart will show that there is a river bed curving round into a southerly course and reaching 600 fathoms in depth, where it passes into the Atlantic. The soundings at either side are comparatively shallow. The hundred-fathom line is most marked where there are strong tides, and there is usually another step down showing a more ancient denudation. In ancient seas with small tides, like the Mediterranean, you get deep water very near the shore. We now know that the old see-saw land-and-sea-changing theory is not true, for the *Challenger* expedition has proved the practical constancy and great age of the ocean bed.

With regard to "E. L. G.'s" letter (28534), I wish only to say that I think with our knowledge of how long frozen meat lasts there is nothing unreasonable in supposing that an animal suddenly frozen to death and inclosed in snow becoming ice would last for immense periods. Lord Dufferin, in his "Letters from High Latitudes," tells us of men's bodies found, more or less undecayed, after several hundred years' exposure on the frozen shore of Spitzbergen. The Asiatic continent slopes from south to north in the greater part of its extent. Seeing that the mammoths were found near the mouths of rivers, I consider that they were slowly carried down by glacier action from the higher and more southern site of their sudden deaths. "E. L. G." thinks the water of the Deluge fell scalding hot. If it did so at the Poles, how did it fall at the Equator?—and if it fell scalding hot at the Equator, how did it fall at the Poles? If it reached the higher regions of our atmosphere as steam, seeing that steam up there could hardly be superheated, would it not condense into rain and finally snow long before it reached the earth?

In my letter (28499) where I spoke of the triple Manx leg formation of the land surface, several words were left out in the printing which makes the meaning a little misty. I meant to say that South America, Africa, and the Indo-Australian peninsula would be the three legs.

R.M.S. *Scythia*, April 9. **Francis E. Cane.**

P.S.—In reply to Mr. Quilter (28558), let me remind him of the probable causes of vulcanism. There is the enormous and variable differences in pressure between high and low barometer. There is the enormous pressure and blow delivered to a coast line by an average tide; there is the pull of the sun and moon. From these factors we have force enough to get vast results. What would be the changes set up if one hundred fathoms were added to the ocean? If a tide 3ft. high along a coast line is likely to produce vulcanism, what might we expect from 600ft. of water rapidly added, and still retaining its tidal blow delivered in new places? As regards many Glacial periods, I consider *the* Glacial period as a fact, but the others as unproved theories. Geological ages need much revision, as evidenced by the much lesser period known to be needed for the Niagara gorge, as compared with Lyell's calculation.—F. E. C.

THE ORGAN BUILDER.—I.

[28613.]—IN laying before the musical and mechanical amateurs a series of instructive letters on the above subject, I do so with the hope that they will be benefited thereby, but crave at the same time a little forbearance on their part, for I cannot get at all the wants of the amateurs in their various stages of finish or progress, so that if they wait a little I'll not have to re-write the same information for this article. I, however, do not expect that my letters will escape criticism of perhaps a very cutting spirit; but if they do I shall feel the greater assurance that they are acceptable to the earnest inquirer. I therefore enter the subject without further remarks.

It has been my lot to fall amongst the many who have come to grief in their instruments, and I have observed that the non-success is due *mainly* to a want of decision or purpose, or perhaps I may tersely say a definite end. Nearly all amateurs are prone to build very much more than they have capacity for; others try to build a class of work that requires the ability of a skilled mechanic, and wonder why they fail; whilst others *keep on building* or *adding to* a specification of the smallest limits, expecting to get the results of well-spaced instruments.

This latter class is the most common, and at the same time the worst, class of amateurs; for, after confining a soundboard to its very *smallest limits*, they add other stops, without considering that the bellows are too small, or the pallets of the soundboards and their grooves not large enough to blow them without robbing the others. Then, again, there is a lot of complications of stickers, which, when once fixed, never can be got at without unshipping another lot of mechanism, which, in its turn, leads to removing something else, until the apartment is strewed with such a mess of odds and ends that it is most disheartening to look at. The close packing of the mechanism and pipes renders these jobs very indifferent specimens of "art" organ-building.

Another very bad thing is the adoption of what may be called "toy tools." I recommend all hands to get proper tools and keep them in order, or get a friendly carpenter or cabinet-maker to do it for you until you can do it yourself. Much, if not all, of the success depends on the sharpness of the tools and the decision with which the chisel is used in paring and shaping. Leather should be cut neatly, and trimmed off on the edges with a sharp knife.

Attention must also be paid to glueing—especially leather to wood—as all the glue must be washed off that is not absolutely needful for adhesion. Nothing looks so bad as a lot of discoloured leather and wood slopped all over with glue. We must first make a decided plan of our instruments, or, in plain words, we must be our "architects." We must consider what height, depth, and breadth we have at command; also what our *means* and *skill* amount to; whether we shall make our keys or not; whether we shall buy our metal pipes or our *wood pipe feet*, or try to make them—in fact, to be successful, we must consider well what we *can* do and what we *can't* do. If we have skill enough to plan out the work throughout, we may perhaps buy the keys; if so, then send the sizes to whoever you have selected to make them—a full-size view of the end is all that is necessary—or if one manual simply state the length of one of the natural keys. If we can't make the metal pipes, select a maker or advertise for such, and don't lay out your soundboard until you get your pipes.

Don't try to cram a lot of pipes into your work just as if you were packing them away—recollect that three good stops well disposed are worth six crowded up in a small space—a crowded-up stop loses its quality, and causes more complications in voicing and regulating than you will be prepared for; besides, when listened to, some are so wholly different from what you expected that you feel as if cold water were showered on you. If, therefore, you wish to build successfully, let your first aim be the *design*. Design a suitable case and arrange your speaking pipes in nice groups, or in towers or flats. Cut out a set of circular patterns of the open diapason to middle C, and the principal to tenor C. Cut out a set of the stopped diapason from CC to top G, and use it for setting out your soundboards.

It will be seen from the above suggestions that the first thing will be to get, or make, your pipes, and also to form a decided plan of your case.

You can then see if your specification will fit into the space at your disposal or not, and, if so, then make a hard and fast rule, *not* to diverge from it under any circumstances. Don't be influenced by the many proposals and suggestions of others which, although well meant, divert the mind and unsettle it from its purpose. As the largest pipes leave the greatest amount of cuttings or waste which can be utilised hereafter, I shall commence with the Bourdon in my next. **W. R.**

BENZOLINE LAMPS.

[28614.]—OUR friend "J. D." is quite severe enough on benzoline as a domestic luminant. Tell him to replace it—if he can—for economy, cleanliness, or its light-giving power. Benzoline can be produced for 4½d. a gallon at the works; it is absolutely clean; its light, when properly burnt, is second to none for domestic purposes; when it is burnt in a proper metal lamp it is infinitely safer than any cheap paraffin lamps made.

Benzoline only requires two or three simple rules. Keep it in a screw can, with leather washer, airtight; stand it on a board, and trim the lamps in daylight; and last, but not least, burn it in a safe lamp—and there you are.

Since 1874 I have constantly urged our lampmakers to place a safe benzoline lamp in the market; but no, they and our ironmongers are asleep over it. They are contented with cheap, ill-made, trashy stuff that is a disgrace to the trade to offer.

An immediate and sure fortune could be made by practical men at once in this work, and do a great public service. Millions are wanted for hand, swing, table, fixed, ships, bicycles, and a hundred other uses for everyday work.

Safe benzoline lamps are made, fit for any lady to use, and safer than a candle, since they drop no sparks. The lamp requires filling after eight hours' work, and attention to the wick (half a minute) once in two weeks; giving six hours' light at the cost of one halfpenny, or about 200 hours of four candle-power per gallon of benzoline.

T. Wood.

PARAFFIN-OIL LAMPS.

[28615.]—WE must bear out your correspondent Samuel Ray in his statement in letter 28580 that a paraffin lamp properly constructed and trimmed cannot explode. We do know of cases in which the lamps have been neglected in trimming, and when "put out" a flare-up has occurred. With a china retainer serious results have occurred, but with metal ones only the breakage of glass. The safest way to put lamps out is to turn low and let them go out themselves. We always *blow out*—often whilst lamp is *high up*. If readers will send us their address we will forward them a leaflet how to trim and burn a lamp with perfect safety.

Viaduct-street, E. **H. Jones and Co.**

TIGERS AND TELEOLOGY.

[28616.]—A QUESTION of the following kind is often asked:—Do tigers exist to eat sheep, or do sheep exist to be eaten by tigers? Let us see how the case looks from the tiger's and sheep's point of view respectively. Tiger says: "We are *here*, and being here, we must have food; and those things which are necessary for our food are here for our benefit, else we must starve. *You* are among these things, therefore you are here for us. This may seem hard to you, but you may not be aware that you yourselves have swallowed thousands of small living animals in your time." Sheep says: "It is ill arguing with the master of a hundred legions, so I will only suggest respectfully that to us sheep your highness's view seems rather a one-sided view. But here comes a man with a gun; let us ask what he thinks."

Man says: "We ourselves are not wholly disinterested in this matter, so you must take our opinion for what you think it is worth. There are but few of us, then, who think we have been admitted into the confidence of our Creator as to the details you have mentioned, and therefore, most of us think that the only way we have of finding out what a thing is *for* is by finding out *what service it performs*. And so we can only conclude that those for whose benefit a thing is here are all those who actually derive benefit from it. Thus, we believe that grass-plants, mushrooms, oysters, sheep, &c., are here not merely that each may continue its own species, but for the benefit of whatever is benefited by them. Everything that exists is here to make some contribution to the universal good. It must be added, however, that there are some among us who seem to dissent from this view. Thus, we have a sect called 'Sportsmen,' who seem to think that a large number of animals are here just to gratify the pleasure they feel in killing them. They call such animals 'Game'—I suppose because it is such fun to hunt and slay them. Then, again, there are those called 'Philosophers,' Mr. Newlights, Mr. Neotsham, Mr. Borl, for instance, who all teach very different things, but whose followers are all agreed in this—that those who do not adopt the maxims and phrases of their favourite teachers know nothing at all about it; but as you have asked me, I will offer a word to each of you. To Mr. T.: If animals are here for you to eat, do not kill just for the fun of the thing like foxes, yahoos, and sportsmen; and to Mr. S.: If grass is for you, do not eat till you become so fat that you can't run away, or so lazy that you won't. This is a struggling world, in which it is often a case of 'Devil take the hindmost,' and if you happen to be the one, you will find it poor consolation to be told that though it is awkward for yourself to be caught, it is in reality a benefit to your species that its surplus population should be reduced by the 'removing' of its shiftless members. This I am told is the view which hawks take when they kill grouse."—*Exeunt omnes.*

The word "teleology" is often introduced into these discussions. It means "the *telos* or end, for which an arrangement of things exists." What may be called the old teleology is somewhat as has been described above; but in opposition to this a new view of it has been lately introduced to the effect that a "species" exists for its own benefit and not for that of others.

This seems a simple view, but when we look at it closely, it becomes very difficult to see exactly what it means. There is one thing about it, however, which is clear, and that is, that it is still only another form of teleology. This will, no doubt, be denied by those who hold it; for it seems by some of them to be proposed for the express purpose of avoiding the necessity of introducing the idea of an end at all. But in this it most surely fails; for, if it is pointed out that many things do derive benefit from the existence of a species besides the species itself, it may be replied, "True, but you don't seem to see the distinction between saying that A is benefited by B, and saying that B exists *for* the benefit of A." But whatever force may be in this answer, it should be carefully noted that the making the distinction implies the *recognition of an end*; otherwise it is absolutely unmeaning. And thus, *apparent diræ facies*, the irrepressible idea of an end crops up again, and we have after all only a new teleology instead of the old one, and is it either truer or more intelligible?

If each "species" were a thing so complete in itself that it would stand alone, a kind of self-supporting institution, which neither needed other things nor other things it, there might be something to be said for the view, that each exists for itself and not for others. But when each depends for its very existence upon things external to itself, it is not easy to see in what sense the statement can be justified, or even what is its meaning.

W. G. P.

HYDROSTATICS AND STRESSES ON IRON CISTERNS.

[28617.]—MR. FRANK CAWS (letter 28603) seems to have got hold of some wrong formula, and has produced some astonishing results in his paper. At bottom of page 127, he gets by means of his formula $f = 9,298$; but if he will work it out again he will find that $f = 94,700$, or about 10 times more. Continuing the calculation, we come to this astounding result, that if we take a plate of sheet iron $\frac{3}{16}$in. thick, and support it in a horizontal position at the four edges, the length being 10ft. and the breadth 8ft.; then if we subject the plate to a pressure of less than ¼lb. on the square inch, the sheet iron will be torn asunder by the strain; or, if we consider the sheet iron to be the bottom of a tank, 1ft. of water in the tank will be sufficient to fracture the iron, and therefore only 3in. or 4in. of water would be a safe load.

This is evidently an absurd result, and as the same formula is used through a whole column of the "E. M.," I fear the results cannot be depended on. But the fact is that no practical engineer would set about calculating the strength of the tank in this way; the tank supported only on its four lower edges, and filled with water to any depth, would bulge and get out of shape, and finally collapse long before the iron would have a chance of exerting its full power to resist a stress or strain tending to tear it asunder. If I were not afraid of still further occupying the columns of the "E. M.," I would like to ask Mr. Caws where, or how, he obtained this formula?

Bath. **M.I.C.E.**

ON VIOLINS.

[28618.]—F. WATSON (letter 28567) thinks I am in error concerning difference in tone of back and breast; he admits that the hard wood gives the lowest tone, but he thinks this is compensated for by the thinness of the belly. Now, I am not going to argue the point decisively till I make trial. I said in the two violins I tried that I was not sure whether the *f* holes were cut or not; if the *f* holes were not cut, cutting them would lower the tone. But I scarcely think the difference in thickness would amount to five or six semitones.

I have got two very good-toned violins here; I have taken the harness off them, and knocked down the props, thinking by removing all pressures and strains I would be able to detect any difference in tone; but the backs and breasts of each give the same tone. In one violin—the smallest one—the note given is B flat; in the larger instrument the note is A flat, the back and breast of each one being in unison. However this may be, it does not affect my argument; the back is mechanically the strongest, and is the backbone of the instrument.

To readers who are trying the new bridge, it is only just that the said bridges should work under the same conditions. Perhaps all instruments will not at first care for the change. Their constitutions will have adapted themselves to the double swing of the old bridge, and to the position on the belly on which it at present stands; and when the proper position is found, all fiddles are not identical in their constitutions; like their owners, the breast of one may be weaker or more sensitive than another. But the same difficulty existed with the old form of bridge. The only method is to choose a bridge to suit the instrument. The idea of the new bridge was to give more equality of tone, and more sensitiveness of touch, combined with power if required. It was also designed to stand on the centre of the instrument. Yes, I suppose the old one was designed to stand there too; the difficulty is to find it.

Here I give the method. I doubt if even "Strad" ever dreamt about it. I think it will be found on trial that some of the old makers did not know where it was, nor how to find it; the *f* holes seem generally too high up. The idea is very simple; no mathematics required. Procure about 2½lb. of rice; remove the sound-post, strings, &c., fold a piece of stiff paper, wide at the top, and narrow enough at the bottom to insert in *f* hole; now proceed to half fill it with rice, to find when it is just half full is just what is wanted; have a piece of stout paper, about 6 or 7in. long, 3½in. wide, the edges cut straight; place this paper on breast, with the edge square across, about centre of *f* holes; this serves, by being held closely, to keep the rice in. Now stand up on table, shaking, to bring the rice level with the top edge of paper; mark position of this edge on belly; now lay down on table again, and reverse paper, keeping it pressed over the *f* holes; turn the violin the other end up (the edge of paper to be on the previous mark); put more rice in or out, as required, and reversing till the centre is found; when found it should be marked; the bridge stands on this line, the sound-post a little behind. It will vary according to the thickness of belly. **Oasis.**

POWERS OF MICROSCOPE EYEPIECES.

[28619.]—REFERRING to the letters and queries on this subject, I some years ago drew up a table of the powers of the eyepieces of different makers as deduced from the total magnification with the 1in. objective; and as this may be of use to others, I send a copy of it, with a few additions and alterations. Some of the firms mentioned no longer exist; but as their instruments are still in use, I have not thought it necessary to strike them out.

In all cases the 10in. body is taken as the standard, except in the case of Zeiss; but as the actual equivalent focal length in millimètres is given, as well as the eyepiece magnification, due allowance can be made in the case of his eyepieces. I have mislaid Nachet's and Hartnack's lists; but doubtless some other correspondent can fill in the blanks, which I have left for that purpose opposite their (and other) names. It seems a pity makers do not adopt a standard focus for each eyepiece so as to give powers of, say, 5, 7½, 10, 15, 20, 25, and 30, which would be a rough average of those in the table. Failing this, there seems no reason why each maker should not give the exact equivalent focus of the several eyepieces; but I only remember to have found this information in the price list of Zeiss. **A. S. L.**

APPROXIMATE EYEPIECE MAGNIFICATION DEDUCED FROM THE TOTAL MAGNIFICATION WITH THE 1IN. OBJECTIVE.

Ross	...	3·7	6	...	10·5	17	...	25·5	...	34
Swift	...	3·7	6	...	10·5	17	...	25·5	...	34
Dancer	...	3·7	6	...	10·5	17	...	22·5	30	...
Wheeler	...	3·7	6	...	10·5	17	...	...	...	...
Crouch	...	...	5	8·5	12	...	...	...	...	...
Collins	...	...	5	8·5	12	...	...	...	...	...
Smith and Beck	...	...	5	8	...	15	20	25	...	...
Powell and Lealand	...	...	5	7·4	10	...	20	...	30	...
Ladd	...	...	6	8	10	...	...	...	...	...
Parkes	...	...	6	8	10	...	...	...	...	...
Baker	...	...	...	...	...	...	...	...	...	...
Field	...	...	...	...	...	...	...	...	...	...
Nachet	...	...	...	...	...	...	...	...	...	...
Hartnack	...	...	...	...	...	...	...	...	...	...
Wasserlein	...	...	5	7·5	10	...	...	...	...	...
Zeiss	3	4	5·5	7·5	10	Eyepiece magnification				
	48	40	30	22·5	17·5	Equivalent		focus	Huyghenian	
	45	36	27·7	21·2	16·4	do.	do.	do.	Orthoscopic	
Suggested	[3]	[4]	5	7·5	10	15	20	25	[30]	[35]

ENGLISH AND CONTINENTAL OBJECTIVES.

[28620.]—I AM afraid that to make such a list as "A Constant Reader" requires (letter 28595) would be impossible, from the simple fact that the magnifying powers of the objectives as supplied by the makers do not agree with their own catalogues. I have lately bought a Zeiss apochromatic of 6·0mm. focus, and the magnifying power with four eyepieces, as given in the catalogue, should be 833, 500, 750, and 1,125 diameters; but actually, as measured, is 420, 610, 886, and 1,363. If, then, this discrepancy occurs when both objectives and eyepieces are supplied by the same maker, and measured on the standard length of tube, how much greater is it likely to be when objectives and eyepieces are by different manufacturers, and measured some on a long tube and some on a short? It is easy thus to explain why the power of Swift's 1in. and Reichart's ⅛in. are the same. The 1in. is probably measured on a 10in. tube and the ⅛in. on a 7in., in which case the discrepancy disappears. Within certain limits, however, the focal distance of the objective is not of the slightest importance, the numerical aperture being the only measure of its capacity to show fine detail. Thus if a ¼in. and a ⅛in. objective have the same N.A., and an object is shown under the first with an eyepiece magnifying eight, and under the latter with an eyepiece magnifying four times, there will be no difference between the images whatever, neither in brightness nor in the amount of detail shown, provided both glasses are equally corrected.

The measuring the capacity of an objective by its focus is an old superstition handed down from the time when the angle had to be limited from a want of skill in making the necessary corrections for chromatic and spherical aberration, and like most superstitions, has lingered for a long time after the cause, which made it a real faith, has disappeared. In Pritchard's paper on "Test Objects," published in 1832, he says that he has never been able to see the lines on the Podura scale with a power much below 350 diameters, "and, therefore, microscopes of a lower power cannot be expected to show them except of very superior quality."

At present, I can see lines as he shows them with less than 100 diameters, provided the glass has sufficient angle. The explanation is found in the fact that even a ⅛in. of that date was limited to an angle of 50 degrees, or less than is now given to a working ⅛in. Just before the introduction of the water immersion objectives, dry $\frac{1}{50}$in., and even $\frac{1}{80}$in. objectives, were made by Powell and Lealand, and the owners thought they saw wonderful things with them; but I am not afraid to state that more can be seen with an apochromatic ¼in. to-day than could be seen with these wonderful glasses.

I can only, then, counsel "A Constant Reader" to throw aside all notions of measuring the capacity of a glass by its focal length, and in its place to study the "Aperture Table" given in the *Journal* of the Royal Microscopical Society, where he will find the resolving power for any given aperture, and can then compare catalogues for himself. **T. F. S.**

A NEW MOVEMENT OF THE GEOMETRIC CHUCK.

[28621.]—I GIVE the above title with some diffidence, for although certainly original with the maker, I discovered in a back volume of the ENGLISH MECHANIC, a letter of Mr. Hartley, undoubtedly originator of the so-called "Plant" chuck as differing in plan of construction from the earlier Ibbetson pattern. In this letter Mr. Hartley states that the first train was "attached to a plate on front of the headstock," so that it did not rotate with the chuck. This was, however, inseparable from the other parts, and so does not seem to have served the same purpose as the simple contrivance here described. No account of Mr. Hartley's train has appeared.

On p. 137, "Index to the Geom. Chuck," is described an effect produced by moving (counting) at stated intervals, the "First Motion Wheel"; that one on the "boss" of the foundation plate which remains fixed by a detent when the chuck is working. This, counting round, produced an interpolation of the curve, which was repeated at each "count." Of the results, two examples only (Figs. 3449 and 3454) are given.

The late Mr. James Howland, of Mount Vernon, Westchester, New York, took up, late in life, the subject of curve turning, constructing his own chuck, and attained the result above noted by gearing instead of by counting. His success was so complete, his method so easy to adopt, the connection so instantly made or broken, that it merits a description for the general benefit.

The first motion wheel of Hartley's chuck is usually kept from rotating (as this one was at first) by a pin on a link placed between the wheel and the headstock. In Mr. Howland's chuck there happened to be more space than usual between these two, admitting the subsequent addition. His chuck was made on a very small lathe, and it was very small indeed (less than 6in. diameter of plate), and the F.M. Wh. had only 64 teeth, of 32 diametral pitch.

On the back of this wheel he bolted firmly a larger wheel, and of coarser pitch, of 96 teeth. The holding pin was discarded. A thin plate carrying a detent with cam clamp was added to the headstock to hold the F.M. wheel, the two wheels now acting as one. Mr. H. could have discarded the smaller wheel, but for the fact that the reverser wheels worked on it, and he preferred not to change too much.

It is apparent now that the F.M.W. is held or released precisely as is Ibbetson's. Parallel to the mandrel, and behind the headstock—i.e., away from the operator—he fixed a long socket, each end of which was turned down outside to allow an arm to be mounted. These arms were capable of being fixed either up or down; they were alotted to take adjusting studs bearing wheels. One of the arms was at the left of the pulley, the other about on a vertical plane with front of headstock.

Through the socket passes an arbor, to each end of which is fixed a wheel; both wheels have same number of teeth. All the wheels are of same pitch (24) as the large, 96. On the mandrel, to left of pulley, is fixed as small a wheel as practicable (in this case it was 32 teeth), and the wheel on left end of socket arbor is in the same plane as 32. They are connected by one or two wheels, as carriers only, on studs in the left-arm slot. When the arm is turned up and fixed, the mandrel-wheel drives the socket below.

The wheel on right-hand end of socket partakes of this motion, and is in turn connected (when the right arm is turned up and fixed) with the first motion wheel, by means of wheels on studs in the right-arm slot, and these last are either in one or two planes, as preferred, to turn the F.M.W. forward or backward. Of course, when the movement is in action, the detent is raised from contact with the F.M.W. Usually such wheels are used as to drive the F.M.W. one turn to sixteen or more of mandrel.

The F.M.W. is moved continuously instead of intermittently, as by counting, and the resultant curve is more satisfactory and certain to be correctly made. Practically, this simple train adds another part to the chuck without the objectionable "overhang"; and not its least merit is that it may be thrown entirely off in a second of time.

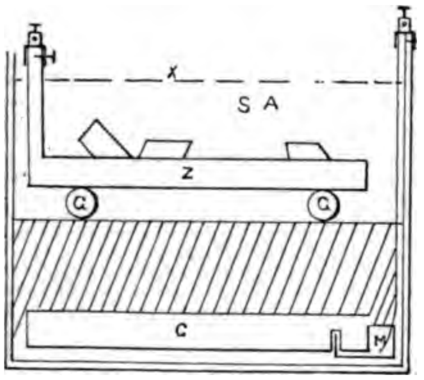
Mr. Howland possessed an inquiring mind, and "four No. 16's." There are several ways of overcoming the difficulty of variation of "difference of potential" (not E.M.F.) at the vats. You may employ a Willans governor on a shunt circuit, to vary the engine speed, so as to keep the D.P. constant under all loads, or you may insert resistances into the F.M. circuit, or you may employ accumulators as a shunt regulator; or you may insert resistances in main circuit (this is simplest in practice where you have a number of vats in parallel); or you may keep the current constant, and shunt it off from each vat, as required (when vats are in series).

I hope "Bijli" will excuse these remarks; but really I, for one, could not let such an assertion pass without comment.

Engineer, Govan.

GRAVITY LECLANCHE.

[28626.]—On page 585, Vol. XLIII., a querist at the end of a very interesting article on Leclanché batteries, asked if anyone could tell him of a method of connecting carbons to lie at the bottom of the cell. I happened to come across a plan whilst reading Vol. I. of the *Electrician* (old series, page 86). Mr. D. G. Fitzgerald used a carbon lying down for his Marie-Davy pattern cells. I inclose a rough sketch of same. C is the carbon; it will be noticed it has a piece cut out with a saw close to the top, so as to let the end fall into the mercury vessel M. From this vessel goes a wire T dipping into the mercury, which makes the connection with the carbon. On the carbon is packed the powdered manganese and carbon (shown shaded in sketch); then on that are placed two pieces of glass rod G, and the zinc plate Z on the glass rods. Water is added, and a few lumps of salammoniac are placed on the zinc plate, and the cell is complete. The binding screws to zinc and carbon are left and right of the cell. I should like to ask the opinions of those qualified as to what material the trough with the mercury in should be made of, and the wire leading from same? For my own part I think iron would be best; mercury does not seem to affect it. Perhaps the ammonia formed would, though? I think of making some of these cells to see how they act, so any suggestion will oblige.



Assoc.Inst.Elect.Engs.

DIRECT TRANSFORMERS OR INDUCTION COILS.

[28627.]—I WAS pleased to see the letter of Mr. W. Perren-Maycock (28597) on this subject. I claim to be (so far as I know) the first to suggest the continuous magnetic circuit for Ruhmkorff coils (see "E. M." Vol. XLVI., page 442, letter 68947). Mr. P.-M. fears that there may be additional expense involved in this form of R. coil; but, on the contrary, I think that there would, if anything, be rather less, in the elec. work at any rate. Let two cores be wrapped, one with secondary, and the other with primary coils, and connected by heavy yoke pieces; a separate contact breaker would, of course, be required. Does not the advantage of this form lie in the fact that the permeability of iron is much greater than air? and since in the proposed form the lines of force are closed through iron instead of air, as in the accepted pattern, therefore with a given exciting power we can obtain a much greater induction for a given weight; but too great an induction is not advisable, owing to heating and singeing of the cores, which latter is observable more or less even in glow lamps fed by alternating currents.

Engineer, Govan.

AN ELECTRO-MOTOR SUITABLE FOR DRIVING TRAMCARS.

[28628.]—THERE has been a great deal of talk about patent motors of various kinds for the driving of tramcars, although up to now almost next to nothing has been done in England. I therefore venture to give you my idea and views for a suitable electro-motor for the above purpose, and I hope you will find a spare corner in your valuable journal.

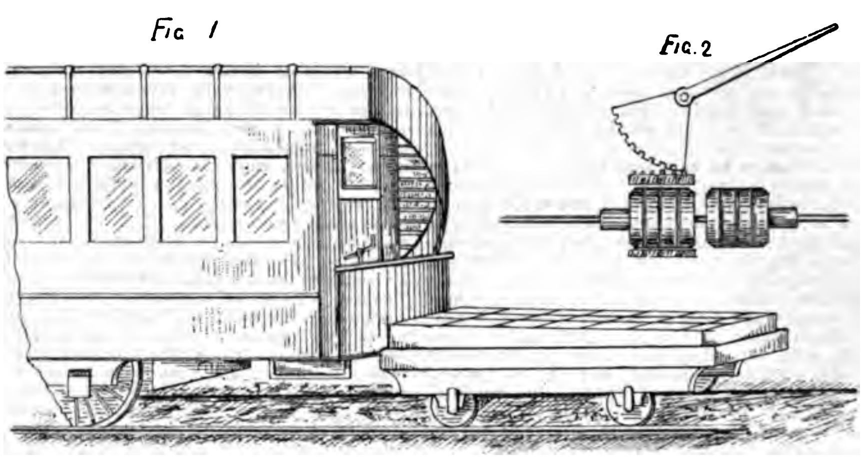


Fig 1

Fig. 2

It will be self-evident that it may be driven by taking the current from the rails as well as with an accumulator. If accumulators are used, I would propose to carry them in a separate truck, and not in the car itself. This truck could run behind the car or in front, with its set of storage cells, and thus supply the electro-motor, which should be fitted underneath the tramcar itself, and act as a tender does to a locomotive. The cells could be stored in sets above each other for compactness, thus making the truck not more than half the length of the car; one set of cells could then be left to be charged, while another was operating the car. Fig. 1 represents this, which will explain itself.

My idea for an electro-motor is to place two armatures on one axle or shaft, and instead of employing two sets of field-magnets, to employ only one, and so arrange this one field-magnet that it will be movable, and can be used to operate either armature by being made to slide from one armature to the other. This could easily be accomplished by using rack-gear, toothed-wheels, or in many other ways; for instance, by means of a sliding screw.

The plan is very simple, and will lend itself in a variety of ways. Double brushes will allow either armature to run in either direction, the power being transmitted from the ends, or any suitable part of the motor-shaft. A sliding magnet may be of some service in certain electro-motors. Fig. 2 will also explain itself.

The above idea may be of use to many engaged upon tram-work; if so, it will satisfy me to know that I have helped a subject on, that deserves more attention than it has yet received.

C. E.

COMPOUND LOCOMOTIVES.

[28629.]—I HAVE lately heard it often stated that expansion had been carried as far as practicable in locomotives, and that a further rate of expansion could only be attained by compounding them. It is also stated that this has become a necessity with the higher pressures now in use.

These statements are somewhat curious, and in no wise substantiated. This important question has been entirely misunderstood. More than 80 years ago compound locomotives were running; but it was not because higher pressures were coming into use at that time. I think it will not be out of place to explain the considerations which led to the adoption of the compound system on other classes of steam-engines, and show how far these considerations apply in the case of locomotives. No amount of calculation will ever prove that compounding is advantageous in the case of locomotive engines. A lengthy trial of the various systems now in use can alone show what value is to be attached to it.

From a purely theoretical point of view the compound system does not seem to present any advantage, for it is always possible (even in the case of the receiver engine) to find a cylinder diameter such that the work done in a pair of such cylinders by a certain volume of steam, will be the same as that it would do in the equivalent compound system. But this is under the supposition that steam behaves like a perfect gas. When, however, we consider the influence of the cylinder walls, the problem is by no means an easy one; in fact, the laws governing the expansion of steam in cylinders are not known yet. It is hardly possible that it should be otherwise, as the results obtained vary from one system of engine to another. Compounding gives wonderful results in the case of marine and stationary engines; in locomotives the advantages are not so well marked. There is one great advantage in compounding steam-engines—viz., the influence of the cylinder walls is certainly less than in the single-cylinder engine. In the former system the walls of the high-pressure cylinder are never put in communication with the atmosphere or the condenser. The steam is cut off later in the high-pressure cylinder than it would be in the single-cylinder engine; that part of the cylinder where the exhaust into the low-pressure one takes place remains at a relatively high temperature when compared with the single-cylinder engine. The steam which has condensed during the period of admission in the little cylinder is re-evaporated during the exhaust into the big one and utilised there.

However, these considerations do not apply exactly in the manner just stated to the comparison between the ordinary and compound locomotive. It is well known that the efficiency of a locomotive increases with the speed. This fact is solely attributable to the higher speed of the pistons, the heat having too little time, so to speak, to pass through the cylinder walls. For this reason the use of a steam jacket for locomotive cylinder has proved a failure, and for the same reason, too, it seems not likely that any appreciable difference would be found between the ordinary and compound express locomotive. Railway companies do not seem too ready either to boast of the savings they have effected with such engines. Of course the difference I have just spoken of would not be good enough to justify the complication consequent upon the adaptation of the compound system to locomotives. It would be otherwise with goods engines, which are slow-going, and cut off steam later than the passenger engines. I should not be surprised to hear that the compound system gives more marked advantages in the case of goods engines. The unavoidable necessity of frequently altering the rate of expansion on locomotives, so as to suit the exigencies of the traffic and line, is another drawback in the applications of the compound system to railway locomotives. In this respect marine engines present, I dare say, an indisputable advantage.

All what I have just said may explain why the advantages expected at first from the compounding of locomotives are of a doubtful nature, and justify the hesitation of many engineers in adopting this system.

The sole reason why expansion cannot be carried further in the ordinary locomotive is that the link does not give advantageous early cut-offs. The earlier the cut-off the greater the compression. The advantageous utilisation of the high pressures used at present in locomotives will be obtained by an additional or cut-off slide on the back of the main valve, the latter securing a constant pre-admission and a constant exhaust and compression. The thing is well worth trying, and would not be so costly as compounding wherever there is room for the additional or cut-off valve.

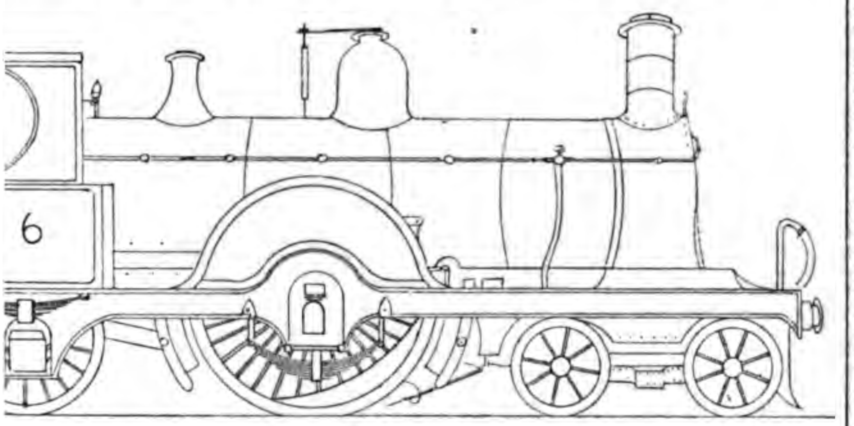
A good many years ago the use of a special cut-off valve was resorted to on a few Continental railways. The trials made with it in France by Camille Polonceau, and later on in Bavaria by Bauschinger, showed that these additional valves gave no economical results whatever, but that they would do so if the boiler pressures could be increased. At that time 100lb. and 120lb. were the highest pressures in use in locomotive boilers. Now that we are using boilers capable of well withstanding pressures of 160lb. and 175lb., it would not be uninteresting to resume these trials.

Lastly, I must mention a fact which is strongly against compound locomotives. It is the question of back-pressure. The ordinary locomotive seems to have attained the limit of speed it will ever attain. The back pressure, which is about 10lb. at that speed, is too high, and does not permit to work economically beyond it. In compound engines the back pressure is greater than in ordinary ones. This is undesirable. As a matter of fact, no compound engine gives the same results as some of the express engines used on lines which have not mpounding. The back pressure in the locomotive will be lessened by the use of e cut-off valve, or by a different kind of ır. The Americans seem to have already ad in this direction. **E. Gobert.**

ıe-street, Liverpool, April 4th.

MIDLAND ENGINES.

.]—I HAVE observed a number of your ıdents asking for sketch and dimensions Iid. bogie singles, and as no one has re- venture to do so. The C. are 18 by 26, D. B.W. 3ft. 6in., T.W. 4ft. 2in.; weight in order, 43 tons 13cwt. 3qr. (without The engine is fitted with the auto. vac. also steam brake acting on D.W.'s of nd wheels of tender. The engines work raffic between London and Nottingham, ımption of coal being on an average 21lb. shire coal per mile with a load of 170 tons, g engine and tender, at about 54 miles per



to thank Mr. Stretton for the excellent of Mid. and other locos. with which he has . "Ours." Would he favour me with of the following old locos.? Stephenson's pass. loco. 1838; also of the "Planet" and d L. and N.W.R. Liverpool.

Engraver.

IIGH-SPEED GOVERNORS.

.]—I HOPE this will draw out "W. J. R." ined my desire to hear more from him. ıe, I will point out that "F. A. M." has made the mistake he imputes to the I gave. The apex of arms must be pro- complete the cone, and I make height of in., and revs. 104. At 208 revs. the height ·81. I make W = ·47, which is evidently as $\frac{\cdot 81}{3\cdot 23} = \frac{\cdot 157}{\cdot 157 + \cdot 47} = \frac{\cdot 157}{\cdot 627} = \frac{1}{4}$. does "F. A. M.'s" "110" come from? nula given is applicable where the weight ce the amount of rise of the balls.

T. C., Bristol.

.]—IN reply to letter 28605, page 128, I t "F. A. M." is seeking information as high-speed governors. Has he yet seen ıich was patented in 1885, No. 2694? If ot, and would like to know particulars con- it, I should have much pleasure in inform-

C. T. Bullough.

.ater-road, Brixton.

.]—REFERRING to the letter of "F. A. M." I shall be most pleased to explain any- my previous letters about governors that be quite clear. Possibly, in the anxiety nse my remarks, I omitted much that I have referred to, and became obscure in ence. But the letters in question were in o a query for a high-speed spring governor for a 3H.P. engine, and supposing that no a practical mechanic would attempt to ıe, I omitted all mechanical details as sary, merely giving leading dimensions. ame time I attempted to illustrate a few eading principles of spring governor de- thinking that the reply would then prove ble use to others. No doubt the whole f governors is one that is well worthy of tailed treatment, and should it not fall hands of those possessing more ability and ure, I will try and squeeze out the time ittle more about it shortly. In the mean- few words anent "F. A. M.'s" proposed orter" governor, which he thinks I shall e as a toy. Nothing, in my opinion, e called a toy simply because it is small. A watchmaker's lathe is no more a toy than the monstrous tools used at Woolwich. But in all these things the question to be asked is, "Can the proposed arrangement do the work for which it is intended?" If it can, it is not a toy, however minute. If it cannot, then it is of no use mincing matters—it is either a toy or worse. Until, therefore, one knows precisely what the governor has to do, it is impossible to give an opinion. But I surmise that "F. A. M." wants to fit a governor to a very small steam-engine, of, say, ½ or 1H.P. If so, the governor would have to operate some kind of throttle valve in probably a ⅜ or ½in. steam pipe, and the question is, Would the proposed governor do it? The dimensions given are 2½in. arms centred ⅝in. from centre of rotation, the arms to be (at the mean position?) 30° from vertical. This means the governor must rotate at 104·15 per minute if unloaded, and the height of the cone would be 3·2476in. (It is quite correct to prolong the axis of the arm until it meets the axis of rotation to get the "cone.") It is, however, proposed to weight this governor until with the same position of arm it rotates at 210. This speed would give a height of cone, when free from weight, of ·798in., and the weight required for a pair of balls weighing ·157lb. each would be ·471b. This is on the assumption that the lower links (not shown in "F. A. M.'s" diagram) are equal in length to the arms, make equal angles with the vertical, and are attached to the balls themselves in the usual manner of a Porter governor. If this is not so, the formula for the centre weight will require modification, it being correct only if the sleeve rises twice as fast as the balls. I am afraid that this very diminutive affair would not do much in the way of valve moving. Why, however, can it not be run at something like a speed, say, 350, which is not at all high for so small a governor? The weight then required (other things remaining the same) would be 1·616lb., the increase of speed resulting at once in a governor just three times as powerful. But in addition, I would suggest the following modifications, which would be hardly noticeable, and yet would greatly enhance its capabilities:—Balls, 1½in. diameter; weight, ·531b.; length of arms, 3in.; angle of arms, 45° at mean position; height of cone unloaded, 2·75in.; ditto when loaded to obtain a speed of 400, ·22in.; centre weight, 6·081b. This would, I think, probably make a workable governor capable of dealing with a valve of very small resistance. "F. A. M." will observe that I have altered the angle of the arms very considerably. It is not at all advisable to place the arms at the inclination proposed—viz., 30°, as at that position the vertical rise of the weight is not sufficiently rapid in proportion to the radial movement of the balls. Governors so arranged are certain to "hunt" if they have anything to move. The reason of this is easy to see. The centrifugal force varies as the sine of the angle of inclination; the effect of the weight or centripetal force varies as the co sine. But it is absolutely necessary for the stability of a governor that the latter should vary more rapidly than the former, which cannot be the case at low angles. In a gravity governor, which in this particular differs altogether from a spring governor, the only way we can get the proportion we require is the disposition of the arms at suitable angles. In practice it is found that 45° is a very convenient angle for the mean position, and I would strongly advise that the arms be not placed at any lesser inclination.

W. J. R.

FLUID extract of quebracho, according to a writer in *Arch. Med. Belges*, applied to a wound, burn, ulcer, or frost bite, is more healing even than iodoform. On evaporation the fluid extract leaves a tough adhesive brownish crust, under which the process of repair goes on rapidly. If desired, this can be removed by soaking in warm water.

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[63838.]—**Bromine Method of Estimating Manganese in Steel** (U.Q.)—In reply to "Il Penseroso," the following is the bromine method of estimating manganese in steel. Take 2grm. of sample, dissolve in conc. HCl in a large beaker on hot plate; HNO_3 is added till all the iron is converted into ferric salt. Evaporate to absolute dryness, re-dissolve in HCl (conc.), and a few drops HNO_3; dilute to 500cc., and heat nearly to boiling; carefully add AmHO—all iron must be in ferric state; add AmHO as long as ppt. redissolves, and until liquor is a dark brown, with scales on its surface. The AmHO must be added very cautiously, neutrality of solution being the object. Make a solution of 50grm. ammonium acetate in 100cc. of water, and add 35cc. of this solution. The liquor gets nearly black, but no ppt.; boil in large flask for three minutes, and allow ppt. to settle; filter, and wash with boiling water; re-dissolve ppt. in HCl (conc.) with a little HNO_3, dilute to 500cc., boil, and re-precipitate with AmHO and ammonium acetate as before. Mix filtrates, evaporate to about 6oz., filter, and wash. Cool filtrate, add 3 or 4cc. bromine, a little at a time, until liquor is strongly coloured with the bromine; add excess AmHO (sp. gr. ·880). The manganese is ppd. in dark brown flocks; boil, let it settle, filter through Swedish paper, wash with boiling water, dry, detach ppt. from filter paper, and ignite filter paper separately; ignite ppt. over blowpipe, weigh as Mn_3O_4; multiply weight by ·7205, and then by 50, and the result is the percentage of manganese. This Mn_3O_4 should afterwards be qualitatively tested for Fe with K_4FeCy_6; should iron be present manipulation has been faulty. The former part of this query I am unable to answer, having never tried the method. I fail to find it in "Fresenius." I fancy the barium method of estimating sulphur in steel is most used.—V. I. A., Pilgrim's Rest, South Africa, March 13.

[64066.]—**Gold Working.**—In answer to query 54066, p. 400, sorry I didn't see this query before. In answer to 1. "Traveller" should first very carefully scrape the amalgam from his tables with suitable scraper of steel (old saw plate is the best). Having carefully scraped his plates, he should next rub them down with mercury into the table wells. The amalgam should then be cleaned by mixing it in the following proportions with mercury. Say there are 1,000 ounces of amalgam, place this in an enamelled iron bucket and pour over it about 200lb. of mercury saturated with gold, add clean water, and work the amalgam up in the mercury with the finger until all the dirt, pyrites, &c., are separated and floating on the mercury, clean off carefully with a sponge until not a speck can be seen, and preserve the cleanings or "skimmings" for further treatment. When the mercury is cleaned, squeeze it through a double thickness of very dense, strong calico. Not more than 60lb. should be squeezed at a time. The amalgam should be left clean, hard, and bright in the calico. When all the amalgam has been so obtained, it is retorted in specially constructed retorts, and the mercury condensed and used again upon the tables. I have no doubt your querist has seen a mercury retort, as I presume from his query that he has had previous experience in mills. When the mercury is driven off, the gold is left behind on the retort. This retorted gold is then melted and cast into bars. In the melting, impurities such as iron are removed by adding a little borax before the commencement of the operation. When the bar is cast the borax and impurities may be scraped or dissolved off its surface. 2. The amalgamation of copper plates for gold-saving purposes is not an affair which can be picked up by merely getting an answer to a query; it requires practice. The copper plate is first cut to the size required, and holes are drilled at various distances and countersunk for the insertion of copper screws to fasten the plates down. The plate is then fastened down and scoured with pumice or Bath brick until it shines like a mirror. It is then carefully washed with strong caustic soda to remove grease stains. All traces of soda having been removed, the hands should be cased in indiarubber gloves and the plate should then be rubbed over with cyanide of potassium. One person should rub in the cyanide, and another should follow him up by rubbing in the mercury. As soon as the plate is covered, wash it thoroughly, throw upon it some clean sand and ammonium chloride, to prevent oxidation, and mercury, and rub in well. Then, for every square foot of plate rub in one ounce of gold amalgam. Provided there be fairly good ore to pass over it, this plate should be set and bright in 24 hours. Plates for this purpose are made specially of thoroughly annealed and porous copper. The best way to anneal copper for amalgamating purposes is to heat it over a charcoal fire till dry wood will ignite when brought in contact with the upper side. Your querist need not be alarmed if his plate shows all the colours of the rainbow for a day or two. He should sponge it down during work about every four hours, and rub in a little more gold amalgam. With care nearly all the amalgam so used can be recovered. I have a case in my mind of the setting of 50sq.ft. of plates with 25oz. of gold amalgam, and of these 23oz. were recovered. The plates were clear of all stain, and bright in 24 hours; but then the ore was a good one.—V. I. A., Pilgrim's Rest, March 18.

[64180.]—**Oval Tub.**—If you have a lot of these to make, why not get large trusses made? But if you only have one to make, try the following plan that my father did:—He took the staves and cut a saw slit for the groove; then bored a small hole on each side of the staves to take pegs. He struck the bottom in the ordinary way, eight times instead of six, as in circle. When he had got the bottom right, he took the staves and pegs, fitted the saw slit to the bottom, and pegged one stave to the other to keep them in their place, then hooped it up. The tub has been in use over ten years. If my friend does not quite see how to do it, if he will write again I will write off to my father and ask his opinion.—J. HY. WILSON.

[64266.]—**Reflecting Telescope.**—Silver-on-glass, decidedly. It is much cheaper, easier to work, lighter, and, weight for weight, more rigid than speculum metal. Six inches is as large as ought to be attempted at first.—MOONSTARER.

[64266.]—**Reflecting Telescope.**—"Esne Caralita" will find detailed information in Vol. X., ENG. MECH., and the fullest and most complete instructions in Vol. XXX. and following volumes, about fifty letters in all, by Mr. Wassell. A diameter of 8in. is very suitable for a first attempt.—J. C. LINSCOTT.

[64859.]—**Wheatmeal Bread.**—Under the above heading, "R. G." asks an important question—namely, Does bran pass through the human body unchanged, &c.? I should reply, Yes; and then he goes on in a manner similar to this: "White flour is good; bran, which nature associates with white flour, is not consumed by the body; therefore it ought not to be eaten." The same idea could be applied to another function of the body—namely, respiration: "Oxygen is good; nitrogen, which is connected with it, is not consumed"; therefore we should not breathe it. The fact of the matter is this: food requires to be diluted with negative matter. People can drink wine with profit and impunity; but the moment they touch alcohol they become devilised. Another reason why bran should be eaten is because of its antiseptical properties, rendering the stomach, as it does, impregnable against the attacks of germs—the one great enemy, according to the doctors, the human race have to contend with. In conclusion, I can assure "R. G." that the diarrhœa he complains of disappears after the third day, leaving the body all the better for it.—VEGETARIAN.

[64859.]—**Wheatmeal Bread.**—Though replying to a query, I did not intend being drawn into a correspondence. But "R. G.'s" question is such a reasonable one from what I think to be his standpoint, that I will in this case reply. It is quite true that whole wheatmeal bread does favour a more rapid peristaltic motion of the bowels; but to say it causes diarrhœa (frequent evacuations of a diseased kind) is a mistake. Of course, if he simply means the evacuations were more frequent, we may say no more, as other foods will produce the same effect on a system that has a healthy balance. The main inquiry of "R. G." seems to be, Does the bran of wheat pass through the system practically unchanged? I answer, Certainly not, if the person has got any teeth for chewing, or saliva as a solvent, and gastric juice for digestion, and each and every process has been brought to bear. The woody fibre *does* pass through intact (practically), yet *that* gets somewhat softened and curled up. "R. G." says it is needless to put indigestible husks into bread. Why does he not say the same of other foods as well? It would be just as reasonable. I will endeavour to show him it is necessary that other than digestible matter should be mixed with food. The first and foremost reason is, that food is too dense and concentrated without such husks, forming a sticky, clay-like substance which coats over the surface of the intestines, which no purgatives have the power to remove when once constipation has thoroughly set in. Secondly, bread made from fine flour does not encourage chewing, excepting the crust; hence people do not masticate sufficiently to get a modicum of saliva from the glands to flow it down into the kitchen of the body, and have, as a consequence, to get into the bad habit of drinking tea, &c., to wash such dry foods down. Thirdly, light, innutritious matter like bran saves a healthy stomach from real excess in feeding, giving a sense of repletion and timely warning. Fourthly, I believe it is equally as beneficial for the stomach as the intestines, and in the same way by giving a gentle but sufficient scouring. Fifthly, pill manufactories *might* soon be *non est* if real bread (natural bread, I call it) were used. I think sometimes we get astray, even when we have reasoned most, in some things, and that there is some truth in the lines—

> "Reasoning at every step he treads,
> Man yet mistakes his way;
> While meaner things whom instinct leads
> Are rarely known to stray."

—HYGIENIST.

[64382.]—**Turbine or Water-wheel.**—Might I ask "A. J." how he would use up all the water in a stream, the head of which might be 8ft. or 8ft. 6in. in the morning at commencing work, and after eight or nine hours (in dry or short-water seasons) the head is nil? He ought to have felt assured there was a good reason for it, which I hope he will now see. I should like to know what town in the South of England the noted maker of water-wheels alluded to hailed from.—MILLWRIGHT.

[64424.]—**Telescope.**—While thanking "Solar Radiance" for his reply, he has failed to grasp the purport of my query. I beg once more to refer him to his diagram on page 36, which seemed to me to be incorrectly drawn, as the combination there shown would apparently have no converging effect whatever. My doubt is now confirmed by his own statement—viz., "when the angle of incidence is 90° the ray passes through as if the glass were not in its path"; but then that is precisely what does not happen in the diagram. Mind, it is the sketch, and not the statement, that I question. It may be possible to construct an objective plane on both sides that will throw a picture, but it will be a sorry picture I should imagine. Will "F.R.A.S." kindly give us the benefit of his opinion upon the diagram in question, as it was specially drawn for his edification?—H. H.

[64493.]—**Shooting.**—Many books have been published on rifle-shooting, and are advertised in the service papers—i.e., the *Volunteer Service Gazette* and the *Volunteer Record*, to which I refer the querist for particulars.—WM. JOHN GREY, F.C.S., Staff-Sergt. 5th V. B. Durham Light Infantry, Hon. Sec. Derwent Rifle Club.

[64547.]—**Problem.**—It is due to "J. C." to say that his reply on p. 85 is quite correct as the question was worded. I overlooked the word "originally," and therefore it is very likely my reply was not what "Reymond" wanted. I should like also to thank "E. L. G." for his correction (p. 129) of my statement. I ought to have said that 22 and 922 were the smallest and greatest available even numbers when the sixteen numbers form an arithmetical series without a break.—F. S. S.

[64547.]—**Problem.**—I am much obliged to "J. C." and "F. S. S." for noticing my query, and also to "E. L. G." The latter asserts that only 11 arrangements are possible, but does not offer any proof. By following a process of reasoning similar to that of "J. C.," I obtain a result of 190,899,411, which agrees very closely with his—viz., 190,902,411, a difference of only 3. I have gone most carefully over the calculation, but can detect no error. I should be glad if "J. C." would go over his again and let me know result. The following are the values I obtain from 2 to 12:—

No. of objects.	No. of combinations in a line.
2	1
3	3
4	11
5	53
6	309
7	2,119
8	16,687
9	148,329
10	1,468,457
11	16,019,531
12	190,899,411

I have not yet solved the circular arrangement.—REYMOND.

[64568.]—**Kiln.**—"F. T." had best pay a visit to the nearest pottery or brickworks, and see for himself how kilns or ovens are built or made. He could then suit himself as to size and shape of his kiln. All china-clay ware should be placed in saggars, and embedded in ground flint for firing. As biscuit or clay china requires firing until it is vitrefied, I doubt if terracotta would stand the heat. The time of drying depends on the thickness of the articles.—POTTER.

[64599.]—**Razors.**—It is a fact that if the razor is dipped in boiling water it will shave better. I did not believe it till I tried it, and found it to be so. It is plain that the hot water cannot make the razor sharper, its effect must be to make the edge stiffer and more unyielding. This appears at variance with the law of nature, that as temperature rises rigidity decreases. At one time I thought that the expansion of the volume of metal in the back of the razor might have had some straining effect on the slender edge; but my mind was not set at rest until I found accidentally a passage in Clerk Maxwell's "Theory of Heat" (page 18), whereby it appeared that steel wire is stiffer at 212° F. than at 32° F., and that it is her
ception to the general law. Imagining t
edge to be a wire of extreme tenuity, it i
that the principle of Clerk Maxwell's ex
the general law is applicable to it, and tl
become more rigid when dipped in boil
and will thus do its shaving work mor
A. F. BAKER.

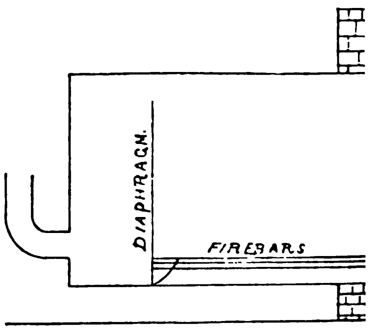
[64629.]—**Fresnel's Rhomb.**—Is this
the microscope at all? If so, it must b
Nicol prism, I think.—J. T.

[64638.]—**Didymium.**—An account o
ponents of didymium will no doubt be fou
Chemical News, and I remember seei
about them some time ago in these pag
are, of course, of interest mainly to the
chemistry.—F. I. C.

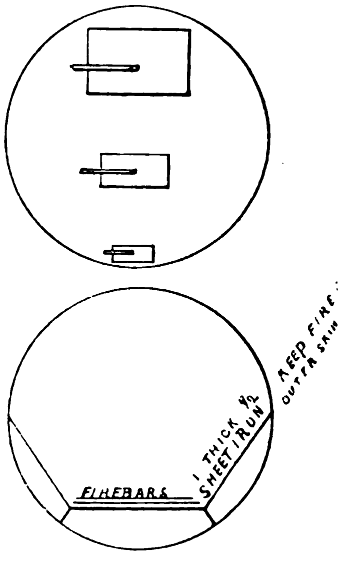
[64646.]—**Reservoir.**—From the qu
would appear that the querist includes
"reservoirs," and perhaps the largest is
dock of the Albert and Victoria Dock
Thames, or one of the Bute Docks at
one of the Floats at Birkenhead. Let th
look through Harcourt's "Harbours an
published by the Clarendon Press. Vyr
voir (1,115 acres) will be about the bigge
voir" when completed; but perhaps th
what is wanted.—S. M. P.

[64670.]—**Stain from Oak.**—Water-g
do; but why not varnish the oak?—J.

[64705.]—**Turkish Bath.**—"T. H. W
obliged to "J. R." for wishing to know p
of the bath-heating stove. It is made



and the outer skin is made of thin sheet-
millimètre in thickness; the length is
and the sheet making the outer skin i
mètres. The stove is built into a wall,
being in the wall, the balance of length
the heated chamber. Thus it is stoked
outer room, and no dirt is brought into
proper. The grill or firebox is made of
made on an iron stand, with thick sheet-i
sides to keep fire from sides of skin.
used is wood to light and coal after.
gives such a good heat as coal, and woo
too quick, and the heat goes down at on
of the samples of the sheet-iron skin
easily, in thirty-five minutes, with abov



wood to start and coal, 180° F.; the ot
double the fuel, would only give me abo
I want a porous iron to let out the heat
the worst possible sheet-iron that can be
Belgian iron is ductile, and will not le

ne of these skins. I had the upper sur-
ve a red heat, with the other scarcely a
hey cannot tell here why this is. Can
n me what bad description of iron I can
l I believe, after many years' experience
h baths, that this is the simplest and best
n use.—T. H. W.

]—**Paint for Bicycles.**—A good and
an for this purpose can be made by melt-
st asphaltum in a pan and thinning with
e to the consistency of paint. Give the
coats. Take care that the asphaltum is
Egyptian, which will cost about tenpence
ng a pound.—T. CLARKE.

]—**Telephone.**—Re-ply about 80 yards
ered wire ·008in. in diameter, giving a
of about 40 ohms in each instrument.—
E.

—**Bleached Paint.**—The common green
e not durable under any circumstances.
rally consist of a green, struck on barytes,
ften aniline colours are used to make a
reen. The best green to stand a strong
mineral green, which costs about two
a pound. This is the colour used by
blind makers.—T. CLARKE.

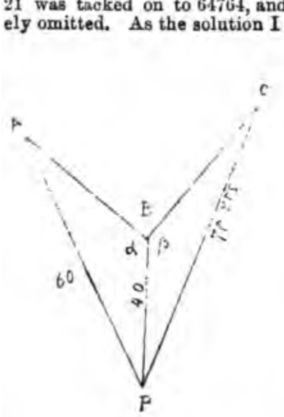
]—**Defective Electro-Magnet.**—I have
he three correspondents very much who
ied to the above query. I had my own
ut the cast iron. What my friend wants
strong electro-magnet having a large
surface—say, 3 or 4in. square. Now, if
erren-Maycock would kindly say how this
st obtained, I shall feel greatly obliged.
ought-iron tubing filled with Norwegian
e, and covered with No. 16 c.c.w. do? or
re bundle alone without tube, be better,
Norwegian bar large size? I presume
bobbins joined by end piece would be
to get the full power. Would Mr. May-
say the proportion of weight of c.c. wire
iron, or the best dimensions of iron por-
length of wire necessary to give the
ull over a surface of about 4 by 4in. with
mite quart cells, or as many more as may
ry; and also where the best Norwegian
h iron for this class of work can be
I hope this will not be trespassing too
your correspondent's good nature.—

]—**Dying by an Effort of Will.**—In
rt and Camp of Runjeet Singh," a book
y the Hon. Captain Osborne, then military
to his cousin, Lord Auckland, Governor-
f India, there is a full account of the
o died at will. I can remember many
claimants to similar powers in various
Iindoostan as described by their disciples;
er witnessed their performances, though
peans have told me there was no trickery
ibition.—EOS.

]—**Photography—View Meter—Cor-**
-For "sliding-valve" read "sliding
.Sc., Plymouth.

]—**Measuring Buildings.**—The method
C.E., Bath," is accurate, but his reduction
ation wrong. The result is 30 yards, and
be tested thus: Let A C B be a right
) = C B = 30 yards. Produce B C to P
P = 40 yards. Then P A = 50 and P B
ls. I find that the elements of analytical
give a much easier solution.—J. GEO.
s, B.A., B.Sc.

]—**Measuring Building.**—I am very
the two solutions I sent to queries 64764
got mixed. The latter half of the work-
21 was tacked on to 64764, and the first
ely omitted. As the solution I sent may



repeat it. Let A B C be the three
the building, P the point from which
streets diverge; then P A = 60 yards,
yards, and P C = 70 yards. Denote the angles P B A and P B C by α and β respectively; then, by a well-known trigonometrical formula—

$$\cos.\ \alpha = \frac{x^2 + 40^2 - 60^2}{2 . x . 40} = \frac{x^2 - 2000}{80x}$$

$$\text{and } \cos.\ \beta = \frac{x^2 + 40^2 - 70^2}{2 . x . 40} = \frac{x^2 - 3300}{80x}$$

Where x denotes the side A B of the building. Now $\alpha + \beta + 90° = 360°$

$$\therefore \alpha = 360 - (90 + \beta)$$

$$\therefore \cos.\ \alpha = \cos. \left\{ 360 - (90 + \beta) \right\} = \cos.\ (90 + \beta)$$

$$\therefore \cos.\ \alpha = -\sin.\ \beta$$

$$\therefore \cos.^2 \alpha = \sin.^2 \beta = 1 - \cos.^2 \beta$$

$$\therefore \frac{(x^2 - 2000)^2}{(80x)^2} = 1 - \frac{(x^2 - 3300)^2}{(80x)^2}$$

$$\therefore (x^2 - 2{,}000)^2 = 6{,}400x^2 - (x^2 - 3{,}300)^2$$

$$\therefore x^4 - 4{,}000x^2 + 4{,}000{,}000 = 6{,}400x^2 - x^4 + 6{,}600x^2 - 10{,}890{,}000$$

$$\therefore 2x^4 - 17{,}000x^2 = -14{,}890{,}000$$

$$\therefore x^4 - 8{,}500x^2 = -7{,}445{,}000$$

$$\therefore x^4 - 8{,}500x^2 + (4{,}250)^2 = -7{,}445{,}000 + 18{,}062{,}500 = 10{,}617{,}500$$

$$\therefore x^2 - 4{,}250 = \pm 3{,}258{\cdot}4 \text{ nearly}$$

$$\therefore x^2 = 4{,}250 \pm 3{,}258{\cdot}4 = 7{,}508{\cdot}4, \text{ or } 991{\cdot}6 \text{ yards nearly}$$

Since x^2 must be less than 60^2, the latter is the only admissible value.

$$\therefore x = \sqrt{991{\cdot}6} - 31{\cdot}5 \text{ or } 31\tfrac{1}{2} \text{ yards nearly.}$$

I am glad to see that I arrive at about the same result as Capt. Battersby, though I must demur a little to his remarks on analytical methods. I think that many trials would have to be made, and many measurements taken, before he got the sides B A, B C of his wooden square absolutely equal, and, as these trials would all take time, I fail to see the advantage which his method may have. The analytical method will at all events give a result either absolutely accurate, or as accurate as we please, whereas the graphic method he adopts can only be approximate. Again, he gets his result to about 32 yards; I get mine to 31½ nearly. If the side were 32 yards, the area would be 1,024 square yards; if the side were 31½ yards, the area would be as near as possible 992. This gives a difference of 32 square yards: a consideration this if the land was to be sold for building purposes, at, let us say, the sum of but £5 per square yard.—S. REPTON.

[64830.]—**Delta Metal.**—If "Metallurgist" is a metallurgist, I should think he would be in the habit of looking in the technical papers; but he certainly does not do so. On reading his remarks on this alloy, he says the price is 2½ times that of brass. If he refers to the price lists in the technical papers, he will see at once it is only the price of ordinary good brass, and under the price of gun-metal. I can endorse what some of your other correspondents say as to easy manipulation, whilst its strength is superior to steel, and does not draw verdigris.—ANOTHER METALLURGIST.

[64844.]—**Electro-Brassing.**—1. You can get a deposit of $\frac{1}{16}$in. by taking the articles out of the solution and scratch-brushing them every five minutes or so. 2. You have probably failed by not doing so. Use as large a current as possible. Elmore dynamos are generally connected in simple series for brassing. Too much E.M.F. and not enough C for heavy deposits.—BIJLI.

[64847.]—**Fuller's Battery.**—"M.M.I.Sc.S." exactly described my first experiences with this cell, granule form, made up with sulp. acid and chlor. ammonia in the porous pot; but I substituted hydrochloric acid, sat. solution of pot. bichromate, and water in equal parts for outer, and a solution of zinc chloride of about equal specific gravity in porous cell, with freedom from such troubles. This battery continued in full strength, giving about 1·5 volt per cell for nearly a fortnight, lighting lamps and doing other work intermittently, but it continued operating all I wanted from it, except lighting for about three months. The zincs suffered badly, however, as described by Mr. Perren-Maycock, page 132, and I shall in future paraffin the pots in strips longitudinally; but first I would like to hear of the probable loss of current from Mr. Perren-Maycock, who appears to have some experience of this arrangement. The zincs for this form of cell should always be cast in the form of a pillar with large base. They appear to be acted upon most at the bottom of the cell.—SEPTENTRION.

[64873.]—**Cement for Glass and Brass.**—*Scientific American* recommends silicate of soda for this purpose.—WOLFENBUTTEL.

[64873.]—**Cement for Glass and Brass.**—Boil one part caustic soda, three parts rosin, five parts of water; then knead this rosin soap with half its weight of fresh plaster of Paris. This cement will stand petroleum. Or use fresh plaster of Paris mixed with a solution of gum-arabic. Both must be used as soon as mixed.—J. W. M.

[64872.]—**Electro-Gilding.**—Dissolve fine gold in one part nitric to three of hydrochloric acid, add cyanide of potassium; the gold is precipitated like yellow chrome. Wash through filtering-paper in a glass funnel, then redissolve in cyanide; 1oz. of gold to the gallon of solution is good strength, and with proper battery will give a rich colour. Use gold anode. If a silver solution is meant by the second part of the above query, add bisulphide of carbon to get a bright deposit. Add common salt for a chalky one.—BIJLI.

[64874.]—**Glazing China.**—The following are the materials used, and method of using:—Fritt, 55 parts; Cornwall stone, 25; flint, 20; Paris whiting, 50; borax. Pass the whole through a riddle (½in. mesh), well mix, and put it into saggars lined with flint; calcine in kiln to glass. When calcined, clean off all the flint possible, roughly pound, and to 100 parts of fritt add 10 parts stone, 20 flint, 40 white-lead, and 1oz. Cobalt blue. Grind the whole together in water to an impalpable powder. Before applying to the ware, pass the glaze (in a slop state) through a very fine sieve. The glaze must be so thick that when the ware is dipped into it the glaze will not run in streaks. For brown, use manganese, or chromate of iron, 1 part colour to 10 parts glaze. The following is a brown glaze for common earthenware:—35lb. red-lead, 12lb. stone, 6lb. flint, 7lb. manganese; well mix in water and sift. In both glazes the ware must be placed in saggars for firing.—POTTER.

[64882.]—**Electro-Depositing.**—ERRATUM.—In the preparation of the gold solution it should read "50 grammes of potassium cyanide," not "50 grains of potassium cyanide."—M. ISADER, Lewes.

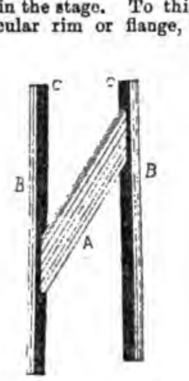
[64882.]—**Electro-Depositing.**—Gilding: see Electro-Gilding, 64872. Silvering: Dissolve silver in nitric acid, precipitate with cyanide, filter, and redissolve in cyanide; 2oz. of silver to the gallon of solution. Copper: Dissolve copper sulphate in water, add to saturated solution, quarter water and a drop of sulphuric acid. No use for iron goods. To sulphate solution add cyanide; collect and wash, precipitate, and redissolve in cyanide solution. Work hot—10 cells, Daniell's, in series—till coated, then finish plating in the sulphate solution.—BIJLI.

[64891.]—**Hospital Floors — Correction.**—For "walked all the great hospital floors in Europe," please read "walked all the great hospitals in Europe."—B.Sc., Plymouth.

[64891.]—**Hospital Floors.**—The best way to treat pitch-pine flooring to fulfil all the conditions named by "Bertha" is to give the floor about three coats of the following varnish:—Dissolve Scio turps, also known as pistachia gum, in turpentine, to the consistency of varnish, and mix three quarts of this varnish to one of shellac varnish. This mixture will be cheaper than a good hard oak varnish. In appearance it will be equal to any other, and it will not yield to the action of soap or soda. This is about the only varnish that possesses this property.—T. CLARKE.

[64894.]—**White Enamel for Iron.**—For small pieces of iron, a simple enamel is made of 4 parts red or white lead, 1 pint flint, 1 pint oxide of tin. If you have convenience for grinding, this is a good enamel:—4lb. lead, 1lb. oxide of tin, 1lb. calcined felspar, ¼lb. flint, ½lb. borax; well mix, calcine to glass, and grind.—POTTER.

[64896.]—**Micro-polariscope.**—Yes; thin glass makes a very good polariscope. Round ones are not so good as elliptical or oblong square ones. To make one, proceed as follows: Make two brown-paper tubes by rolling stout brown paper round a cylinder, and gluing together with thin glue. Let these be of such a size that the one slips easily into the main tube of the microscope (when the eyepiece is removed), while the other fits the circular aperture in the stage. To this latter must be glued a circular rim or flange, to prevent it falling right through the hole in the stage. Now make two smaller tubes, about $\frac{1}{16}$th of an inch thick, that will just fit tightly into the tubes previously made. Let these latter dry thoroughly. When quite dry, divide each one of these latter into two tubes, by a diagonal cut, at an angle of 67° from the base of the tube. Glue one of these cross-cut



pieces into each of the larger tubes. Set aside to dry. Wipe carefully, with a wash leather, 40 thin cover glasses, of such shape and size as will easily slip into the tube and rest on the diagonal ledge. Put 20 such glasses in each tube. Put a little glue on the remaing two diagonally-cut tubes, and push them in the larger tube.—S. BOTTONE.

[64897.]—**Indicator Diagram.**—Perhaps it's the fault of the indicator instrument. You should clean it well, and see that there is no unnecessary stiffness about it; then lubricate it, and after attaching it to cylinder, open the steam-cock, and let it work up and down a few times. Then take a copy, and if it is no better, the fault is either a leaky slide-valve face or leaky piston-ring, or water getting at indicator piston. Take the governors out of gear when taking diagrams.—F. C.

[64898.]—**Strength of Cast-Iron Pipe.**—Your c.-iron T will be quite safe at 60lb., as bursting pressure is 2343·75lb.; considered safe at half that pressure.—ARTHUR BIRD, Brandon.

[64900.]—**Blast Fan for Smith's Fires.**—The following may perhaps be of service to "F. E. F.": —1lb. of coal requires for its combustion 274 cubic feet of air at ordinary temperature and atmospheric pressure. Let it be assumed that each fire burns 10lb. of coal per hour, and that the nozzles are each 1in. in diameter, or 0·7854sq.in. area, then air per second $\frac{274 \times 10}{60 \times 60}$ cubic feet, and as the diameter of nozzle is 1in., and area 0·7854sq.in., the volume of air passing per square inch per second will be $\frac{274 \times 10}{60 \times 60 \times {\cdot}7854}$ = 0,969c.ft., or, say, 0·98c.ft. Prof. Wiebe gives a table of data relative to fans, in which (col. 1) n R product of revol. of disc per second, and the semi-diam of blades in inches. (Col. 2) $V = 0{\cdot}05236\ nR$ corresponding vel. of blade tips. (Col. 3) v = efflux vel. of air at 32° a atmos. pressure, and without contraction. (Col. 4) $h = 14{\cdot}5 + \sqrt{210{\cdot}25 + 0{\cdot}0001\ n^2R^2}$ pressure of air in fan above atmos. in inches of mercury. (Col. 5) $h^1 = 13{\cdot}6\ h$ same in inches of water. (Col. 6) $Q_1 = 0{\cdot}0028\ nR$ volume of air in cubic feet per second, efflux per square inch under atmospheric pressure. (Col. 7) $N = \frac{0{\cdot}00457(nR)^3}{1{,}000{,}000}$ work in horse-power required for the fan per square inch of efflux opening, assuming a useful effect of 0·265.—

TABLE OF DATA RELATIVE TO FANS CALCULATED FOR AN EFFLUX OF 1SQ.IN.

1 nR	2 $V = 0{\cdot}5236\ nR$	3 $v = 0{\cdot}77\ V.$	4 $h = -14{\cdot}5 + \sqrt{210{\cdot}25 + 0{\cdot}0001\ n^2R^2}$	5 $h^1 = 13{\cdot}6\ h$	6 $Q_1 = 0{\cdot}0028\ nR$	7 $N = \frac{0\ 00457\ (nR)^3}{1{,}000{,}000}$
100	52·36	40·317	0·0344	0·467	0·28	0·00457
150	78·54	60·476	0·0773	1·051	0·42	0·01542
200	104·72	80·634	0·1373	1·867	0·56	0·03656
250	130·90	100·793	0·2140	2·910	0·70	0·07141
300	157·08	120·951	0 3077	4·185	0·84	0·12339
350	183·26	141·110	0·4165	5·665	0·98	0·19593
400	209·44	161·269	0·5414	7·361	0·12	0·29248
450	235·62	181·427	0·6821	9·276	0·26	0·41645
500	261·80	201 586	0·8521	11·588	0·40	0 57025

Looking for the volume in cubic feet per second per square inch, in column 6, we find against 0·98 the other values—viz.: $nR = 350$; $V = 183{\cdot}26$; $v = 141{\cdot}110$; $h = 0{\cdot}4165$; $h^1 = 5\ 665$, and $N = 0{\cdot}196$. As, however, the same total of nozzle outlets = 6 × 0·7854 = 4·7124sq.in., the power required to drive the fan is 4·7124 × 0·196 = 0 92363H.P. The area of each blade, as also the area of each side inlet in the fan case, should be eight times the cross sectional area of all the nozzles; therefore, 6 × 0·7854 × 8 = 37·6992sq.in. The diameter of each side inlet is therefore— $\sqrt{\frac{37\ 6992 \times 452}{355}} = 6{\cdot}93$, or, say, 7in.; and as the diameter of inlet should be at most one-third the diameter of the disc, it follows that this latter will be 3 × 7 = 21in., and its semi-diameter 10½in. But nR is found by table to be = 350 (Col. 1), and the number of revolutions of fan disc per second $n = \frac{350}{10{\cdot}5} = 33{\cdot}3$ —or, say, in round numbers, 2,000 per minute. Deducting from the semi-diameter of disc the semi-diameter of the side air-inlets, 10·5 − 3·5 = 7in. = the height or length of each blade or vane, and as each blade surface or area = 37·6992sq.in., the width of blade will be $\frac{37{\cdot}6992}{7}$ = 5·386in., or, in round numbers, 5½in. The cross sectional area of the air-conducting pipe should be 4 times that of all the nozzles; therefore, 4 × 6 × ·7854 = 18·8496sq.in., and the diameter will be, say, 5in. (for 30 yards of length, and, as several bends may very likely occur, it would be better to make it 6in. internal diameter, and preferably of iron). The outlet throat of fan-case should have the same area, and as it has the same width as the blades, the height of throat will be $\frac{18{\cdot}8496}{5{\cdot}386}$ = 3·5in. = half of the height or length of blades. Reducing to formula, and assuming F = total cross-sectional of all the nozzles in square inches, then—

Area of each side inlet $= 8\ F$

Diameter of side inlets $= 3{\cdot}2\sqrt{F}$
$= \frac{2}{3}\ R$

Radius of disc R $= 4{\cdot}8\sqrt{F}$

Area of each blade surface
$a\ b = 8\ F$

Height or length of each blade
$a = \frac{2}{3}\ R$
$= 3{\cdot}2\sqrt{F} = d$

Width of each blade $b = \frac{25}{32}\ a$
$= 2{\cdot}5\sqrt{F} = 0{\cdot}52\ R$

Area of air-conducting pipe
$a_1\ b_1 = 4\ F$

Diameter of ditto $d_1 = 2{\cdot}26\sqrt{F} = 0{\cdot}47\ R$

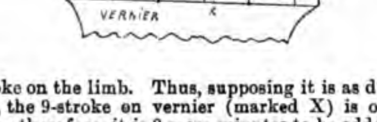
Width of throat $h_1 = b = 2{\cdot}5\sqrt{F} = 0{\cdot}52\ R$

Height of ditto $a_1 = \frac{16}{25}\ b_1 = 1{\cdot}6\sqrt{F}$
$= \frac{1}{2}\ a = \frac{1}{3}\ R$

Finally, $F = z\ f = 0{\cdot}7854\ z\ g^2$, in which f, the cross-sectional area, g the diameter of each nozzle, and z their number, assuming them all of same size. The number of blades are usually six, and they consist (beyond the periphery of side inlet openings) of thin flat sheet-iron plates, and are either radial or inclined to the radius. The case should be of the arithmetical spiral form, in order that the air may be delivered freely.—MARIENBERG.

[64908.]—**Quadrant.**—Every two divisions on the limb exceed one division on the vernier by 1′. If the stroke of the arrow or lozenge on the vernier exactly corresponds to a stroke on the limb, the reading at this point is the measurement required; when the stroke of the arrow or lozenge falls beyond a stroke on the limb, this distance is equal to 1, 2, or 3 times 1′, according as the 1st, 2nd, or 3rd stroke on the vernier from the arrow coincides with a stroke on the limb. This distance must be added to the degrees and ⅓ degrees read.—T. O. D.

[64908.]—**Quadrant.** — Place the O line on vernier half-way between, say, 35 and 40. Now, first examine limb; it reads, 37° 20′, and part of another 20′. Now the question comes: What part? Look along the vernier, commencing at the O line, until you come to the stroke (which may be about the 9 or 11), which is exactly opposite to any stroke on the limb. Thus, supposing it is as drawing, the 9-stroke on vernier (marked X) is opposite; therefore, it is 9 more minutes to be added to the first 20, which makes 37° 29′; but if you are undecided whether it is nearer opposite the 9 or 10, and if there is, or is not, a short mark between, call it 37° 29′ 30″.—DADDY.



[64911.]—**Electric Lighting.**—In continuation of my query inserted in the issue of March 30, I am now able to give more definite information for the use of those who may be inclined to help me by their advice, in the fitting up of my proposed electric light installation. The exact height of the fall at my service is 50ft., while the quantity of water available is 48 gallons per minute. I have calculated this out by "Molesworth," and find that this represents a little more than one half horse-power. The question now arises as to what form of hydraulic motor would be the most suitable. My own idea is one of the "Thirlemere" type, made by Bowley, of Salford, or of a spade mill water-motor, made by Wheeler, of Preston; but as I have had no experience of these motors, I should be glad to profit by that of others. I live in a mountainous district of the north of France, and if I could get the designs of a suitable motor, I should prefer making it myself—having all the tools necessary—as the cost of carriage from England is prohibitive. If any brother amateur, after having examined into my requirements, could publish in these columns a sketch with dimensions of a small motor, I should not only be personally obliged to him, but I am sure that his information would be of use to many. As to the dynamo, I propose making that also, the more so, as I have already successfully built two before leaving England. The only question is as to the most suitable and efficient type, and this must be governed by the power, say, ½H.P. at my disposal. I should prefer also coupling the dynamo direct on to the shaft of the motor without intermediate gearing, provided always that the motor ran at a sufficient speed. Before commencing to carry out this scheme, I invite the criticisms of my fellow readers of the "E. M." upon it, and I should be glad of information as to the design and details of a small motor, the general dimensions of a dynamo suitable for the power available, and the results in lighting, that is, the number of 5 or 10 c.p. lamps I should be able to keep going. As to this latter point, while I am, of course, desirous of obtaining as high an efficiency both from the motor and the dynamo as possible, I should be quite content if I were able to light up a small sitting room and an entrance hall, or even the room alone. My thanks are due to Mr. Bottone and to Messrs. Walker and Hyde for their kind replies to my first query; I sincerely trust that the Editor will allow these latter gentlemen to publish the details with sketches of their cottage illumination, and I am sure that many amateurs besides myself will be greatly interested in reading their article. I had sent a similar query to a French paper, *La Nature*, but the only answer I obtained was that the "question is a much more difficult one than our correspondent imagines it to be," or words to that effect.—D'ELGO.

[64913.]—**Arcs of Large Radius.**—The only plain and simple way to do this is to strike out a part of the circle by means of a radius bar. The only feasible alternative as an instrument would be one like that figured on p. 462, Vol. XXXIX. "E. M.," with a hinge joint, clamp, and other accessories. But I must tell "Spherical" that this could not be worked without reference to tables of logarithms, as used in trigonometrical calculations for every variation of curve required, unless a very complicated apparatus was made. I have worked out four examples approximately. First, a speculum of 12in. diameter, and 72in. focus has a depth of curve at centre of 13-100ths; a speculum of same size, but 144in. focus, a depth of 6-100ths; a 24in. speculum of 72in. focus, a central depth of 50-100ths, and a 60in. speculum of 27ft. 3½in. focus has a central depth of concavity of 70-100ths. Now a variation of even 1-100in. in the depth of the curve will make more than 2in. difference in the focus. The latter part of his query is hardly explicit enough for me to reply to.—J. C. LINSCOTT, Ramsgate.

[64916.]—**Cementing Bicycle Rubbers.**—To make a good job, take off the rubber tire, and heat the edge of the wheel in a gas flame, and apply some Prout's elastic glue all round (or a composition of shellac, pitch, and guttapercha), then put the tire on again, and heat the inside of the rim with point of gas flame directed by a blowpipe, or else heat it by applying a very hot iron to the rim. The heat causes the cement to soften, and fixes the cement firmly to tire and wheel. Be careful not to let the hot iron or gas flame touch the rubber; when the rim is cold it can be cleaned. —J. W. M.

[64919.]—**Breechloader.**—In the first place, cartridges are very expensive, and not to be had in some parts of America. To make the cases it would cost £100 for the machinery. The most useful gun to take there would be a double muzzle loader, left barrel choke, and not less than 36in. in length, 12 or 14 bore; cost about 40s. in London or Birmingham.—ROBERT GOODWIN.

[64923.]—**Electric Bells.**—"Nero" should fix a piece of thin paper on to his relay armatures in such a way that there is no direct metallic contact between armatures and pole pieces of electro-magnets. If "Nero" is a fitter, he will find it a good plan to carry some stamp-edging, as supplied with post-office stamps. This is ready gummed, and of a suitable width for the purpose.—C. BURMAN, Callow.

[64924.]—**Chiretta.**—I think this simple remedy is well adapted to your rather common complaint of "torpid liver." An earthenware teapot kept for the purpose will be a suitable vessel; but you must make the infusion with cold, soft water only —a pint to the ½oz. of the sticks. Prepare the infusion at night; early next morning take a large wineglassful, again at bedtime, and so on, as long as the liquor lasts; then throw away the old sticks and make a fresh brew. Chiretta is a mild aperient, of cholagogue, febrifuge, and tonic properties.

l, therefore, need no other medicine, if
e gentle pedestrian exercise daily, and
your sedentary occupations. In my house
taken it daily as above rerommended for
st (regularly, without fail, I mean). When
l it relieves your complaint, reduce the
of infusion to ½oz. chiretta and one pint
Eos.

.]—**Hardening Drills.**—I never use any-
t cold water, and drill softened cast steel
Have you well softened the steel? Per-
run your drill too fast, or the drills are
steel.—T. C., Bristol.

.]—**Earth's Speed.**—The ratio between
extreme speeds, being the same as between
test and least distances, is nearly 14 : 15, so
are not between 18 and 19 miles per second,
tated by "F.R.A.S.," p. 122, end of letter
This, however, is no reason for accepting
er statement therein. The Lisson-grove
as not been in that place 4,991 years, and
rork, not of time, but of a cataclysm.—

.]—**Tempering Turning Chisel.**—Heat
sel to a good blood-red heat about an inch
m the end that has to cut, and suddenly
in salt water; then place the required
e hardened on a bar of red-hot iron, and
ll a light-straw colour comes over it, then
t in the water again till cold.—F. C.

.]—**Model Loco.**—Springs are not neces-
models, but may be put on if desired.
oiler 13in. long, 3½in. diam., firebox (in-
4in. by 3in.; put a 1¾in. copper tube
barrel. Construct firebox after pattern
bed by me on page 85 of "Ours," No. 1,200,
ill give satisfaction.—J. A.

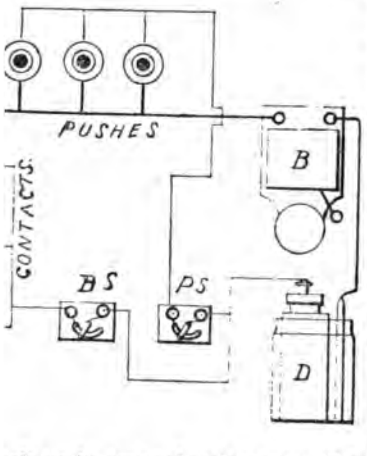
.]—**Model Loco.**—It is not necessary to
gs, but decidedly more real. I made some
nes from wide crinoline steel; the temper
ight. I think I used four leaves in each
Your boiler for such a size, to be any-
e scale to the real thing, should be, say—
. long and 4in. diameter, and firebox
in. by 4½in., and a single 2in. tube through;
large enough for the cylinders. Circles
unsatisfactory—say 12ft. at least.—T. C.,

.]—**Battery.**—If A. Hutton will procure
bon plates ¼in. thick, and same surface
as his zincs, and use them in place of his
ylinders, he may get a fair amount of work
s battery. He appears to be rather mixed,
ould advise him to buy an elementary
the subject, and to study it.—C. BURMAN,

.]—**Chemical.**—Both potassium nitrate
ate can be fused over an ordinary Bunsen
What do you mean by saying that the
"takes fire"? It does not do anything of
—SM.

.]—**Continuous Ringing Bell.**—"One
es" has evidently been trying to work his
us bells with reversed battery leads; but
otten that if he reverses any he must
he whole. It is a matter of opinion as to
the copper should be connected to press or
but as far as my experience goes, it is a
f no moment whatever.—C. BURMAN,

]—**Continuous Ringing Bell.**—The
of the bells in the catalogues you mention
ged differently. Take my Fig. 56: the
of the terminals of the bell in the similar
are from left to right; King, Mendham,
C. Z. L.; Gent's, L. C. Z. It is obvious



als can be arranged various ways. Mine
ged with a view to avoid unnecessary
nd recrossing of the connections. Connect as shown in my diagram, and then simply reverse the battery connections, and you will have your push connected to carbon. As a rule, the carbon is usually taken to the push; but in some of the diagrams, in order to make them clearer, zinc is shown to the push. The following sketch will show how you can connect up your pushes and contacts. Use switches of the form shown in Fig. 46, page 569. B S will cut off your burglar contacts, and P S your pushes.—F. C. ALLSOP.

[64947.]—**Diamond Cement.**—Soak isinglass in cold water till it becomes soft, then gently warm it till it becomes fluid; then add half its bulk of strong alcohol (or a little more than half of French brandy or rum), warm the mixture, and stir so as to incorporate it, then filter. Add while hot a little alcoholic milky emulsion of gum-ammoniac, also a little alcoholic solution of gum mastic; the proportion of the solutions of the gums to add to 1oz. of isinglass solution is 1 drachm of each.—J. W. M.

[64950.]—**Rudders.**—

Let A = feet, area immersed blade.
L = feet, length from head to ⅔ draught.
R = feet, radius from centre of immersed blade area to axis on which rudder turns.
θ = max. angle of rudder deflection from tongitudinal axis of ship.
V = feet per second, speed of ship.
P = lb. max. pressure on rudder normal to its blade.
D = inches diam. rudder head.

$$A \sin. \theta V^2 = \text{lbs. resis. caused by rudder against the speed of ship.}$$

$$A \sin.^2 \theta V^2 = P.$$

$$\sqrt[4]{\frac{2\ LRP}{49\ \text{(for iron)}}} = D.$$

—FRANK CAWS, Sunderland.

[64951.]—**Violin.**—I have a genuine "Kloz," which is 98 years old (I am sure of this) and is worth £40. When I first got it, about 4 years ago, it had a like failing to yours, although very slight. I took it to a very efficient person to whom I was privately recommended, who fitted a new bridge and soundpost. The fourth string now excels the others. I will give his address if you like to advertise yours; but I strongly warn you against trying to improve it yourself, or trusting it to inefficient workmen.—COPPER.

[64952.]—**Dynamo and Accumulator.**—TO S. BOTTONE.—A dynamo to light direct a 5c.p. lamp of about 8 ohms resistance, should be a laminated Siemens, with armature about 3in. by 1½in., and field magnets about 5in. high, by ½in. thick, and 3½in. broad. This dynamo would also charge an accumulator consisting of four cells coupled up in series, each cell containing at least two square feet of lead plates, 1ft. for the positive, and 1ft. for the negative plate. To get four hours' work out of the cells in the evening you would probably have to charge during six hours in the daytime.—S. BOTTONE.

[64955.]—**Chloride of Zinc and Fluxes.**—Chloride of zinc is very deliquescent—i.e., absorbs moisture with great avidity from the atmosphere. During soldering with a hot iron, the water which holds the zinc chloride in solution is evaporated; but on cooling, water is again absorbed by the adhering chloride, and this produced the "dreadful mess." Tinmen generally employ powdered rosin for this reason, as it does not give rise to any of the effects above mentioned. The nose of the bit may be kept in good condition by rubbing it while warm against a block of salammoniac, more especially if this latter be hollowed out a little in the centre, so as to hold a globule of solder. The action of a good flux is to clean, either chemically or mechanically, the surface of the metal to be soldered; and so to cover it, during the application of heat as to prevent the atmospheric oxygen from oxidising it. See also my book on "Elect. Inst. for Amateurs," pp. 4 to 9.—S. BOTTONE.

[64956.]—**Faulty Magneto-Machine.**—If the coils are "somewhat thinly insulated with cotton," so that you can see the cotton through, the mischief may be there, as there may be a considerable amount of leakage. But unless the coils have been tampered with after being sent out by maker, it is not probable that the fault is there. Remedy: rewind with same gauge wire, but better insulated. The spindle is divided into two distinct halves by means of an insulating collar of ebonite or ivory. One wire is connected to one half of this divided spindle, the other wire being connected to the opposite half. (See "Electrical Instrument-Making for Amateurs," p. 90, *et seq.*) If the magnet has lost its power, you must not expect to get any perceptible current. The magnet can be re-magnetised by placing (in the right position) against the poles of a powerful electro-magnet, or by coiling it with insulated wire, and then sending an electrical current in the proper direction round it.—S. BOTTONE.

[64960.]—**Harmonium Pedal Organ.**—The defect is evidently due to a badly-constructed soundboard. The reed veneer should be of good pine or beech, the latter being preferable to the former. The reed veneer (as also the pallet veneer) should be perfectly level, and the reed block should fit close on the veneer, without being strained when screwed down. Beech is preferable to pine, as the reed screws hold better in beech. I should advise the querist to have a new soundboard, and have it made by someone who understands how to make it as it should be made. See that there is no escape of wind between the wind-chest of harmonium and the wind-chamber of pedal action. It is quite evident to me that no good will result from the present soundboard. From the description given in query, I should imagine it to be only good for firewood, and it is not improbable that the other portions of the pedal action are not altogether as they should be.—G. FRYER.

[64961.]—**Hot-Water Fittings.**—Take sink supply from rising hot pipe at some point between top of boiler and underside of cylinder, and (if necessary) take return pipe from sink to return pipe at its lowest end. Note.—Sink tap should not be below top of boiler, but at least, say, 20in. above it. See that your pipes are not trapped.—FRANK CAWS, Sunderland.

[64962.]—**Forced Draught for Boiler.**—The simplest, cheapest, and, I believe, the most efficient appliance is a steam jet, as applied to locomotives. This will work in horizontal flue or up the chimney. I think I should prefer the former, having it made to blow just beyond the bridge.—G. H. D.

[64962.]—**Forced Draught for Boiler.**—As a metallurgist of some years' experience, I have had much to do with forced and natural draughts. If you must have forced draught, there are two systems open—1st, a blast produced by a fan or blower; 2nd, a blast produced by a jet of steam. In the first case, it is simply necessary to close in the ash-pit with a sheet or cast-iron movable door, and conduct the forced draught into the ash-pit through a suitable pipe passing through this door. The second case is simpler, or, at least, is less expensive, but the ground is pretty well covered by several patents, leaving but little scope to put up a well-tried apparatus. Why not burn "Welsh smokeless" steam coal? There is surely something wrong with your stack or flues when its draught is dependent upon the direction of the wind.—METALLURGIST.

[64964.]—**Hard-Water Well.**—The first step to take in softening about four gallons of the above water, is to obtain a suitable vessel. This should hold about 4½ gallons, and have a tap about 3in. or 4in. from the bottom, so that you can draw off the clear soft water without disturbing the sediment. If this vessel is fixed, a plug should be fitted in the bottom with a chain attached, that can be removed to get rid of the sediment. If loose, you can pick it up and swill it out. For drinking water, I should only use lime. The easiest way to treat such a small quantity would be to make about two quarts of lime-water in another vessel. The lime should be stirred in excess, and allowed to settle, the clear portion being poured into the water to be softened at night. In the morning your soft water will be clear and ready for use. When you use the two quarts of lime-water you can mix some more at once, it will then be clear and ready when required. This process also purifies the water, but does not always remove all the hardness. There are many other reagents which remove all the hardness; but they leave something in solution in place of the lime which may be more hurtful in drinking water, although beneficial for water used in steam boilers and for manufacturing purposes. The sediment does no harm if only cleaned out, say, twice a week. Hard waters differ very much in composition.—CHAS. E. GITTINS.

[64965.]—**Halse's Battery and Coil.**—TO MR. BOTTONE.—1st. Halse's battery is a modification of Smee's with a single zinc instead of a double. 2nd. The zincs should be amalgamated. 3rd. The duration of one charge will depend entirely on how hard the battery is worked. The cells would probably be almost entirely exhausted if run for three hours at a stretch. 4th. I prefer the chromic-acid cell as being far more compact and powerful. When fitted with a lifting arrangement, so as to withdraw the plates from acid when not in action; it is also much cheaper. Three cells of chromic-acid battery give as much effect as a dozen of the above. 5th. The effect of platinising the silver is to liberate more freely the evolved hydrogen, which would otherwise polarise the silver plate. This is the essential point in the Smee cell. 6th. The more chloride you put on, the longer the cell will keep in action without polarising.—S. BOTTONE.

[64970.]—**Pulley.**—If the engine only indicates 10H.P. a 3in. strap should do the work on an ordinary pulley; but it is probably giving more than this, and requires a wider belt. Try a few holes in present pulley.—T. C., Bristol.

[64970.]—**Perforated Pulleys.**—Is your belt wide enough to transmit the necessary power? You do not state the width. The drum of my threshing machine runs at 900 revs., having an 8in. pulley driven by a 48in. flywheel, without perceptible slip.—A. F. P.

[64972.]—**Ventilating Church.**—"M." mentions openings in ceiling, but says nothing about how these conduct to the open air. The velocity of current depends on the head of the air siphon. I suspect as "M.'s" church ceiling is only 18ft. high, which is only about 20ft. above the lower end of the air inlet tubes, the summit of extracting shaft, or shafts, is not nearly high enough to promote the current needed. If the top of the outlet were 25ft. higher than the bottom of the inlet tubes, the action would be, on a calm day, as follows:—For every 20deg. the temperature within the church was raised above that of the outer air, the bulk of the 25ft. column (or head of air siphon) would expand $\frac{1}{25}$ its height; the time occupied in the expansion of 1ft. height will equal (if there were no frictional resistance) the time occupied by a free body in falling 1ft.—i.e., ¼ second. The velocity of expansion is the velocity of the current—viz. (in this case) 4ft. per second. The volume of fresh air admitted per hour, when—doors and windows being closed—only the zinc tubes are at work, will be as follows:—

$$\frac{3 \times 6^2 \times \cdot 7854 \times 4 \times 60^2}{144} = 8{,}482 \text{ cubic feet per}$$

hour. This presupposes that the outlets have an area considerably in excess of the inlets so as to allow for retardation due to friction of influx and efflux. "M." says there are 80 persons, and probably the gas and stove consume as much oxygen as another 320 persons; so that it is as if, say, 400 persons had to share between them in the first hour of service 10,400 cubic feet of air initially contained in the building plus 8,400ft. air supplied $= \frac{18{,}800}{400}$ = 47ft. per individual per hour. But each person should have at least five times as much air as that. So the inlets and outlets need improving in area and head accordingly.—FRANK CAWS, Sunderland.

[64973.]—**Motor for Dynamo.**—Any motor capable of giving ⅛ horse-power will drive this. I should prefer steam-engine; next gas-engine, then hot air engine, and lastly water.—S. BOTTONE.

[64974.]—**Battery Connecting.**—The best way to connect a battery of 15 cells depends entirely on what you want to do with the battery. Do you want a large current, against a small outer resistance, as in working an electro-magnet or decomposing chemical solutions? Then couple all the zincs together so as to form virtually one large zinc, and all the carbons together so as to form but one large carbon. Are you desirous of overcoming a large outer resistance, as in lighting an incandescent lamp? Then couple in series the zinc of one cell to the carbon of the next, and so on. Arranged thus, 15 cells would give 30 volts, so that you could light a low-resistance 20c.p. lamp well. Mix 1lb. chromic acid with 5 pints of water; add ⅛ pint of oil of vitriol. Broken graphite can be joined together by boring holes through the pieces and sewing together with leaden wire.—S. BOTTONE.

[64975.]—**Soldering Fluids.**—Chloride of zinc, if the parts can afterwards be washed; powdered rosin if otherwise. Sheet brass can be tinned by being placed in a tinned copper along with grain tin and cream of tartar, with only just enough boiling water to dissolve this latter. If this mixture be kept boiling some six or seven hours, the brass will be found effectually tinned. (See also 64955).—S. BOTTONE.

[64975.] — **Soldering Solution.**—I think "Aladdin" will be able to tin this metal ready for soldering with sodium amalgam, which I am told will tin even cast iron. I should like to know myself how to use this properly; the chemist I purchased it of picked it out of some liquid with a pair of tongs. I have tried it on several metals very successfully. It will tin anything, but I am afraid to handle it much; but for a flat surface I should think it would answer well.—NEMO.

[64976.]—**Brass - Casting at Home.**—You must use moulding sand. I tried the same scheme as described by you, with precisely similar results, when I first attempted this business.—A. F. P.

[64976.] — **Brass - Casting at Home.**—If "Amateur" will get some moulding-sand (instead of plaster of Paris) and coke dust, and make moulds of sand, and dust the face of them with plumbago Battersea brand, he will get both sharp and smooth castings free from holes.—W. W.

[64976.]— **Brass-Casting at Home.**—It is of no use to try casting brass in moulds made of plaster of Paris, whatever it may be mixed with. You must take to the casting-sand; get a practical lesson, not only in casting the models, but in making the proper gates, as also the knack of pouring the metal so as to insure the casting being solid throughout, for it cannot be got at by any amount of printed instructions.—DENS.

[64976.]— **Brass-Casting at Home.**—Throw away your plaster of Paris, and powder no more coke. Make your moulding sand from Bath brick rubbed down to powder, and carefully sift or sort out all large particles. Damp very slightly, cautiously, and uniformly. Leave plenty of vent holes, and leave the oven alone. Dry the mould in a warm place, and do not move the mould after placing it to dry until you have poured your brass into it and the metal has set.—METALLURGIST.

[64981.] — **Heating and Lighting of a Church.**—What "A Subscriber" proposes, though not advisable on strictly £ s. d. grounds, is quite easily practicable; but let him take care to have *one* specially qualified contractor for the whole job. Five years ago I heated with steam a large new institution, including a public assembly room, many smaller halls and class-rooms, and two restaurants. After the steam-heating contract was let, but before the work was commenced, we decided to have the whole place lighted by electricity (incandescent). It became necessary to provide a much more powerful boiler than was originally intended for the mere heating, so that one boiler should serve both for heating and lighting. A mutual arrangement between the contractor for heating and the contractor for lighting resulted in the necessity of keeping a fireman working "like grim death" to maintain heating and lighting both full on at once, because the contractors, being limited for price, took it (as the event proved) out of the boiler power. Consequently the gas-lighting, which I also provided (to cover the contingency of an electrical break down), is the thing now generally used there, the electric being reserved for special occasions. A greater reserve of boiler power would have given the electric light a better chance of being economically used. Each of the contractors claimed to have done his part satisfactorily; but, from an economical point of view, the total result was not encouraging. Since then, however, we have witnessed five years of advance in the economies of electric lighting; and though gas is still less expensive, both in installation and working, the difference of cost between the two systems is much less than it was.—FRANK CAWS, Sunderland.

[64982.]—**Plating Dynamo.**—To MR. BOTTONE.—After reading carefully your description, I come to the conclusion that the iron of the F.M.'s must be hard, or else that the teeth of the ring do not make good magnetic connection with the wire core. Personally, I dislike wire cores very much. I have seldom seen any that work even half as well as laminated cores. It would certainly make matters worse to remove the teeth, as by so doing the armature would be carried still further from the inducing action of the pole pieces. I should strongly advise you to replace your wire armature by one built up of punchings. I built one a short time ago, using about 4lb. No. 12 wire on the armature, with about 40lb. No. 14 on the fields, which gave me 100 ampères. The fact of the F.M.'s requiring to be coupled up in parallel points to one of two things: (1) The iron is hard. (2) The E.M.F. and the current given by armature are both very small.—S. BOTTONE.

[64983.]—**Rust in Kitchen Boiler.** — The only way to remedy your trouble is to remove the iron from the water before it enters the boiler. This can be done by a specially constructed filter. I replied to a similar question (No. 64855) in the same number as your query appears, and shall be pleased to help you if you will send me a sample of the water.—CHAS. E. GITTINS, 100, Fenchurch-street, E.C.

[64984.] — **Hydraulic Leather.** — Have you tried vulcanite fibre? This is made in sheets very firm and even, and is cheaper than leather.—CHAS. E. GITTINS.

[64985.]—**Spring-Water Storage Tanks.**—Those in use hereabouts are made of great slabs of slate. They are very clean.—B.SC., Plymouth.

[64985.]—**Spring-Water Storage Tanks.** — If the tank is very large, one of cast iron would be best; if a moderate size, a slate one.—CHAS. E. GITTINS.

[64986.]—**Electrical.**—A 6H.P. engine running from 9 to 4, if coupled to an efficient dynamo, could charge accumulators sufficient to give 1,800 candle-power for five hours, so that your very modest requirements would certainly be very easily met. Dynamo, £15; lamps, at 5s. each, 25s.; 10 cells E.P.S. accumulators, £10; wires, leads, switches, ammeter, £5; total, about £32.—S. BOTTONE.

[64986.] — **Electrical.**—Possible?—easy! For such a small job I should advise you to use all 5c.p. lamps, and not 10c.p. How long do you want the light for? Let volts per lamp = 10, C = 1·25; then for seven lamps you have C = 8·75 ampères. Running for five hours, ampère-hours = 43·75. Charging at the rate of 8 ampères, you should charge (in theory) for 5·5 hours; but in practice allow at least 6·5 hours or, say, 7 hours, as efficiency of cells in ampère-hours may be taken roughly at 8 per cent. if fairly insulated. Number of cells, say, 6, allowing one spare one; E.M.F. = 12 volts; E.M.F. of dynamo, 10 per cent. × 12 + 12 =, say, 14 volts (it is just as well to have a margin to work on); H.P. = 14 × 8 ÷ 746 = 0·15 electrical. Allowing 40 per cent. efficiency for dynamo and belting, $0{\cdot}15 \times \frac{100}{40}$ = ·375H.P., say ½H.P. at outside. N.B.—You may use a dynamo of 15 or 16 volts if you like; but insert resistance into shunt or main circuit, so as not to exceed about 8 ampères. Cost depends on character of fittings, &c., and amount of wire required. Subjoined is a rough estimate:—

	£	s.	d.
Dynamo	7	0	0
Wire, at 10s. per lamp	3	10	0
Shades, &c., at 6s.	2	2	0
Switches, at 2s. 6d.	0	17	6
Accumulators, E.P.S. glass boxes, 7 S type, at 16s.	4	16	0
Glass covers, trays, insulators, &c. ...	0	13	3
Total	18	18	9

This is the lowest price at which you could do the job decently. If all the lamps are on at once, I should advise next size larger accumulator, discharge = 13 ampères, price £6. Further advice with pleasure.—ENGINEER, Govan.

[64988.]—**Fastening Velvet to Wood.**—Gum the wood, and when it is half-dry gently press the velvet upon it.—H. D. B.

[64988.]—**Fastening Velvet to Wood.**—I use shellac dissolved in methylated spirit, and do not find it injure the velvet in any way.—B.SC., Plymouth.

[64988.]—**Fastening Velvet to Wood.**—I think gold size, if laid on the wood, and the velvet applied when the size is tacky, would accomplish this. I have not tried it.—A. F. P.

[64988.]—**Fastening Velvet to Wood.**—Lay the velvet over cardboard, cut to size of box, turn edges over, and sew at the back. You can then glue to the wood; a separate piece for each side. If you want the velvet to show through the fretwork, lay a piece inside, and glue round the edges only, then the covered card.—Y.

[64988.]—**Fastening Velvet to Wood.**—To fasten velvet to the inside of workbox use French glue soaked 24 hours in water, then melted, and a small proportion of sugar added, or a little sugar added to a strong solution of gum-arabic. Coat the inside with either of the above, and, when set, place the velvet in the correct position.—J. W. M.

[64989.]—**Soapstone or Steatite.**—While in charge of a metallurgical establishment on the other side of the Atlantic I found myself short of firebrick to complete some rather extensive alterations to several furnaces. Steatite being obtainable in the neighbourhood, I turned my attention to it; but after pulverising the stuff, I was quite unable to agglomerate it into brick. If "Bola" can get hold of considerable masses of steatite, I advise him to do as I did under the circumstances, which was to cut rectangular pieces out of the natural mineral with a carpenter's old saw. I may say that pieces of about 2in. by 2in. by 3in. by [illegible] were the largest I could master. In a course of nearly ten years' experience in extensive metallurgical engineering, I have not met with steatite, brick, or any sold under that designation. A proportion of steatite might be mixed with the clay, perhaps.—METALLURGIST.

[64991.]—**Hardening Drills.**—Other means may be adopted for the purpose of hardening drills for drilling steel than by the use of mercury, and one of the following will be found less expensive:—Heat to cherry red and quench in one of the following: Repeatedly plunge into sealing-wax, beeswax, or yellow soap till cold, or drive repeatedly into lead till cold, and moisten the work when drilling with turpentine and camphor.—A. BIRD, Brandon.

[64991.] — **Hardening Drills.**—Probably the cast tool steel that you are working requires annealing. Drills hardened by being heated to a cherry red, and afterwards immersing immediately in salt and water, should be hard enough—too hard, without tempering, for the majority of work. But try the following:—Wheat flour, salt, and water (⅛ part of flour, 1 of salt, and two of water, all by measure); heat the drill enough to coat it with paste by immersing it in the composition; then heat to cherry red, and quench in cold, soft water. The drill, if rightly hardened, will come out with a white surface, and be exceedingly hard.—J. W. M.

[64993.]—**Shooting.**—If the querist means rifle shooting, he cannot do better than get H. P. Miller's "Queen's Hundred," published by T. G. Johnson, Fleet-street, price 1s. 6d.—C. E. K.

—**Fret-saw Attachment to Foot-** The change of motion from the circular ind-down motion of a fret-saw is often 1 eccentric fastened on the mandrel nose. est of the details, look up illustrated , such as Churchill's, and choose them irself.—B.SC., Plymouth.

—**Butter Blending.**—No chemicals yed in the blending of butter except loride, and when colour is needed solu- natto. To give querist the information bout creameries, &c., would take up too he space required for matters of general but if he will advertise his address, I him any information he requires.—MEDICINÆ.

—**Chemical.—Test for Mercury.**— iece of sheet copper. Rub the suspected rly on the clean surface of the copper, drop of pure vinegar, if necessary, to If the body contain mercury the copper ie whitened, like silver.—S. BOTTONE.

—**Chemical.**—Ammonia would prob- them black if calomel was present. If lve entirely in water, it is not present. the solution with hydrochloric acid. A cipitate turned black by ammonia indi- cury. There are other tests; but if res to send me two or three pills by post, l out if there is mercury in them for him asure.—R. A. R. BENNETT, Walton xford.

—**Chemical.**—One way of testing for s to mix the suspected substance with n carbonate, and heat it in a bulb-tube. present, a metallic mirror is formed in art of the tube. I would like to sug- A. B. S." that if he be ill it is best to medical man, and if he be well he need pills.—WM. JOHN GREY, F.C.S., Ana- emist, Newcaste-on-Tyne.

—**Chemical.**—If mercury is present in it is probably as "calomel." Dissolve re of your pills in hot water, and if the s not clear filter through white blotting aper) placed in a funnel. To the clear dd a few drops of a strong solution of alt. A white precipitate will probably be ercury. It may also be due to lead or ich are hardly likely to be present in a TALLURGIST.

NSWERED QUERIES.

bers and titles of queries which remain unan- five weeks are inserted in this list, and if still are repeated four weeks afterwards. We trust will look over the list, and send what information the benefit of their fellow contributors.

ce our last, V. I. A. has replied to 63838.
ing Lever, p. 541.
arers for Cutler's Wheels, 541.
t Graters, 541.
kwork for Eyepieces, 541.
l Boiler, 541.
oeing, 541.
c Etchings, 541.
lanché Bells for Lighting. To "Lyulph Lum- ey," 541.
g Paste, 541.
tomatic Gas Apparatus, 541.

hing Stones, p. 20.
cycles, 20.
vection Currents, 20.
noforte Repairing, 20.
t-Air Engine, 20.
rp, 20.
ht Feed Lubricator, 20.
y-hydrogen Microscope, 20.
ishing Artificial Eyes, 20.

ctrical laboratory is about to be con- n Vienna for the purpose of carrying out he public of the power and efficiency of the candle-power and economical working d incandescent lamps, electro-chemical ents, the calibration of measuring instru- ie working of primary and secondary &c. The fees to be paid for these various have been determined: for testing a he charge is from 30f. to 100f., according iensions of the machine; for an arc lamp 30f. to 40f.; for an incandescent lamp f., and for the calibration of measuring 6·25f. to 40f. This will be a benefit, as regards the lighting power of electric

r did you do for milk?" asked a lady, to the recent snow blockade in New Why, we took hot water, and looked at it ientific point of view," was the reply. er cent. milk, you know; that is to say, per cent. water, which is about the same

QUERIES.

[64998.]—**Ice Cream.**—Information required as to the method of making the above, and the plant required.—X. O. X.

[64999.]—**S.E.R. Engines.**—Will one of your readers let me have a sketch and the dimensions of one of the S.E. engines of the class of No. 211?—W. Y.

[65000.]—**Methylated Spirit.**—I want to disguise the smell of methylated spirit. How can this be best done?—T. C.

[65001.]—**Grinding Gauge Cocks.**—Will some reader say how this can be best done so as to be thoroughly tight?—WATCHMAN.

[65002.]—**Deodorising Fish Oil.**—Can some one explain how this is effected?—CAPTAIN.

[65003.]—**Rag Water.**—What is rag water? I have consulted various authorities, but cannot find the meaning of the term. Will any of our friends oblige me with information?—A. J. JOY.

[65004.]—**Poultry Hopper.**—Will any of your correspondents kindly give instructions for making a self-supplying hopper by which poultry may supply themselves with grain, without its being scatttered over the ground? AVIS.

[65005.]—**Bicycle Making.**—Could any reader tell me best way to fix the gunmetal flanges to the spindle for a front wheel to ordinary bicycle hub? Also how to fix horn handles to hollow handle bar?—C. A. G.

[65006.]—**Protecting Iron from Rust.**—In Vol. XLVI. p. 108, super-oxidised linoleine acid is recommended to protect the iron. I cannot find out anything about this acid. Can any one of "ours" tell me how to make?—SARDEGNA.

[65007.]—**Isochromatic Dry-Plates.**—I have seen it stated that soaking dry plates in a solution of the silver salt of certain dyes of the eosin type in dilute ammonia or acetic acid renders them isochromatic and doubles their sensitiveness. Can anyone oblige with details of the process?—H. C. MILMAN.

[65008.]—**Kiln.**—Not having a reply to my query re Gas-Heated Kiln for Firing China Paintings, I presume it is unattainable. Will some one kindly give instructions for a kiln heated by coke or charcoal suitable for amateur use, which would take, say, ½ doz. cups and saucers, or a terra-cotta bust about 12in. high? Also a few hints regarding the working of it.—F. B. S.

[65009.]—**Porcelain.**—Will any reader give me some of the formulæ of powders used in making above? I want to make very small pieces of porcelain, which will be fused in platinum moulds, and only one surface showing? I shall want to colour it, and it must not be porous, as I may want to grind and repolish it.—DUFFER.

[65010.]—**Eccentrics on Crank Shaft.**—Can you tell me the best and quickest way to set eccentrics on crank shaft for compound engines with reversing gear, and the best way to set the slide-valves, allowing for expansion of boiler, and the best way to take tubes out of boiler without injuring the ends, as we must take them out every year?—W. S., Magdeburg.

[65011.]—**Lathe Fitting.**—Will any reader tell me how to fit a bridge to gap, one to bolt down, not screw on top of shears? Are there any pins to prevent it moving if not fastened tight? Also how to measure screw threads. Do as many as will come in 1in. count, or must a cut be counted at end? If thread is 3-16in. and cut 3-16in., will three be 1in. or 1⅛in., and how is pitch line measured?—HARRIS.

[65012.]—**Battery for Motor for Sewing Machine.**—TO MR. BOTTONE.—Would you kindly inform me what would be the best form of battery to drive a small motor for a sewing machine? Would the elements of cells be required to be lifted out of solution when not in use? Which is the best battery with regard to smelling? The motor I propose using is a 70c.p. dynamo from Jones' castings.—P. E. GATES.

[65013.]—**Marine Boiler.**—I am running a steam yacht, the boiler of which is of the vertical type with one cross tube. The engine is fitted with a condensing arrangement, cooled by the motion of the boat through the water; but there is not nearly enough natural draught in funnel to get more than four knots an hour with condenser. I have been using the sea water for feed, and exhausting up funnel. By this means we can get our full speed out of boat—i.e., eleven knots. Can any of your readers inform me if it is much injurious to the boiler to use salt water? How can I dissolve the salt deposited? Engine is high-pressure working at 150lb. Boiler is of steel.—SALT WATER.

[65014.]—**Wire Ropeways.**—Can any reader furnish a simple method for ascertaining the strains exerted upon angularly suspended ropes along which loads have to be hauled—e.g. assume a rope is fixed at 45°, 1,000ft. between supports and the loads to be hauled along same equal one ton? Then what is the simplest method of ascertaining the strains exerted upon the fixed guide rope?—A. J. S.

[65015.]—**Concrete Floors.**—By what theory is it that concrete beams or slabs are made thinner in the centre than at the ends. In a floor shewn in the "E. M." a week or so ago, the underside formed a shallow dome. Would not the floor have been much stronger if the same amount of concrete had been formed into a slab of equal thickness all over, and the centring cheaper?—TEE SQUARE.

[65016.]—**Gramme Dynamo.**—Will some practical reader kindly answer the following? What power will it take to drive a 125c.p. Gramme dynamo, and what would be the best motive power? I have no gas or water, and will adopt anything recommended. Would a hot-air engine be most economical, steam or petroleum? I could manage the firing of either. Also please give me particulars as to sizes of boiler or displacer, as I can make either.—A. J. POOL.

[65017.]—**Incubator.**—I am constructing an incubator according to the design which appeared in the "E. M." of 17 Feb. last, and I shall be glad if any of our readers who may have one in use, would inform me the best method to adopt to bring up the hatch after they have left the incubator. This seems a problem to me which I am unable to solve, and I am informed there is a loss of 50 per cent., and I am anxious to avoid this if possible.—E. GRIFFIN.

[65018.]—**Calcium and Ammonium.**—Will Mr. J. A. Wilson or other readers who have worked up for Hon. Prac. Chem. Exam., Science and Art Depart., kindly inform me of a simple and accurate method of determining the above? Also how many gases and acids are there, as a rule, in the mixtures for qualitative analysis at the same exam.?—NO TUTOR.

[65019.]—**Gas-Engine.**—TO "T. C., BRISTOL."—I have lately got out drawings for a gas-engine with a cylinder 2¼in. by 4in.; but I am told by some people that it will not work when made. I should, therefore, be extremely obliged if you would give your opinion on this, and say if it would work. Also could some one oblige me with a sketch, and dimensions of a governor for a gas-engine with a cylinder, 4in. by 7in.?—W. O. S.

[65020.]—**Adjusting Eyepiece.**—Will "F.R.A.S." or any optical correspondent kindly give me instructions how to get a telescope eyepiece and achromatic object glass (both made by an optician) in perfect adjustment with each other in a home-made tube? I want to know how to mount them optically correct—not the mechanical part: I can do that.—AMATEUR.

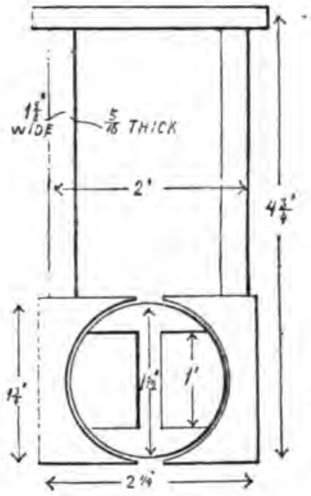
[65021.]—**Precipitated Iron in Metallic Grains.**—I find it very difficult to get iron filings quite free from film of oxide, and to file down iron merely for this purpose is very tedious and laborious. I fancy there may be some way known to our chemical friends of getting at the same result by dissolving iron in acid, &c., and then precipitating the iron in the form of metallic particles or fine grains, on same lines as silver bronze, copper bronze, &c., are made. I have tried several solutions of iron, but cannot get the precipitate in a regular condition. If any party replies to this, would he kindly use plain language, as I cannot read chemical formulæ?—MACK.

[65022.]—**Electro-Deposition of Iron or Aciertype.**—I have looked carefully through the last twelve volumes of "Ours" for some account of above, and failed to find any information, so will feel greatly obliged to any party who will kindly give the particulars of making and working solution, battery power, and general management necessary for copying in reguline iron an engraved disc, 1½in. across face, and I would like, if possible, to have the deposited iron surface about the thickness of a penny piece. I got Watt's book on "Electro-Metallurgy" for this special job; but was disappointed to find nothing there of any practical use as regards electro-deposition of iron, so am forced to fall back on the assistance of our contributors.—MACK.

[65023.]—**Dew Point.**—I have only Glaisher's factors up to 100 Fahr., as given in Parkes' "Hygiene," p. 441; do his hygrometric tables carry them on for higher temperatures. If not, how can I calculate the dew point, say, up to 120° shade temperature? I suppose Apjohn's formula would do. Please recommend a table of vapour tensions.—SHAEK UL JABEo.

[65024.]—**Induction Coil.**—Some years ago I commenced to make a vertical coil. The core a bundle of soft iron wires 1in. diam. The reel is 4in. diam., and 6in. long between the flanges. I put on for the primary coil four layers of No. 16 c.c. copper wire, and gave it a good coating of shellac varnish, and when dry covered it with a mixture of rosin and beeswax, so as to get a smooth surface to commence winding on the secondary wire. I think now of completing it, and should be glad if some of our practical readers will kindly say if I am likely to get good results, or have I too much primary on? I purpose putting on about 1lb. of 38 s.c. secondary, and shall bring out about four intermediate powers, and use a water regulator. The contact breaker I should fix on the top end.—LANCASHIRE AMATEUR.

[65025.]—**Model Dynamo.**—TO MR. BOTTONE.—I have castings of a small dynamo as sketch with measures. Will you kindly inform the sizes and amounts of the wire to be used on armatura and fields to obtain best results?



Does it matter what size the commutator is? I have your book on "The Dynamo," and I suppose I should have to connect it up as there shown. What c.p. may I expect from it? The armatures are 2⅜in. Poles 2⅜in. long.—L. E. E.

[65026.]—**Nickel-Plating.**—Will the writer of present articles kindly help me with my plating? Some time ago I bought from a London firm about 1gal. of nickel solution. I managed to plate very successfully for some time; but now I cannot get the solutions to work. Articles are coated, but often black, and I cannot get it to adhere correctly. Can anything have evaporated? Should solution be acid or alkaline? I want to be able to plate small things without fear of it peeling off afterwards.—A WOULD-BE PLATER.

[65027.]—**Perspective.**—There is a difficulty in the principles of perspective which I am unable to understand and would wish to have explained. Suppose the houses on one side of a street are built all of the same height, or, architectually speaking, that a continuous "blocking course" runs along the whole side of the street, how then is the "skyline" or uppermost visible line to be represented in perspective as seen by a person standing on the opposite side of the street, and what is the analytic equation to its form? In a geometrical drawing the skyline would, of course, be represented as a straight line, but in a perspective drawing it seems to me that that cannot be so, inasmuch as the line is to be drawn downwards both towards the right and left from the point of observation, and, therefore, must be bent or curved in form.—ART STUDENT.

[65028.]—**Microscopic Lithology.**—1. How to use the Calderon prism. 2. Where is it placed? 3. What class of objects is it used with? 4. In what respect does the Klein quartz plate differ from selenite plate? 5. The best colour for selenite plate. 6. The proper position for quartz and selenite. Also ¼ undulation plate. 7. Is the Calderon plate used with convergent light? 8. What powers best to use. 9. How to polish Iceland spar. 10. The best locality to get selenite that will clean in suitable size pieces.—W. H. B.

[65029.]—**Brightening Brass, &c.** — I have a steam launch which is only used at distant intervals. The whole of the boiler and engine fittings are brass or copper. Can any reader inform me of a way or composition to clean and brighten up the brass immediately? It takes me now five or six hours to clean up to look anything decent. All the brass, &c., going quite black after having been left a few weeks.—A. A.

[65030.]—**Fistula on the Gum.**—I should like to know what a fistula on the gum is, and what it is likely to develop into. Also whether there is any treatment for it without having the tooth taken out? I have heard of a person having it whose nerves are not in a state to permit extraction of the tooth, and I should be very glad to have a reply to the two points mentioned above.—BRAG.

[Such queries had really be better addressed to Dr. Allinson in the *Weekly Times and Echo.*—ED.]

[65031.]—**Paralysis.**—Have been recommended to try galvanism to alleviate this affliction. The left arm and leg are the parts chiefly affected, the brain slightly. Have a primary coil with 14 middle-sized Leclanché cells. Will some kind friend advise the best method to go to work?—REX.

[65032.]—**Tandem or Sociable Tricycles.**—An ignoramus regarding these machines would like to know, before purchasing, the best one to get for the use of young lady and gentleman in a rather hilly country (W.R. Yorkshire), but good roads. Height of lady, 5ft. 4in.; weight, 116lb.; height of gentleman, 5ft. 6in.; weight, 130lb. I should be glad if practical riders would advise me—with their reasons—as to what is best under these circumstances for ordinary travel and exercise—not for racing.—INTENDING CYCLIST.

[65033.]—**Hair Dye.**—I am using the juice of the walnut expressed from the rind of the fruit and preserved in methylated spirits for the purpose of keeping my hair a natural brown colour. It works well, and is harmless. Can anyone tell me how to set the colour in any way without injury to the hair, as the stain is not as permanent as I could wish?—VIRGO DOLOROSA.

[65034.]—**Incubator.**—1. Of what material is the tank of incubator, described a few numbers back, made? Would tin do? 2. Is it possible for water to remain hot for a whole day without adding hot water, as mentioned in the article on the incubator? 3. What is the meaning of a burnisher having a "roll of 6¼in." like Tylar's?—TERRANOVA.

[65035.]—**Rifling and Rifle.**—1. Has the improved method of rifling by Mr. W. Murphy, which consisted of the barrel being bored out smooth to within about 4in. at the muzzle, been adopted, and are any rifles constructed of that pattern, as, according to "E. M.," May 23, 1873, p. 240, it did away with a great proportion of recoil? Capt. O'Hea spoke highly of it, having fired several thousand rounds without the bullets stripping. 2. Has the German repeating rifle been described in these pages?—J. W. M.

[65036.]—**Force and Energy.**—In "The Story of Creation," Mr. Clodd, after referring to the want of precision as to these words, defines force as producing motion which binds matter together and resists the separation of it, and energy as producing motion which separates matter and resists the binding together of it, or of the etherial medium. Hardly satisfactory, I think. What do other readers of the "E. M." think about these definitions?—J. S. C.

[65037.]—**Model Dynamo.**—TO MR. BOTTONE.—1. Is there such a thing in the market as a model dynamo to light small incandescent lamps of about 4 volts which you could work with a model steam-engine? 2. How can I make chloride of silver battery and constant bichromate? 3. What is the length, breadth, height, weight, &c., of the smallest dynamo?—which pattern is the best? Sketch would oblige.—DYNAMO.

[65038.]—**Varnish for Motors and Dynamos.**—Can you kindly inform me of a varnish for finishing off motors and dynamos that will not change or darken the shade of colour and that will remain hard? I have tried pale carriage and hard varnish; but to no effect.—C. CORBETT.

[65039.]—**Recovering Tin and Zinc.**—I shall be glad to be informed what would recover tin and zinc. I have striped some tin and it has duly precipitated, but cannot recover the metal. Subjected to good heat, but it fails to satisfy me.—READER.

[65040.]—**Steam-Engine.** — How much water is evaporated in 12 hours by a marine engine indicating 9H.P. and running 200 revs. per minute? Boiler pressure 130. Steam is expanded by Bremme's pat. single eccentric reversing gear and cut off as early as possible?—L. TERRY.

[65041.]—**Persian Mystic Jewels.**—Can any correspondent give the traditions and supposed virtues of the square of nine jewels or precious stones worn in Persia and India? I have one of these brought from Ceylon and should like to know the "folk lore" concerning it.—998.

[65042.]—**Cold Bluing.**—I have a recipe for cold bluing as follows:—3oz. butter of antimony; 3oz. bromic acid; 1½oz. indigo blue, and ½oz. prussiate of potash. What is it used for and how?—J. W. M.

[65043.]—**Enamelling.**—Will any reader kindly tell me the formulæ for an easily fused non-porous enamel with the colouring matter for grey and yellow?—POROUS.

[65044.]—**Muffle Furnace.**—Will some kind reader tell me what muffle furnaces are made of and how baked and burned? I want to make one for gas about 8in. square with a platinum muffle.—FIRECLAY.

[65045.]—**Left-Hand Threads for Clocks and Watches.**—How is a left-hand thread made for clocks or watches?—J. R. ELWELL.

[65046.]—**Iron Roof.**—What can be done to prevent moisture dropping from inside of roof? It is curved. Floor concreted as it is for a showroom. It is very objectionable. Shall be pleased to hear from some one who has stopped it.—CONSTANT SUBSCRIBER.

[65047.]—**Armature Velocity.**—Would Mr. Bottone kindly explain how to determine the speed of armature of any given dynamo? For instance, suppose I had a dynamo with ring armature, the fields wound with No. 16 s. wire, the armature with No. 22 s., how am I to ascertain what speed to drive it at to get the best results, and would it make any difference for the speed if I was to substitute a Siemens H armature for the ring?—J. G.

[65048.]—**The Jensen Electric Bell.**—TO "F.C.A." OR OTHERS.—Would you describe the method of winding the coil for above? I believe there is a special mode. I have made one, but cannot get the hammer to strike with sufficient force. I wound with 12 layers of No. 26 s.c. wire (core is ½in. by 1¼in.); but the armature is not attracted to the magnet sufficiently. It only just leaves the contact spring.—A. H. S.

[65049.]—**Dry Battery.**—Will Mr. Bottone kindly describe the best form of dry battery which is not a patent, with the time it will last in constant use? Will dry battery give equal current and E.M.F. with chloride of silver form?—H. H.

[65050.]—**Violin Bow.**—Can any reader tell me how to make a violin bow? Should it be made straight and bent afterwards, or should it be cut to the proper shape? What are the best sorts of wood?—ROSIN.

[65051.]—**Varnish.**—What can I put in oil varnish to give it a rich rosewood colour and still leave it transparent?—V. S.

[65052.]—**Electric Bell.**—Will Mr. F. C. Allsop kindly give details for the electric bell of which he gave two diagrams on March 30, 1888 (reply 64805)?—J. D.

[65053.]—**Sealing over Battery Tops.**—How do you seal over the tops of Leclanché outer cells? Is pitch the best thing to do it with? I seal my porous pots with it. Ought not I to mix it with some thing else?—METEOR.

[65054.]—**Shafting.**—Can any reader tell me of some application which will keep shafting from rust where it is a good deal exposed to steam? Paint would do, but then it is so hard to shift pullies on a painted shaft.—DOCTOR MEDICINA.

[65055.]—**American Wire Gauge.**—What is No. 18 in this gauge in B.W.G. and S.W.G.? It is mentioned in the article in No. 1,202 on a "Simple Electro-Motor."—METEOR.

[65056.]—**Box Tunnel.**—I have been told that at certain times in the year the sun shines through Box Tunnel. Is that possible?—E. MASHITER.

[65057.]—**Chatterton's Compounds.**—Will any reader give me the composition of Chatterton's compounds, used for electrical purposes? Also the proportions of the ingredients.—A. B.

[65058.]—**Blowpipe Solder.**—Will any of our readers oblige by giving the best method of making blowpipe solder for ordinary gas-fittings?—MECHANIC.

[65059.]—**Black Thick Dye for Leather.**—Will some kind friend inform me how to make a cheap black thick dye for leather?—W. C.

[65060.]—**Pewterers' Repairs.**—Can any reader enlighten me on the repairing of pewter, such as pewter troughs and measures? I find the soldering bit makes a patchy job of it, it being too hot or too cold.—CONSTANT READER.

[65061.]—**Medical Indicators.** — Will any kind reader inform me how to make the indicator used in medical or street coils.—FRED.

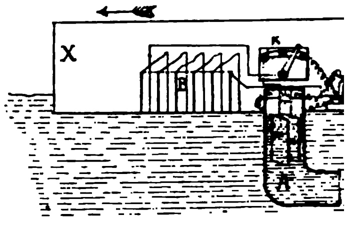
[65062.]—**Great Western Railway.**—Will some one kindly state details of No. 7, compound engine, giving size of cylinders, and saying if on Worsdell's system or what?—W. B. P.

[65063.]—**Vertical Sundials.**—In the "E. M." of March 9th, instructions are given for making a horizontal sundial. Cannot you give us also directions for making a vertical one for a wall facing (a) due south (b) nearly south?—JOHN E. GREAVES.

[65064.]—**Bunsen Batteries.** — Can any of our readers tell me why the current falls off so in my Bunsen batteries? After they have been at work a short time it becomes very feeble and the zinc turns black? Can I do anything to remedy it? Also I want to light up a room with electric light. What c.p. lamp would be sufficient for a room 15ft. square? Can it be worked well from 14 1½-pint Bunsens?—STEAM.

[65065.]—**Fan for House Fire.**—I have just been shown a small fan to be worked by hand, for use in the house instead of bellows (Clarke patentee). This has a small wheel about 1in. diam., fixed on fan spindle. Another friction wheel, about 6in. diam. (in which is the handle), rotates on a stud attached to fan casing. The peripheries of the wheels are held in co of a spiral spring. Can anyone tell me i this kind is still made and describe it?—FA

[65066.]—**Une Idee.**—Messieurs les é donnent ses conseils et ses opinions aux lecteurs de l' "E. M.," sont si obligeant et réponse, que, moi aussi, je serais charmé si m été sujete à la critique de M. S. Botto amateurs of "Ours." Il s'agit de la propul par l'électricité (La scheme ci-contre). S



par le trou de fond d'un canot X Y on fa tuyeau A en forme de la lettre L, de manière supérieure soit ajustée dans le fond et f couvercle, tandis que le reste de tuyeau étant dessous de fond, soit plongé dans l'eau. Le fait, supposons, en verre. Dans son interi renferme deux fer[illegible] de platine *m n* so circuits, qui après avoir passé par le c joindre l'un à la batterie B (les piles élect accumulateurs), l'autre—au commutateur K. circuits, *m'* et *n'*, sortent aussi de l'intérieur ils ont formé sous le couvercle deux points faire passage à une étincelle électrique. C circuits se combine respectivement avec Ruhmkorff R et le même commutateur K. ce dernier on peut mettra alternativeme munication soit la batterie avec les feuilles décomposer l'eau, soit avec la bobine faisan étincelle entre les pointes *m' n'* pour prod de la mixture de gaz H et O, provenant de tion de l'eau. Cette explosion, chassant l'eau hors de tuyeau A, effectuera, par s avancement du canot dans le sens oppos reprendra immédiatement sa place dans l vertue des vide qu'il s'y forme après l'expl faisant à des intervales convenable, change levier du commutateur, nous produirons un plosions faisant avancer notre canot. Il fa partie supérieur de tuyeau ait conservé un pe adoucir les chocs, qui, sans cela étant tr n'auraient pas suffisamment de temps pour sa force au profit de la propulsion. L'idée v peine pour lui sacrifier le temps et les fra CRABSKI, Russie, Mars, 1888.

[65067.]—**Electro-Deposition of C** Vol. XXXV. p. 411 (query No. 47321), " states that he got a brilliant black depo which adhered firmly to zinc, then raised he could be certain that it was pure carbo ends by saying that none of the acids w This is proof enough to my mind. If he sees be obliged if he would give particulars of t this "brilliant black deposit." If not, perha party would kindly say if it was possible bon, and how it is done. I think this is o importance, as by depositing carbon in su with iron a superior steel might be made plates, &c.—MACK.

[65068.]—**Electric Bell.**—Thanks to Maycock and "A.S.T.E." for their inform subject; but they don't seem to compreh What I want to know is this—Some of th are 18 miles in length. Again, I have some (S.N.) that I should like to know how t earth, and how should I know which end t earth was bad. The relays are ordinary i If I fill the cells half-full of solution and the would they work if I should fill them to the tion.—NERO.

[65069.]—**Atmospheric Pressure.** reader of the "E.M." be able to speak with on the following query:—If an ordinary co such as we see in the plumber's windows, 4 or 5ft. in diameter instead of a few inche air-pump, be entirely exhausted and herme as tight as a bladder, would its shape be very least? I only wish to know if anyone it.—JOHN HAMPDEN.

[65070.]—**Income-tax.**—If Income-tax upon nett income, why should the owner o he is also the occupier be compelled to pay A when he is exempted under schedule makes no profit? Is not the term Income-t applied in this case, and should it not be t tax, and if the possession of land entails should the possession of cattle, furniture, w &c., be exempt?—DOCTOR MEDICINÆ.

[65071.]—**To S. Bottone.**—I have m chromate cell on which I should be glad o In the outer cell I have a carbon rod and fil with nut carbon. In the porous cell I ha sheet zinc, 6in. by 18in. This is filling th only use the porous cell to keep the zin with the carbon, and to hold the mercury f tion of zinc. I have made holes in the por crease the internal resistance. I shou sheet zinc is rolled to the size of the poro improve on this?—J. J. RATHBONE.

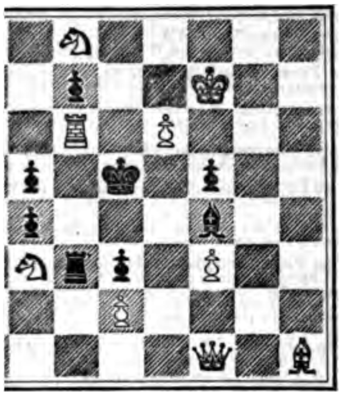
The Panama Canal.—The *P Herald* says:—"On the 22nd Feb. the the Panama Canal through the Mi miles from Colon, was accomplished. now a continuous waterway open fro Colon to a point near Bojio station, on railroad, about fifteen miles."

CHESS.

mmunications for this department must be o J. PIERCE, Langley House, Dorking.

PROBLEM MXCII.

Black.



White. [9 + 8

Vhite to play and mate in two moves.

SOLUTION TO 1,090.

ite.	*Black.*
6.	1. K takes B (*a*).
kes K P (ch).	2. R takes Q.
4 disc. mate.	
	(*a*) 1. Q takes P (*b*).
kes Kt P (ch) &c.	
	(*b*) 1. K-B 4 (*c*).
5 (ch), &c.	
	(*c*) 1. K-B 5.
6 (ch), &c.	

olem has two other solutions. 1. R-Q sq (ch) and 1. Q-Q B 3.

NOTICES TO CORRESPONDENTS.

solutions to 1,090 by G. W. Middleton (3), J. Wheeler, J. Bryden, A. Dean (2), Sorrel, Black astlerock, Link, R. G. Briscoe, J. Palmer, and ; to 1,089 by G. W. Middleton, H. W. Barnett, oe, H. C. Haycraft, Atol, J. Moulder, W. Jay, Hensing, and Sorrel.

ING 1,089 Hensing writes:—"The only way in is a possible position is through the Q-Kt P ne to the 8th square and become promoted. ite Pawns and two pieces have been captured. Rook Pawns have both been taken by pieces. Q-Kt P has taken a piece; another piece has by a P, and the remaining 3 W P's have been B P's. The problem is a good one, and has e an extremely interesting study."

JAY has kindly offered an additional prize—e s work—to the competitor making the best has never won a Solution Tourney Prize.

LINDFIELD AND SORREL.—If 1. $\frac{}{\text{Kt-K B sq}}$ 8 becoming a Kt mate.

ELER.—Your name is entered.

AWN and G. W. MIDDLETON.—It will suffice second moves only of three-move problems, ond solutions the first move will be enough.

ES.—Thanks for inclosure.

O.—We have often explained before that a dual n after the first move in any variation White more than one way in answer to Black's de-

BEE.—A variation consists in those defences Black which require distinct answers on the Vhite. In 1,088 there are only three mating , therefore, only three variations.

ACKBURNE is arranging for publication a f his blindfold games.

ANDOLPH CHURCHILL has consented to become president of the Liverpool Central Chess Society.

6th March a match was played between Edin- Dundee at Edinburgh, when Dundee won by o 10.

dford and Manningham Football Clubs will play es on behalf of the International Chess Con- the local charities.

rday, March 24, Mr. Jas. Rayner, of Leeds, e members of the Rawdon Club simultaneously, games, drawing 1, and losing 1.

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otal number of the staff of the London and estern Railway is 55,217. The total is 2,548 miles; the number of engines, rriages, 4,548; goods and coal waggons, The train mileage during the year ended h, 1887, was—passenger, 19,533,957 miles; d mineral, 18,158,107—a total of 37,692,064 In other words, the engines ran nearly a three-quarters every second, or 104 miles inute, and in miles run they equalled a und the earth every four hours. During the number of passengers was 56,465,260, number of tons of goods and minerals as 33,937,758. The revenue derived from s was—from passenger traffic, £4,185,818; affic, £5,974,319; or a total of £10,160,187.

ANSWERS TO CORRESPONDENTS.

⁂ *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

⁂ Attention is especially drawn to Hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, April 11, and unacknowledged elsewhere:—

T. CLARKE.—J. Reside.—W. A. McClintock.—J. T. Gent and Co.—A. S. Williams.—A. S. Jones.—J. A. P.—E. L. —Chump.—C. A. B.—F. T. B.—J. H. Burton.—W. P. Maycock.—Vindex.—B. and G.—Ithel Wyn.—An Amateur Electrician.—Vacuum.—David Booth.—Ignotus.— X. Y. Z.—A. Marson.—Alban.—Cloudy.—W. Hamilton. —J. B.

GEORGE GREEN. (We have read your letter on "The Violin and Colour," and have endeavoured to understand it. We are prepared to agree with you that the tone of the belly of a violin should be C flat (whatever that may be), and the tone of the back C sharp, because we know that such a difference has given good results in practice; but we are utterly unable to comprehend what you mean when you say that "heat consists of two things, light and ozone—oxygen of heat and ozone.")— P. S. (About the best filter that anyone can have is the late Prof. Guthrie's "Penny Water Cleaner." It costs more than a penny, but he gave it that name. It consists of a large flower-pot (say, 10in.) with the hole broken out larger, and blocked by a piece of well-burnt stock-brick. The remainder of the pot is to be filled with pieces of similar brick, about the size of filberts, and the filter is complete and very simple. Prof. Guthrie was a chemist, and knew what he was talking about. He never recommended the filter made up of sponge, sand, and charcoal.)—INQUIRER. (Why not read up a textbook of chemistry? Will this make it plain? You can mix hydrogen and oxygen together and keep them as a "mechanical mixture"; but if you apply a light they combine with an explosion and produce water, and surely that is a "new substance" and a chemical combination. It is possible also to mix charcoal, sulphur, and nitrate of potash in a "mechanical mixture"; but on applying heat it becomes converted into a definite "chemical combination." What is it you are driving at?)—SNOWDROP. (The "professional pianist" performs as he pleases. He has his living to get, and no doubt tries to please those who pay him. Running the thumbnail up the keyboard is not a practice that would be adopted by—well, say, Madame Schumann; but perhaps it suits the purpose of your "professional pianist.") —VOALAVO. (Cats and traps being barred, the alternative is poison; but there is one remedy you can try —stop all holes with broken glass and cement, and smear coal tar about any part that cannot be stopped.)—TAR-DISTILLER. (Better keep the sugar out of your steam-boiler. Where do you find any recommendation to put sugar in the boiler? Filter the water and keep the sugar out of the boiler.)—MINOR. (All the training you need is summed up in the expression "the ability to think." Cultivate the art of thinking, turn your thoughts about, and examine them from all sides, and you will have the foundation you require. For the rest, there is a "Colliery Manager's Handbook," which any bookseller can procure, and which will give you a better idea than we can.)—CAMERA-MAKING. (See index of last volume.)—ALPHA. (Dulcimers have been described in back volumes. Not more than one reader in a million cares anything about them, and we begrudge the space.)—A READER. (No; perhaps not in only three years' numbers, because the matter is so very simple, and we really cannot repeat; but you will get an idea by consulting Nos. 402, 405, 459, 582, 801, 967, 973, 974.) —JOHN JONES. (Neither do we, if you made one, as you say, of tin. The usual thing is a piece of zinc in a saturated solution of acetate of lead.)—J. S. (By barem you no doubt mean barm, or yeast. You cannot "make" it, unless you are a creator of vegetable life; but possessed of a small quantity of yeast you can increase and multiply the plant indefinitely. From floating germs in the air, fermentations are often set up, and people imagine they have made yeast. You can no more make it than you can fly. Take a supply of the so-called German yeast with you.)—J. C. (See many references in indices to back numbers. Presumably by "chemist" you mean a druggist, and as likely as not he knows nothing about it. Anyhow, the solution has been often given.)—C. S. (Which "small motor" do you mean? We had a fully descriptive series of articles a short time ago, which have since been published in volume form by Iliffe and Co., Fleet-street, E.C., and in almost any recent back volume you can find details about the winding of electro-motors. We cannot engrave every possible form of electro-motor so that querists can obtain information which has been given over and over again.)—CHAS. LYNEHAM. (A mechanical telephone surely for the house; but why not use speaking tubes, which are much better? However, you will see that full details about telephones are continually being given. The only one that can be used without infringing patent rights is the English Mechanic telephone, described in Vol. XXIII., p. 551.)—TRAMLER. (Certainly, for a few minutes at a time.)—NOVICE. (Procure a catalogue of books from Messrs. Lockwood and Son, Stationers' Hall-court, E.C., or refer to indices of back volumes for measuring timber, &c.)—F. INGOLDLEY. (Yes, at any given moment the top part of a wheel of a cart in motion moves faster than the bottom part. See any work on the Geometry of Cycloids. The question has recently attracted some attention in the Notes and Queries Column of the *Echo*. See Hints No. 5 above.)—A. C. F. (What sort of portraits? If you mean photographs, see p. 597, Vol. XLV., and the indices of back volumes.)—COL. KNIPE. (The American and B.W. gauges are much alike, but few of the numbers correspond exactly. For instance, No. 0000 is ·46 in American, and ·454 in Birmingham; 20 is ·0319 and ·035; 36, ·005 in A., while in B. it is ·004, No. 35 in B corresponding exactly with No. 36 in the American gauge.)—AMATEUR. (Why not look up the indices of back volumes. There was a good deal about windmills a year or two ago; but we do not think you will find them suitable for driving a lathe.)—CHAS. A. MAW. (Why give us trouble to decipher your signature—that is, if we have deciphered it? Copies of specifications of patents can be obtained at the Sale Office, Cursitor-street, Chancery-lane. The price varies. You can see any specification in the Library of the Patent Office, Southampton-buildings, and taking a note of number, year, and price can readily obtain a copy.)—R. C. H. (A pronouncing biographical dictionary would supply the information.)—MILL. (Nothing in the recipe from the American paper. It has been given several times in back volumes.)—MINERAL. (Merely aërated waters with essences added. Here is a recipe for the ginger ale: Plain syrup at 42° Twad. 1 gallon, compound tincture of ginger 4fl oz., acetic acid 4fl.oz., sugar colouring ½fl.oz. About 1oz. or 1½oz. of this mixture is put in each bottle, which is then filled up with aërated water. Why not procure Barnett and Foster's catalogue, Niagara Works, 25U, Eagle-wharf-road, New North-road, London, N.)—MECHANIC. (Similar query answered not long ago. Put in larger pins—to be obtained of Hughes, Drury-lane, or Goddard, Tottenham-court-road. 2. See indices about the flute. It is a matter of taste, and professionals don't agree.)— H. G. B. (It is worked by the pressure of the air. For references to illustrations of such fountains see answer to A READER above.)—HOUSEHOLDER. (See replies in recent numbers (p. 85, for instance), and put an escape-pipe in. Why not employ a competent hot-water engineer? Or consult the articles on Plumbing given about ten volumes back, where several methods are illustrated.)—WATSON. (A patent agent can tell you what patents are still in force in connection with high-pressure hot-water pipes, or you could find out by searching at the Patent Office Library. Is there any patent, by the way?)—OBLIGE J. B. (Liquid blacking without polishing: Dissolve 2lb. of shellac in a gallon of methylated spirit; add 6oz. of camphor, 4oz. lamp-black, and 2oz. of Prussian blue finely powdered. Stir at each addition, and strain and bottle.)—SIMPLE ELECTRO-MOTOR. (Possible, yes; but why? See indices for references to all sorts of dynamos.)—P. S. (You can find a variety of batteries in back numbers. 2. For crystals see any textbook.)—ONTARIO. (Nothing that would pay to take out. They will show him how to clear the land there.)—ACCUMULATOR. (See indices, if it is not described in the book referred to.)—G. F. (Try the ointment of galls, or refer to indices for several remedies.)—JOHN HADDEN. (See p. 184 last volume, and indices of back volumes.)—J. H. W. (E.M.F. means electromotive force.)—E. C. M. (We cannot see any difference; for steam presses equally. 2. We think there are many more simple "automatic feeds" illustrated in back volumes.)—GONGS. (Certainly not for sound.)—J. RENSHAW. (We are not able to "instruct" in such a matter, because we do not know. Besides, such a question is against the rules. See Hints No. 4.)—NEW SUB. (How would the incubator illustrated in the number for Feb. 17 last suit?) —J. WILSON. (The "dead" oils, as they are called—about 1½d. to 3d. a gallon, according to whether they are filtered or not.)—S. H. (Where do you find the name or expression, or whatever it is?)—COTTONOPOLIS. (Have not pocket batteries been described frequently?) W. H. W. (The difference is not material. See answer to Col. Knipe above, and Hints No. 4.)—SUBSCRIBER. (It can be had direct from the office, and "New York" is sufficient address; but we believe you must subscribe for a whole year.)—MOTOR. (What "opinions" do you want?)—FINSBURY. (Why did you not repeat the query? Then we could have answered you.)—J. M. WELLWOOD. (Such questions must be asked privately of Mr. Bottone. A letter addressed Carshalton, Surrey, will find him—see his advertisement in the "Sale" Column.)—IGNORANT. (Your Vernier is quite unintelligible. Each division on the limb = 20′, and 20 divisions on the Vernier corresponding to 39 of these, the first pair of lines must separate by $\frac{1}{1\frac{19}{20}}$ of a primary 20′ division; the second $\frac{2}{1\frac{19}{20}}$, and so on Such a reading would be utterly valueless in practice.)

Harness' Electropathic Belt should be worn by everybody. It is guaranteed to generate a mild continuous current of electricity which will restore health, strength, and energy to the whole body, and promptly cure rheumatism, sciatica, nervous debility, liver and kidney diseases, ladies' ailments, sleeplessness, &c. Illustrated pamphlet, post free, containing copies of thousands of testimonials from royalty, physicians, clergymen, and all classes of society. Advice free, personally or by letter. Send for private advice form. Full particulars of Harness's World-famed Electropathic Belt will be sent (post free) on application to Mr. C. B. Harness, Consulting Electrician, The Medical Battery Company, Limited, 52, Oxford-street, London, W. (corner of Rathbone-place).

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Subscribers receiving their copies direct from the office are requested to observe that the last number of the term for which their subscription is paid will be forwarded to them in a PINK Wrapper, as an intimation that a fresh remittance is necessary, if it is desired to continue the Subscription.

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Holloway's Pills purify the blood, remove all obstacles to its free circulation through the lungs, relieve the engorged air tubes, and render respiration free, without reducing the strength, irritating the nerves, or depressing the spirits: such are the ready means of escaping from suffering when afflicted with colds, coughs, bronchitis, and other chest complaints.

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Tricycle, front steerer, ball bearings and pedals, nearly new. Exchange, value £8, Photo. Apparatus, Bench Drill, or offers.—53, Duncombe-road, Hornsey-rise, London.

Wanted, good back-geared **Lathe**, gap bed. Exchange DISSOLVING LANTERNS, Jewellery, Bicycle, Tricycle, or part cash, part exchange.—MECHANIC, 47, Fernhead-road, Westbourne Park.

Steam Gauge, 2½in., 300lb. pressure, new safety valve, and water guages; ¼ Photo. Apparatus, Youth's Tricycle. Approval. Exchange offers.—W. SMITH, Bilston-road, Wolverhampton.

Good Value Offered (cash or instruments) for all kinds of Scientific Appliances.—CAPLATZI, Science Depot, Chenies-street, near British Museum. Estab. 1862.

½-plate **View Lens**, diaphragms, nearly new, cost £1 last season. Exchange Magic Lantern or anything to value.—S., 12, Thompson's-avenue, Avenue-road, Camberwell, S.E.

52 numbers "**English Mechanics**," 36 numbers "Inventors' Mart," good old Clock Works. Want Watch in good going order for lad.—Apply, Waterside Works, Colchester.

Iron Lathe, 6in. centre, 4ft. 6in. bed, heavy wheel, speeded headstock, treadle sugar chopper. Offers to GROCERS, 7, Rookery-road, Deepfields.

"**English Mechanic**," 14 vols. to date, unbound, what offers? Carpenter or metalworker's tools; latter preferred.—J., 114, Barnsbury-road, N.

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he English Mechanic
) WORLD OF SCIENCE AND ART.
FRIDAY, APRIL 20, 1888.

RACTICAL ELECTRIC BELL-FITTING.—IX.

Connecting-Up.—(*Continued.*)

G. 61 shows an arrangement in which, by means of a switch fixed near the push, ell can be made vibrating or single-stroke ill. The bell B (shown with its cover ved) is an ordinary vibrating bell, but an additional terminal, S, fixed between riginal terminals and connected to the frame F (see Fig. 17, page 425) by the screw J. If the push is pressed while the arm *a* of the switch W is in the position shown, the bell will ring as a vibrating bell; the current flowing from the pole C of the battery to terminal L of the bell, through the bell coils E E to contact post P and terminal Z, thence by wire *d* to terminal *b* of the switch, and from there by arm *a*, wire *g*, and push P to the zinc of the battery. If the arm of the switch is moved over to the opposite side, and the push pressed, the bell will ring as a single-stroke bell; the current now flowing from C of the battery to terminal L, through the bell coils to screw J and terminal S, thence by wire *f* to the terminal c of the switch, and from there by arm *a* and push P to the zinc of the battery. The bridge *n* in the wire *a* indicates that the wire *d* passes over the wire *g*, and is not connected to it in any way.

Fig. 62 shows how the bells and pushes must be arranged for signalling in both directions with three wires and one battery. Pressing the push P rings bell B, while pressing push P′ rings bell B′. The circuit (when the push P is pressed) is from the pole C of the battery, wire *a*, push P, wire *b*, bell B, and zinc of the battery. The circuit through the other push is from the pole C of the battery, wire *a*, bell B′, wire c, push P′, and zinc of the battery. [illegible]

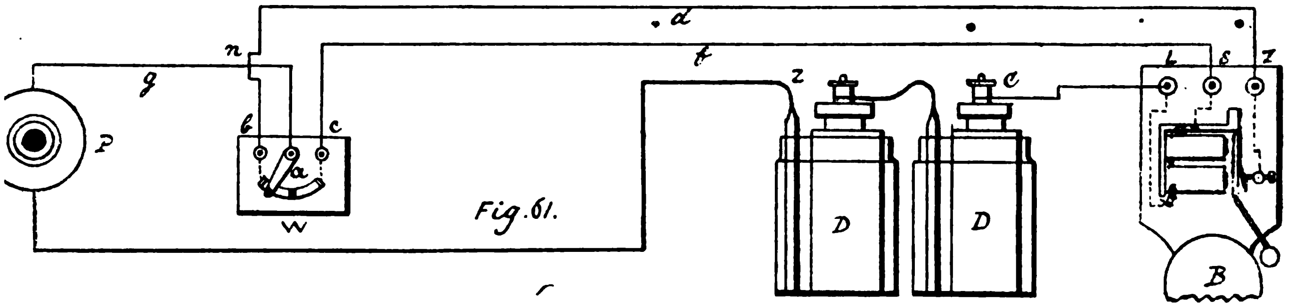


Fig. 61.

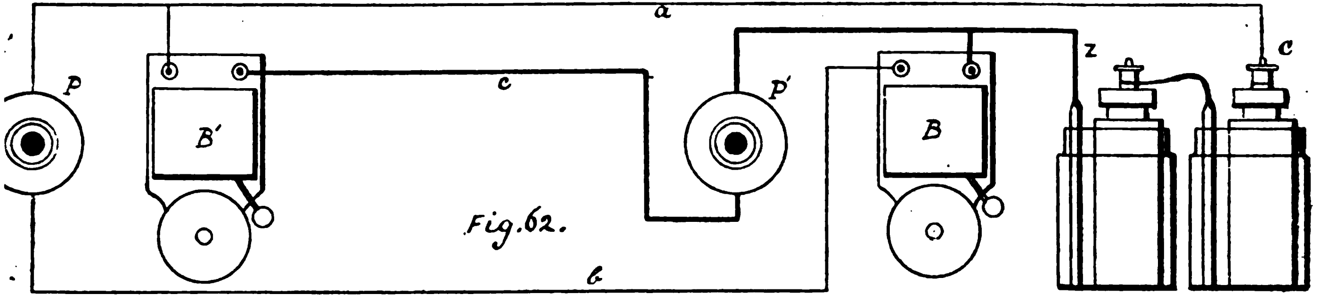


Fig. 62.

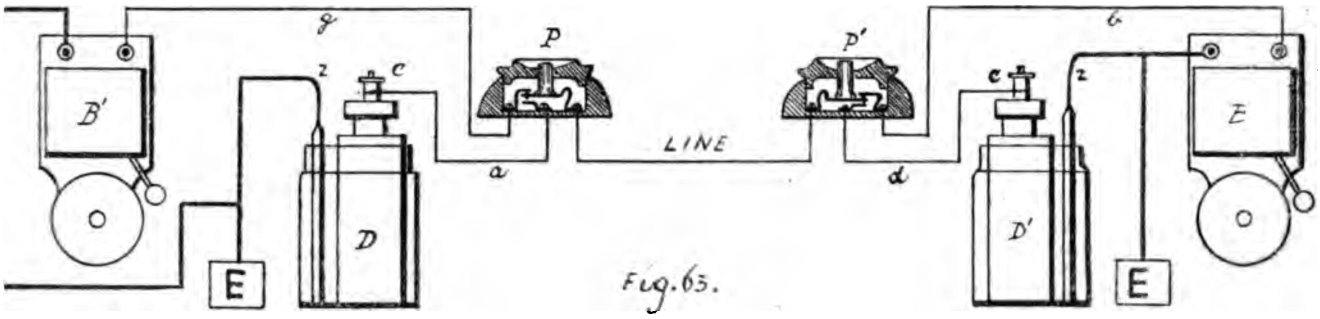


Fig. 63.

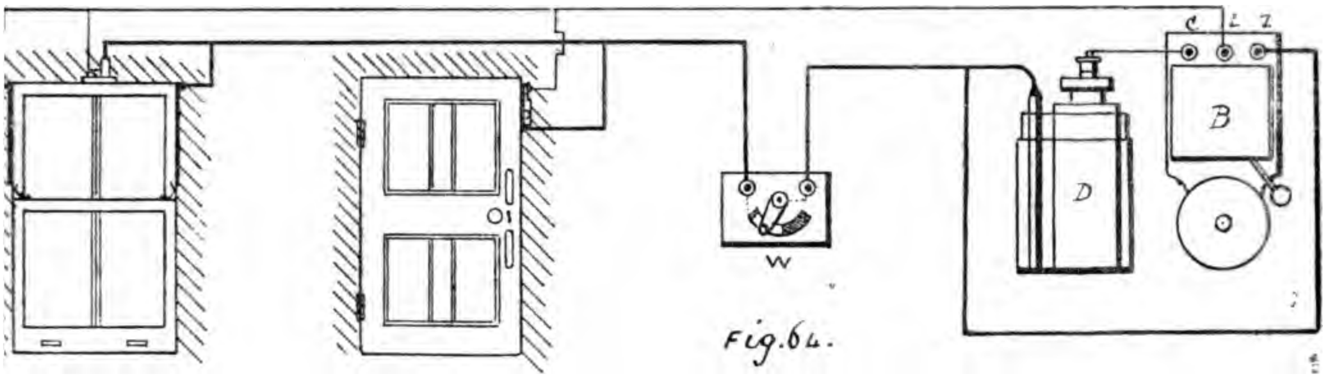


Fig. 64.

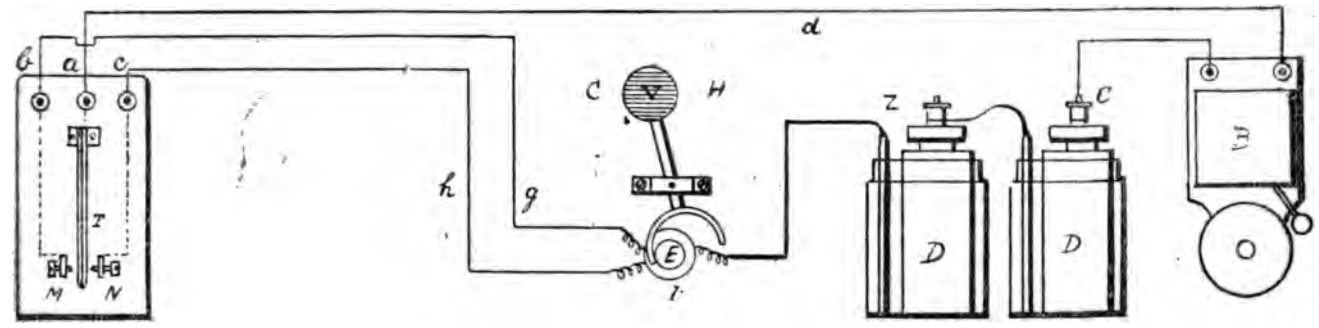


Fig. 63 shows an arrangement for signalling in both directions with one wire and two batteries, double contact pushes of the form shown in Fig. 13, p. 380, being used. Pressing push P causes bell B to ring, and the bell B′ is rung by pressing the push P′. The wire marked "line" is the wire which (taken overhead or underground) runs between the two stations. Having looked at Fig. 13, and read the description on page 381, it will be seen, on referring again to Fig. 63, that pressing the button of push P puts the positive pole C of the battery D to line, the circuit through bell B being as follows: Pole C of the battery D, wire *a*, bottom contact and spring of push P, line, spring, and top contact of push P′, wire *b*, bell, and earth; the other pole of the battery being also put to earth. The circuit closed by pressing push P′ is from battery D′, wire *d*, bottom contact and spring of push P′, line, spring, and top contact of the push P, wire *g*, bell, and earth; the other pole of the battery D′ being likewise put to earth. A Morse key is frequently used instead of the push shown, though, of the two, for general purposes, a good substantially made double contact push is much to be preferred.

Fig. 64 shows how burglar-alarm door and window contacts should be connected-up, a window and door being shown so connected. The door is protected by a contact of the form shown in Fig. 40, page 569, the top sash by the form shown in Fig. 37, and the bottom sash by the form shown in Fig. 39 of the same page. Opening either the window or the door closes the circuit, causing the bell to ring; the action that takes place being the same as that described for Fig. 56. The switch shown at W is for the purpose of breaking the circuit in the daytime, so that the ordinary opening and shutting of the windows will not ring the alarm bell. By a slight addition to the hall clock, it may be made to break the circuit in the day and close it again at night, thus doing away with the necessity for a switch, which is very often liable to be forgotten. A modification of this arrangement (Fig. 64) is much used in factories, &c., to insure all the windows being shut before the premises are closed for the night. Instead of the continuous ringing bell shown in the figure being used a small vibrating bell is substituted. The bell will ring, should any of the windows be open, when, as a test, the arm of the switch W is moved into the position shown. Fig. 65 shows a method of connecting up the hothouse alarm shown in Fig. 45, page 569. The indicator I (the electro-magnet E of which is wound with two coils) is included in the circuit, in order to show whether the bell rings because the house is too hot or too cold. The indicator is shown in detail in Fig. 26, page 473. The bell, battery, and indicator, are generally fixed in the attendant's cottage. The action of the alarm is as follows:—When the temperature falls below a predetermined point the tongue T touches the contact screw M, closing the circuit, the current flowing from the pole C of the battery D through the bell to wire *d* terminal *a* of the switch, tongue T, contact-screw M, terminal *b*, wire *g*, one of the coils of the electro-magnet E (throwing the vane over into the position shown), and then to the zinc of the battery. Any rise in the temperature causes the tongue T to touch the contact-screw N, closing the other circuit; the current now flowing from the pole C of the battery to the terminal *a* of the alarm as before, tongue T, contact-screw N, terminal *c*, wire *h*, through the other coil of the electro-magnet E (throwing the vane over to the opposite side), and then to the zinc of the battery. Two bells of different tone are sometimes employed instead of the indicator shown, or the alarm may be made to act direct on to the ventilating apparatus.

F. C. A.

SIMPLE EXERCISES IN TECHNICAL ANALYSIS.—XXVII.

By AN ANALYTICAL CHEMIST.

Iron and Steel.

(335.) A COMPLETE analysis of these metals is a very difficult and tedious operation. Anyone who is particularly interested will find excellent chapters on the subject—with full details of manipulation, &c.—in four or five numbers of the ENGLISH MECHANIC issued between February and July, 1883. On account of the completeness of the description given there, our remarks will be very brief. As the percentages of carbon, phosphorus, silicon, &c., present in samples of iron are very small, the risk of error is correspondingly great; and 5, or in some cases 10, grammes of the samples must be taken for the analysis.

The determinations usually made are:—

1. Total carbon.
2. Uncombined carbon or graphite.
3. Silicon.
4. Sulphur.
5. Phosphorus.
6. Arsenic.
7. Manganese.

(336.) *Total Carbon.*—A very accurate method is that given in the ENGLISH MECHANIC (No. 938, 16th March, 1883); but the following can be recommended where great exactness is not required, and in the absence of elaborate apparatus:—

Five grammes of turnings or drillings should be dissolved in a nearly saturated solution of cupric chloride, taking care at the same time that the temperature of the contents of the beaker does not increase considerably. When all the iron has dissolved, add a little more cupric chloride, and sufficient HCl to just dissolve the copper salt. Filter through an asbestos filter. Before asbestos can be used for this filtration process it must be submitted to the action of HCl and strong heat. This is done by heating the asbestos in a beaker with HCl; filtering, washing thoroughly with water, and finally igniting in a platinum capsule over a Bunsen flame. The long fibres of the asbestos are then separated from the short, and the filter is constructed by gently packing into the stem of a large funnel, or into a piece of thick glass tubing drawn to a point at one end, first the coarser fibres, and on top of these a layer of the finer ones. The bulk of the clear liquid is decanted through this filter, and then the remainder, with the insoluble carbon, is poured on—the latter being completely retained by the asbestos, if the filter has been properly constructed. The carbon is then thoroughly washed, first with a mixture of equal parts of HCl and water, and finally with hot water. The whole of the asbestos, with its adhering carbon, is next carefully transferred to a platinum capsule, dried at 212° F., till the weight is constant, then ignited thoroughly, and again weighed. The loss on ignition is due to the carbon burnt off, and represents the total carbon present in the portion of the sample taken.

The ignition should be continued over a Bunsen for half an hour, and when the weight is constant a little nitrate of ammonia may with advantage be placed in the capsule, and the ignition repeated once more. This insures the complete ignition of the carbon. As a further precaution against error, the platinum capsule should be weighed before and after each ignition.

(337.) *Uncombined Carbon.*—Dissolve ten grammes of the sample in HCl (sp.gr. 1·1). The uncombined carbon and the silica remain undissolved. These are collected on an asbestos filter, washed with ether to remove traces of liquid hydrocarbons, dried at 212° F. and weighed, then strongly ignited and re-weighed. The loss on ignition represents the uncombined carbon. Precautions as to loss of platinum as above.

(338.) *Silicon.*—Dissolve ten grammes in hydrochloric acid, evaporate the solution to dryness, then add a few drops of concentrated HCl and again evaporate to dryness, repeating this operation two or three times. The silicon is by this treatment converted into the very insoluble oxide silica. Add a considerable quantity of hot water, filter, wash with water till all traces of acid are removed from filter. The silica remains, and is ignited weighed in the usual way. The weight mul plied by ·4666 gives the amount of metal silicon present.

(339.) *Sulphur, Phosphorus, Arsenic.*—T 5g. of the sample finely powdered, place i silver crucible, or a porcelain one if the form cannot be obtained. Add six times its wei of a mixture of

Nitre..................................	5 parts
Potassic carbonate	1 „

and ignite. When cool digest in water, separate by filtration the insoluble oxide iron, washing the filter paper thoroughly. A to the clear filtrate an excess of hydrochlo acid, then baric chloride solution as long a precipitate is formed. Collect the insolu baric sulphate on a filter, wash, dry, and wei Multiplying by ·13748 gives the equivalent sulphur.

(340.) *Arsenic.*—To the filtrate from above add dilute sulphuric acid as long a precipitate is formed, filter and wash. T precipitate is disregarded, as the object here to free the solution from the excess of bariu salt added in the previous operation. Th pass SH_2 gas through the solution to pre pitate the arsenic as sulphide. When al precipitated, pass carbonic acid gas for hour. This expels excess of SH_2 gas. Filt wash, dry at 212° F., and weigh on tared filter paper. One, or perhaps t corrections of this weight may be necessa The first arises from the fact that the pre pitate usually contains a variable proportion free sulphur, and to remove this a giv weight of the well dried and mixed precipit should be placed in a porcelain dish, and treat with a large excess of fuming nitric ac (sp.gr. 1·5), covered immediately with a clo glass, and subsequently heated on a water ba till the whole of the sulphur and the bulk the nitric acid have disappeared. It is th diluted, and baric nitrate added as long as precipitate is formed. Filtration, washin and weighing give the amount of baric su phate, and by calculation as above, the weigh of sulphur also. Subtracting this from th original weight of the precipitate, gives th weight of arsenic. Or, the arsenic may b weighed directly by precipitation as ammoni magnesic arsenate, in exactly the same way a described below for phosphorus. (See als Art. 328*a*).

The second correction is more easily made and is but seldom necessary. A weighed por tion is ignited, and if any non-volatile traces remain their weight is deducted.

(341.) *Phosphorus.*—The filtrate left afte the separation of the sulphide of arsenic should be neutralised with ammonia, and then on the addition of a few drops of ammonic chlorid and sulphate of magnesia—or better still, mag nesia mixture—a white crystalline precipitate of ammonic magnesic phosphate slowly sepa rates. Gradually add excess of ammonia, and allow to stand all night. Filter, and wash with ammonia water; ignite, weigh. The weight multiplied by ·28 gives the amount of phosphorus present.

(342.) Manganese is often present in con siderable amount, and when this is the cas should always be estimated. The process is a long one, and the reader is referred to No. 95 of the ENGLISH MECHANIC.

(To be continued.)

GEARING.—XIII.

Worm Wheels.

THE screw tooth of a worm can be marked out very easily as follows. Prepare a slip of paper, of length equal to the circumference of the worm blank, and of width equal to its width. Upon this draw diagonals (Fig. 91) at the proper angle of the worm thread, and at a distance apart equal to the pitch. Parallel with these draw a second se of lines to represent the tooth width at the point. This paper will be glued round the block in which the worm tooth is to be worked and *a* will meet *a′*, and *b* will meet *b′*, completing the thread. This method is identica with that given for the spiral wheel on p. 394.

Another mode equally correct is to strike ou the worm like a screw, dividing the circumfe

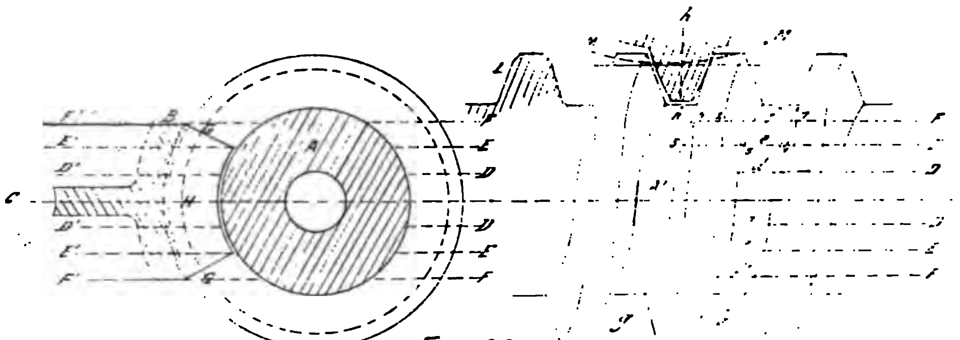


FIG 92

he pitch into the same number of , and drawing the screw line through intersections. But the paper fur- simplest and quickest method.

v tooth is readily worked by means :t cut to the shape of the interspace. sections and spaces being alike all ıt the teeth of the worm wheel are ily cut, because the teeth sections vary at each remove from the central e wheel.

in mind the remarks made in the last 3, on the influence which the lean- screw threads of worm and angle upon the profiles of certain sections taken parallel with a central plane axis longitudinally, let us see what ring this has upon the forms of l teeth.

92, let A represent the transverse ough a worm A′, and let B repre- ion through a worm wheel gear- with, whose teeth, instead of ely straight diagonals, form enve- e worm thread. Looking at this ront view A′, we see how marked rence in angle at the point and root little shading being introduced at d thread space to render this twist ent. It is most clearly evident that eel tooth whose profile curves shall envelopes of the worm profiles, a marked coincidence, both in twist rture from symmetry, with the un- l and twisted space. If this were cial difficulty would be experienced the adaptation; but, as the wheel nd, its teeth-flanks are brought sive contact with different portions ks of the worm tooth, so that a ch has a certain adaptability in one ill not gear correctly in successive Hence the immense difficulty of t the teeth of the wheel with abso- ion. To make my meaning more ill cut the wheels into slices. Com- and A′, there are several sections lel with the plane of the axes C—C, , F F, coinciding with corresponding the worm-wheel B. In any position ar with D, E′ with E, and F′ with e shapes of the worm interspaces ferent from each other, as is evi- the section lines *d*, *e*, *f*, and differ from *d′*, *e′*, *f*, so that the from symmetry is both right, anded. Projecting *d*, *e*, *f* down- obtain sections of these spaces, and the sections corresponding to uld be precisely similar, but on the nd. But D″, E″, F″, only represent ections in relation to one position of ooth, which we suppose to be cut to ; and so, when the tooth so cut er round, its flanks would *interfere* er set of worm sections, precisely their profiles, but *differently placed* the tooth, and a tooth cut to gear foul at *g*. If the wheel were a rack, aight, and parallel with the worm ld be analogous to a screw nut, and is trouble would be experienced, or, ll a wheel, the teeth were diagonal d of enveloping the worm, the task asy, and there could be no inter-

out these wheel-teeth, therefore, nable approach to absolute correct- d thus:—After getting the involute the wheel teeth in the central plane perpendicular to the axis—that is, in the line C C—set out the enlarged pitch around G G, enlarged, of course, because of the difference in diameter of the true pitch line H and the secondary ones G. The pitch divisions or points on G G are, of course, out of perpendicular with those of the pitch in the joint H, by the difference due to the angle of the worm thread. The symmetrical tooth set out on the centre line *h*—*h* representing the wheel axis for the time being, is the correct shape on the axial line C C. But it will not be the correct shape along the line F F, nor for any position intermediate between C and F. We therefore obtain different positions of the wheel-tooth on the faces G G in relation to the corresponding sections of the worm (neglecting D and E sections). We at once see a practical difficulty even in getting these correctly, since the faces of the wheel-teeth slope radially, while the sections are parallel with the central plane C C. We cannot cut the teeth along the line E, nor continue them up to F, without extra trouble and work: hence we compromise, and modify the section F, as shown at K, to correspond with the slope of G. Now, having a worm of small angle, and a drawing to a small scale, the departure of K from perfect symmetry is scarcely perceptible; hence, the better to illustrate the tooth forms, I will suppose that F section, F″ below, stands for K section, and that the tooth forms have to be adapted to F″. Set out a succession of tooth sections, therefore, Fig. 93, precisely like F″, as many as correspond with the number of turns of the worm-thread. Mark out on a piece of card or of thin board a couple of teeth to the shape of *h*, Fig. 94, on a pitch circle of the diameter of G, in Fig. 92, and sweep this templet round, bringing the teeth into successive contact with the tooth spaces in Fig. 93. It will then be apparent at once where interference occurs, and by adapting a tangent curve, or envelope to the various points of interference, we shall obtain the correct form of tooth for the outer face of the wheel. It will be found that in order to continuous contact, the teeth on the faces G will become more spreading at the roots, and narrower at the points than on the line C C in Fig. 92, and will be also unsymmetrical. The similar obtaining of sections on the lines D and E in Fig. 92 is, as far as facility and usefulness go, impracticable, and it is sufficiently accurate to cut direct from the profiles marked on G to those on the face C C, partly assisted by a templet cut to a shape intermediate between the two.

But the plan just described is not one which I should adopt, being too roundabout and troublesome. The method which I have long employed with perfect success is, in principle, that adopted when cutting worm-wheels from metal blanks, by making the worm itself the templet by which to gauge the accuracy of the wheel teeth. Then, no matter what the length of the worm-thread or its angle may be, or the relative dimensions of the worm and wheel, or the amount of interference present, we get precisely the same results as though the worm had been serrated like a milling cutter, to work out its own wheel.

We can go on just as previously described, until we arrive at that stage when the teeth are pitched out on the joint faces, and on the faces G. Then rig up an apparatus in the lathe, Fig. 95; any lathe will do equally well, A A being the bearers, B the rest, C C two pieces of wood or metal screwed to the bearers at exact angles therewith, and embracing the foot of the rest between them, closely yet freely, so that on the slackening of the hold-down bolt

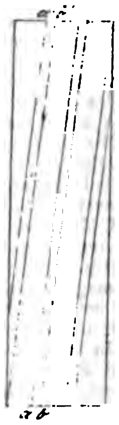


FIG. 94

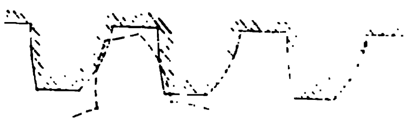
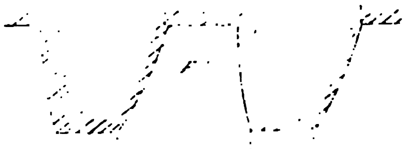
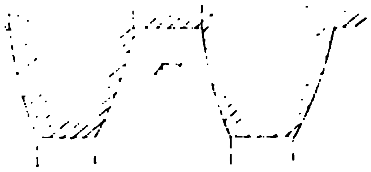
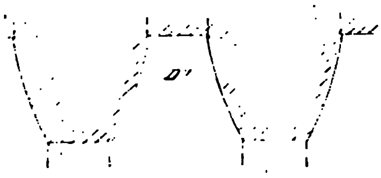
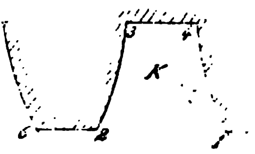


FIG. 93









it can be drawn back by hand. D is a shouldered piece or collar, extending from the top of the rest B to the face of the lower boss of the wheel G. This collar is turned about the centre of a pin or spindle, one portion of which fits into the socket of the rest, the other portion into a hole bored through the centre of the pattern G. The wheel is therefore free to revolve on the pin, and the guides C C preserve its centre, taken longitudinally through its axis, coincident with the worm centre taken perpendicularly to its axis. The height of the collar D is so adjusted that the middle plane of the wheel coincides with the longitudinal axis of the worm E. The relations between the two, therefore, are those of ordinary gear, and the facility afforded by the guides C C for sliding the rest backwards and forwards permits of the tentative working and gradual deepening of the wheel teeth until their ultimate and correct forms are obtained. This is perfectly accurate, supposing the adjustments for height and parallelism are correctly made. By the turning of the worm between centres the wheel is carried round a corresponding distance, and black-lead, or red-lead rubbed over the worm will indicate points of contact on the wheel teeth, showing from what portions the material has to be cut away. The work can be much facilitated by cutting out three or four teeth only first. From these obtain approximate curves for their profiles; strike out the faces of the remainder, and work rapidly all the tooth spaces roughly through.

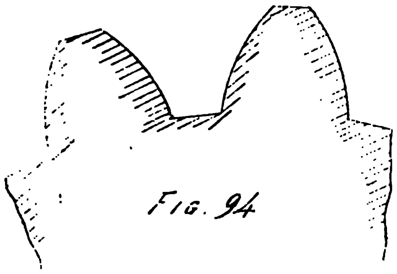


Fig. 94

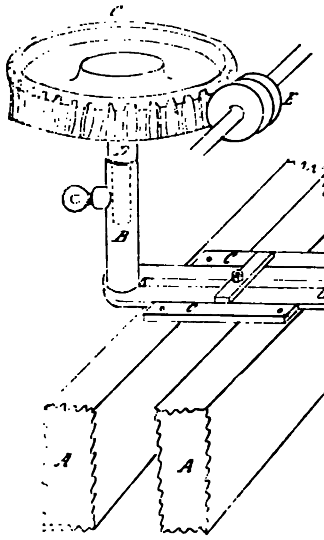


Fig. 95

Then put the finishing touches to the teeth by running the worm through them all a few times and ease off the higher points. This is the most practical and most correct way of making the profiles of worm-wheel teeth, and I have often adopted it not only in the case of complete wheels, but also for tooth blocks for machine moulding.

I have shown the worm teeth in Fig. 92 with perfectly straight flanks the better to illustrate the projection of tooth sections. In practice the teeth ought to be slightly rounded off at the points, as shown in the same figure to the left (L), since square corners *interfere* with the roots of the wheel teeth, hollowing them out and weakening them considerably in the case of all *wheels, excepting those having* large numbers of teeth, and, therefore, very flat arcs of curvature. The roots are hollowed also for increased strength. The teeth in Fig. 92 are involutes, whose flanks, instead of being parallel, are perpendicular to the tangent line of the base circle of the wheel, the result being a gain in strength without the sacrifice of correct principle. The interference alluded to being found greater in small wheels than in large ones, and the result being a hollowing out of the tooth roots, this can easily be avoided without rounding the worm points by simply bringing the base circle of the wheel almost to coincide with the root circle, as in Fig. 92 (G and M). Such extreme disproportion between the dimensions as is there shown is comparatively rare, yet the elasticity of design permitted by the involute gears (see article VII., page 428) is a property which renders them all the more valuable for this class of wheels.

J. H.

NEW DETECTIVE CAMERA.

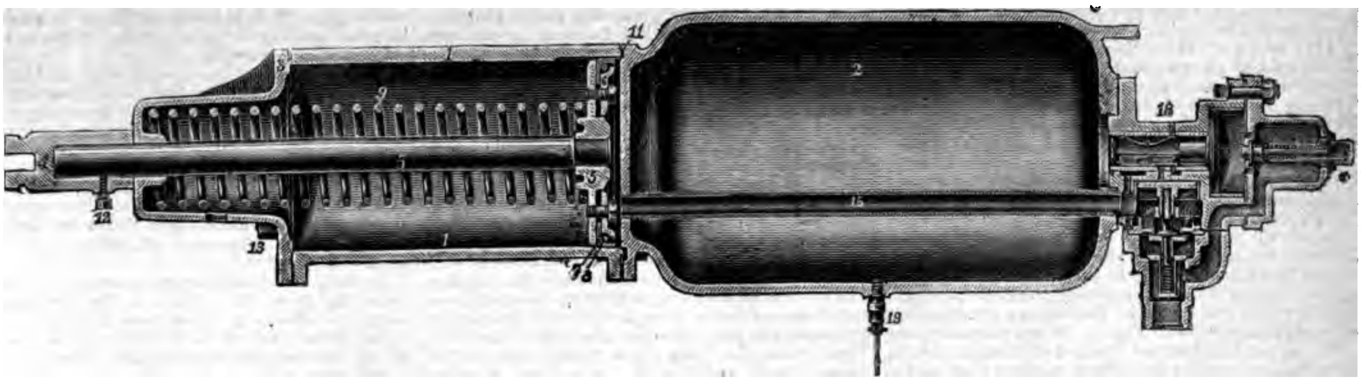
A NEW detective camera has been recently patented by Mr. Rouch, of the Strand, which takes the form by preference of an oblong wooden box, in the front end of which is fixed a lens that is concealed from view, and across which passes a flexible opaque band having in it an aperture that permits the lens to be exposed to the view to be taken. This band is actuated by clockwork or by a simple spring, the arrangement being such that when at repose the lens is covered. By the application of a key the spring is wound up, and is retained *in situ* by a click or catch dropping in a ratchet wheel; pressure upon the tail end of this catch by means of a button or knob accessible from without releases the catch, and causes the opaque band with its opening to pass rapidly across the axis of the lens and admit light for a momentary period. At the posterior end of the camera is a recess capable of holding a number of sensitive plates, each of which is inserted in a sheath, preferably of thin metal, so constructed that while the back is quite protected, the face shall be exposed in all but a slight overlying flap or band of the metal which shall prevent it from falling out or from being damaged by contact with others against which it may be pressing. When the recess at the back of the camera is filled with plates protected in the manner described, and the end is closed by its cover, springs in the latter press against the plates, and keep them tightly up against the ledge or faces forming the front of the recess. The first plate of the series, or that which presses against the faces referred to, rests not upon the bottom of the camera, but upon a strip of wood or metal capable of being made to rise up by guides or grooves in the sides of the camera. This is attached by means of an arm to an axle going across the camera, which axle is midway or nearly so, between the position of the first plate and the lens. By rotating a key or thumb-screw at the side, the metallic strip on which the plate reposes is made to rise towards the top of the camera, carrying with it the plate which it supports, and which is now raised up through a slot extending across the camera into an opaque and flexible bag, preferably of washleather, which, while shielding the sensitive plate from the light, permits of its being grasped by the finger and thumb of the operator, and lifted entirely up from its place, when it is transferred to another and similar slot of suitable dimensions at the back of the supply of plates, through which it is inserted and pushed down behind the others. In the mean time, by the action of the springs in the back, the second plate of the series, on the withdrawal of the first one as described, is pushed forward and takes its position against the faces of the recess. After exposure to light, it too is withdrawn and transferred to the back, and so on in rotation until the whole series has been exposed. It will be understood that the focussing is effected by having the lens attached not to the immovable box to which the faces of the recess are fixed, but to either a movable false bottom or a separate front capable of permitting the focus to be adjusted when desired, although in ordinary practice, when the lens is once adjusted for any object at a moderate distance from the camera, no further adjustment is necessary. When required, focussing can be insured by means of a sliding body to t camera on which is engraved or affixed graduated strip representing the focussi value of an object situated at any defini distance. When not in use the flexible b aforementioned folds down in a recess, and protected by a suitable cover. In order to pla the object to be photographed in proper po tion on the plate, there is a back and foresig so adjusted that correct aim can be taken a perfect accuracy secured. The apparatus c be arranged so that one or more additio nests of plates can be placed in position f use.

THE CRUTO FILAMENTS FOR INCANDESCENT LAMPS.

THE success achieved by the Cruto lamp due mainly to the filament used, and will therefore interest readers to learn that Société A. Cruto et Cie., of Turin, have recent patented further improvements in the produ tion of carbon filaments to be made incand cent in electric lamps and for use in mic phones, &c. The main object of the mo recent invention is to employ ulmic or simil materials, such as metagallic acid (acide e belli feronique) or other acids either containi carbon principles or not. In carrying out t invention materials in a pasty condition a used in preference, thus obtaining easily a desired form either by wire-drawing or pressing the paste into a mould before c bonisation. Amongst ulmic materials, an ulm acid in a plastic or pasty condition is employ A solution is prepared consisting of 80 gramm of sugar in 100gms. of distilled water; this sol tion is filtered, another 100gms. of distill water being added during the operation, a the filtered product is collected in a porcelai receiver. To this solution about 300gms. o sulphuric acid is added drop by drop at the ra of about a drop per second, a spherical funn fitted with a cock being employed for t purpose; the solution, being constantly stirre becomes thick and assumes a dark, near opaque, red colour. This mixture is th allowed to rest for about twelve hours, ke covered over, after that, with a spheric funnel as above described 300 to 400gms. of di tilled water are dropped at the rate of about drops per minute into the mixture, keepi stirring at the same time. Having allowed t mixture to cool, it is poured into a receiver a capacity of about six litres. The receiver filled by adding water a little at a time; aft this it is decanted, water being again add until it is reduced to a density of about Beaumé. The mixture is then filtered until attains a sufficient density to be worked means of an indiarubber roller upon a piece glass or upon a polished marble slab so as render it plastic. This mass contains air th must be expelled. To do this it is placed in receiver of a vertical cylindrical or any oth suitable form in which moves a hermetical tight piston. This receiver is closed at t extremity opposite to the piston by an indi rubber plug, and is connected with an a pump.

When the paste is ready, it is placed in t cylinder, which is filled about three-parts ful after this the indiarubber plug is placed position and the air-pump set to work. Wh this operation is over, by short, quick blows t paste is knocked against the bottom in order work it up and amalgamate it. The paste then in a very plastic condition, and can eas be moulded into articles of any form. obtain, for example, filaments for incandesc electric lamps a small syringe is employed, an apparatus similar to that used for ma facturing vermicelli. Other articles are tained either by pressing the paste in a mo or by modelling by hand. The filaments t obtained can be cut to any desired length, can assume any shape that it is wished impart to them. The articles are first left dry at the ordinary atmospheric temperat in a slightly damp place; they are then pla in an oven, in which they are subjected heat of about 100° C. After being thus dr the articles are placed in crucibles filled powdered charcoal or in furnaces contain an inactive gas to protect them from cont with the air, and they are brought to a h temperature in a reverberatory furnace to o

FIG. 1.



carbonisation. The filaments that are ded for carbons for incandescent electric s are employed without any other treat- just as they come out of the furnace; ther articles, especially those destined for nents, can, if desired, be burnished.

HE QUICK-ACTING WESTINGHOUSE BRAKE.

the annexed engravings we illustrate the new quick-acting Westinghouse brake, h has attracted so much attention in the ed States, where powerful brakes on long s of freight cars are so necessary. Apart gether from the merits of the device as a -stopper, it has attractions for those who appreciate ingenuity and mechanical skill. he works of the company the brake appa- s for a train of fifty vehicles has been d up previous to its despatch to the Brussels ibition, and the movements of the brake- ns along the whole length are so rapid it is not easy to follow them. Readers saw the arrangement at the Inventions ibition will readily appreciate the differ- e in the rapidity of action of the two forms Westinghouse brake. Referring to Fig. 1 will be seen that the brake cylinder, air rvoir, and triple valve are combined in one e, and the train pipe is coupled at E g. 2). From the train pipe air passes ugh E, K, and *l l* to the chamber and by means of the grooves *d* and *f* flows the piston 5, until the air-pressure in the rvoir and that in the train pipe reaches a e of equilibrium. One side of the piston direct connection through the branch C with the reservoir, and the other is open to the pressure of the compressed air until it is placed in equilibrio. The triple valve is placed horizontally as shown, its piston-rod 5 being seen above the passages *a*, *b*, *c*, the details of which are shown in Figs. 3, 4, 5. The position represented shows the interior of the brake cylinder connected to the atmosphere by the branch B, passage and port *a*, cavity *b* (see Fig. 3) of the slide-valve 6, and the port *c*, which leads to the atmosphere. If the pressure in the train pipe is reduced by means of the driver's valve, the piston in cylinder M is moved over to the right by the expansion of the air in the reservoir, and carries with it the valve 7 seated in a recess in the slide-valve 6, the connection between the two being so arranged that the piston can travel a short distance without moving the slide-valve 6. As soon as the piston moves, however, it allows air to pass through *m* (Fig. 3) to the port *e*, and its continued movement brings the port *e* opposite to the port *a* (dotted lines in Fig. 2), which is first shut off from the atmosphere. Air then flows into the brake cylinder, but directly the pressure falls below that in the train pipe, piston 5 moves back a little, and closes valve 7, cutting off the air supply, which is again renewed when the pressure in the train pipe is further reduced, thus giving a considerable gradation of brake power. In an emergency the full power of the brakes is required. The driver's valve is then opened wide, and the pressure in the train pipe is so quickly reduced that piston 5 moves sharply over to and seats itself on leather ring 10, which brings port *e* over port *h*, and port *g* over port *a*. Air from the reservoir then passes through *h*, drives down piston 13, and so opens valve 18; at the same time the check valve 19 rises owing to the pressure below it, and there is a clear passage from the train pipe (E, Fig. 2) into the brake cylinder. A passage also is opened between the ports *g* and *a* to the reservoir; but as the area is small the train pipe has time to relieve itself before accumulation of pressure at B shuts the valve 19. The brakes are released by connecting the train pipe to the main reservoir, when the pressure moves back piston 5 to the position shown in the engraving, when the air passes through *h*, *b*, *c* to the atmosphere, piston 13 is raised by the pressure beneath it, and valve 18 by its spring; the air in brake cylinder exhausts through passage *a*, and the brake piston is returned by its springs, the reservoir being re-charged through grooves *d* and *f*.

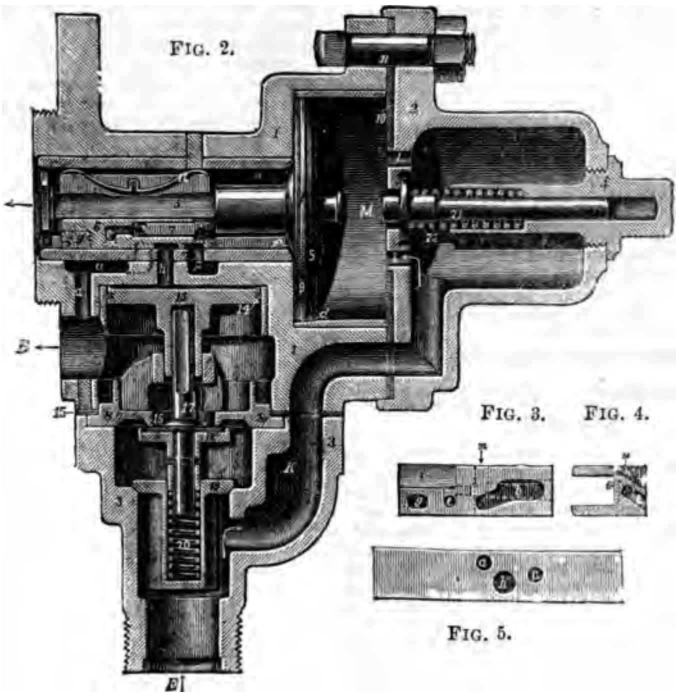


FIG. 2.

FIG. 3. FIG. 4.

FIG. 5.

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DETAILS OF BLACKSMITHING.*

Change of Form for Proportioning Stock—A Sliding Trimming Die—Cast Cast-steel v. Cast Iron for Drop Dies.

IT is said that the reduction of iron in the process of rolling is facilitated by changing the shape of its cross section from one simple form to another at each pass; as from square to oval, oval to round, or feathered to square, the object being to leave it, from each groove, in such shape as shall best fit it in passing through the next, to extend greatly in length, and little in width. While, therefore, it is apparently being distorted from the form which it is finally to assume, it is really being modelled in the shape which is calculated to produce that form in the most direct manner. Something analogous to this is met with in forging, where things are to be made in such shapes as make it difficult to block the stock into each part in the proper proportions. In such cases it is sometimes expedient to block out the piece with the principal object in view, of distributing the stock in the different parts, in approximate proportions, purposely leaving for the finishing operations the work of getting it into the required shape.

Gun triggers were formerly made by taking advantage of this method. They were almost universally forged by hand until 1859-60, but have since be made much easier with the drop. The finger piece of the trigger is broadened to give a good hold, while the part that goes up through the guard is quite thin. The process of making them formerly was to take a piece of flat iron, turn it edgewise, and hammer the end down, on the inside corner of the anvil, and then put it into a stake, set in a sow block, and hammer it into an impression there which gauged the amount of stock left in the finger piece, and thinned down the back. The stock for the finger piece was all on one side, and, although this did not look much like a trigger (Fig. 1), the stock was there in the right pro- 1.
portions. uch
The thin part was then put into a slot and '
or three blows struck on the finger piece to d Dr.
it over into the middle, after which it was put Hong
jumper dies, and these finished it in a very sm cause
and perfect manner full as nicely as they ar in this
made—Fig. 2. With the drop they are str n to the
blow edgewise; next a blow on the flat in English
dies; after which the superfluous stock is t hing sup-
off in a press, and they are then struck a nployed in
blow. This is all done at the same b hod was to
tools are conveniently situated and th r's large atlas,
is done hot. They have sometimes be comet-seeker
last blow cold after annealing and rat ous objects as
Another illustration of the appli
artifice of getting the stock into n Dr. Doberck's
for the purpose of better proportic the case was not
parts, is shown in Fig. 3, in w attending late dis-
oberck advocated an

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* By B. F. SPALDING, in the

connected to the body by a neck of less than its own cross section. The plan adopted in the forging of these pieces was to take iron, which was already of the right size for the body, and cut it to the proper length. It was then taken to the trip hammer, where the lower end was drawn square and tapering in dies made for the purpose; the exact length from the end to the shoulder being obtained by holding the piece in gauge tongs, the ends of which came against the side of the lower die, and thus determined the place for the shoulder. The pieces then went to the blacksmith, who sunk a fuller into the stock, at the proper distance from the shoulder to make the other end, and blocked out the neck, after which it was put into a die, and the end bent over, and the stock easily formed into the shape shown in Fig. 4. In this shape it was ready to put in a die, under the drop, where it readily assumed the form required. The whole piece was in the bottom die standing upright, as shown in Fig. 3. It was necessary that the square should stand in exact position in relation to the arm, and by this plan it was not possible for it to come otherwise. The fin which formed around the arm was afterwards removed by being trimmed in a "sliding die" under a punch press.

The difficulty in the solution of the problem of trimming these pieces is one which frequently comes up, and is of a general nature. It arose from the fact that, on the one hand, the stroke of the press was only 1½in., and on the other hand the height of the piece to be trimmed was about 8in. If this piece had been in the form of a round-headed bolt, or of anything that had a small body and big head, it might have been got in by slanting it over until it had dropped low enough to let the head fall under the bottom of the punch. But in a piece of this kind, which held its size all the way, it was discovered that this stroke of strategy would not avail. This piece was of such form that it had to enter the die nearly straight.

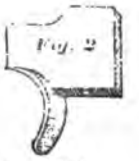
Fig. 2

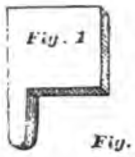
Fig. 1

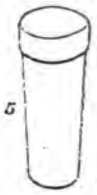
Fig. 5

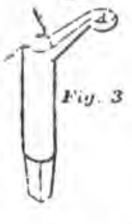

Fig. 3

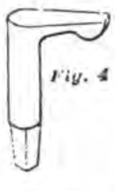
Fig. 4

Several plans suggested themselves—(1) To make the die movable, up and down, in close guides, so that it could be lowered enough to let the forgings be put in, and then raised and locked with some solid packing sufficient to resist the pressure when the fin was punched off. (2) To set the die in a fixed position, at a distance far enough beneath the slide or plunger of the press to permit the forging to be put in, and make the punch at the upper end to fit a socket held in the slide in the same manner that broaches are sometimes fitted in broaching machines—close, but easy of removal. The operation of this method would be to drop the forging into the die, and then insert the upper end of the punch into the socket, and then let the punch come down. As nearly the full length of the stroke, say, 1¼in., could be used, as the distance from the shank to the punch, this, with the assistance of a broad shoulder, would have been ample provision for keeping the punch in position. The third way, which was the one adopted in this case, as in most respects adapted to the purpose, was to make a bed plate for the punch press, in which a die was arranged to slide in and out. This die struck against a stop when it got home into the right position It was moved by a horizontal lever, on was worked by the right hand of the operator. Thungements were made so that when the die was run back into its proper place, the rod running time the treadle of the press to the clutch could the ove, because an arm protruded from it which maki on the lever; but when the die was in the I have lace, the lever had moved out of the way, complet le rod could pass it, and therefore the slide machine ne down, and the punch do its work. I have aution was taken to prevent accidents with perfec have occurred through the careless- trate the projeh gence of the operator, or from any tice the teeth o might have let the punch come the points, as sh die was in the wrong place. It (L), since square make a separate slide, to which of the wheel te fastened, and use the tool for weakening them & It was decided that this was not a complication. The slide bed was all that was necessary for general use, as was subsequently proved when other things were made which required to be trimmed in this manner. The die for the new piece was easily prepared. The punch was made and fastened in the press slide, and the die planed up and put into its place in the bed plate and up against the stop. The punch was then let down to rest on it, and then scribed around to indicate the bounds of the hole in the die. This had to be cut out as it would out of any die. All the extra work remaining was to drill and tap one hole in it for the screw which formed the fulcrum of its moving lever, and with another small screw, held a sheet-iron apron which prevented the dirt and scales from dropping in and around the slide, and thus kept out unnecessary wear. The other pieces which it was found convenient to trim with this tool were for spindles. They would answer very well to the description of round-headed bolts, except that their heads were quite small in proportion to the size of the body. They were 5in. long; the heads were 2in. in diameter and ⅝ thick, while the body was tapering from 1¾in. diameter under the head to 1½in. diameter at the point (See Fig. 5). These pieces were made under the drop by being upset from 1⅘in. round iron. They were not drawn down any on the small end, but were contracted in size by being driven down into the drop die.

Work of this kind is got out of the dies as soon as possible after it fills them, as the rapidity with which it cools around the edges shows that it parts with its heat by communicating it to the surface of the die with which it is brought in close contact. These surfaces expand, while the metal behind them does not. In cooling, subsequently, they shrink, while the metal behind them does not. The necessary consequence is that checks and then cracks come into existence on these surfaces, which, being once started, increase rapidly.

In forging these pieces both steel and cast-iron dies were used, in the form of heading tools, which, guided by three pins, set over a hole of the right depth in the bottom die. The heading tool being 2½in. through, the hole in the bottom die was 2½in. deep, to make up the 5in., which was the length of the spindle. The guiding holes in the tool which set on the pins were recessed in such a manner that by turning the tool one-third of the way around, after the blow was struck, it raised off from the die and lifted the spindle with it, and as this protruded 2½in., it was easily knocked out, and the tool again put back on the die ready for another.

These forgings were also made by dropping them endwise in a die which received their full length. They were ejected from this by a trigger which moved up a steel plug from below in the centre of the die. It was found in working these two styles of dies that steel was much preferable to cast iron in the dies which received the spindle the full depth, while there was so little difference in the wear of the cast iron and the cast-steel heading tools that the cast iron was preferred. Heading tools of forged cast steel were tried, and did not excel those which were cast. If there was any difference, those which were forged checked the worst. The experiment was tried of having a number of tools and using them in succession, giving them a chance to cool off gradually for the purpose of preventing checking. This was unsuccessful, as they checked as badly then as they did when immersed in water immediately after removing them from the die.

AN AUTOMATIC INTERMITTENT SIPHON.

As well known, the general solution of the problem of storing water, a vital question for agriculture, is the following: To unite all the sources that are not utilisable, on account of their too feeble discharge, in a reservoir of appropriate dimensions which is emptied one or more times in twenty-four hours through a sluice of dimensions such that the water collected can be entirely distributed over the surface to be irrigated in a relatively short time. Experience, in fact, has proved that if water is profitable distributed to profusion, it is but slightly so when it flows in a thin stream in a trench of which it wets only the banks.

Instead of having a sluice to be opened at definite intervals, it long ago occurred to some persons to make use of the ordinary siphon. It suffices, in fact, that the latter shall prime itself automatically in order to have a rapid and intermittent emptying of the reservoir. But the conditions necessary for such automatic priming are sometimes difficult to carry out. The source, in fact, must be very regular, and have a pretty large discharge, larger than that of the siphon during the short space of time in which the latter, operating at first as a waste pipe, is upon the point of priming itself. If this critical point is passed, the priming is effected and the reservoir is emptied by reason of the greater velocity that the head of water gives the liquid in the siphon.

But if the source is intermittent, irregu diminishes, it may happen that the siphon w longer perform the functions of anything waste pipe. Priming will no longer be able effected, and the abrupt emptying of the res will no longer take place.

In certain special cases, this state of thin be remedied by establishing a well of water f reception of the long branch of the siphon. overflow is thus reduced and the priming ca place.

This, in reality, is merely a palliative of a that is so uncertain in all cases that it is u preferred to empty the reservoir by open sluice at stated intervals. Hence an ann restraint, and a very poor utilisation of the at one's disposal.

In fact, the land-owner, farmer, or me generally opens the sluice in the mornin evening. Between these two intervals a night, if the reservoir is full, the water flov slowly, and irrigates but a small surface.

Different means have been proposed fo taining an automatic discharge, and especial preventing the ever possible neglect to man

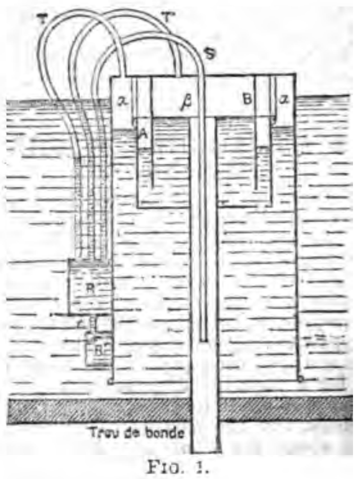

Fig. 1.

the sluice. At the last agricultural exhibit Tulle, we had an opportunity of examin recently devised and very simple system, the advantage of which is the entire absence o mechanism whatever subject to get out of It is a siphon, but it has been so arranged b Delavallade that the problem is entirely s despite all the difficulties that we have enumer

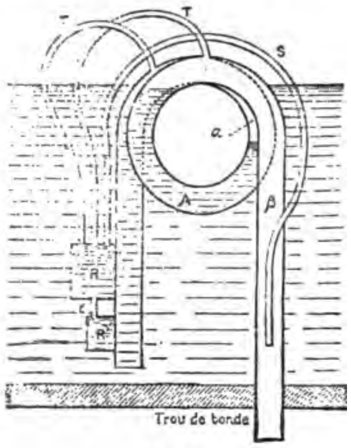

Fig. 2.

Its very regular operation is one of the m teresting things to study close by, as we have able to do. Fig. 3 gives a general view c apparatus and the manner in which it is arr in the sluice hole of a reservoir. Thus place supported by two wooden posts, one has no to pay any attention to it. Whatever b irregularities in the discharge of the sourc siphon will never act as a waste-pipe, an prime itself as soon as the desired level of w reached in the reservoir.

The latter once empty, the siphon will primed, and will reprime itself a few hour The instant of unpriming, and consequent level of the water remaining in the pond, i under the control of the farmer. It suffi fact, to form a series of apertures, *a*, in th branch of the siphon and close them with w extremely low power and large field of view, but many telescopic comets were so faint and diminutive that they would elude discovery altogether with such means, while faint, small star-clusters were extremely plentiful, and could not instantly be distinguished from faint nebulæ or comets with very low power.

Mr. W. Durham, F.R.S.E., read a paper on "Water in the Moon." He observed that the fact that no traces of water have been discovered on the face of the moon had long been a matter of surprise, as undoubtedly that luminary has been, and is, the seat of volcanic action; and this, from all analogy with such phenomena on the earth, seems to necessitate the presence of a considerable quantity of water. There are reasons, however, why we cannot obtain evidence of the presence of water, even although it may exist. The moon having little or no atmosphere, cannot have dust particles floating about, and it has been shown that these are absolutely necessary for the formation of clouds or rain. Again, the conditions on the surface of the moon form a most perfect arrangement for evaporating and condensing water with great rapidity. The water, if it exists would pass bodily as invisible vapour from the bright side and be deposited at once as snow or ice crystals on the dark side. This action would go on continuously, as the sunlight slowly travels round the lunar surface. In fact, the sun would as it were, chase the water round and round the entire surface of our satellite. Mr. Durham considered that perhaps the greater brightness at the edge of the moon, and the variations in the character of the light which have been observed to occur on her surface, may be due to some such action.

In a note on the "Secondary Light of Venus," Mr. W. T. Lynn, B.A., F.R.A.S., examined various hypotheses which had been put forward to account for this phenomenon. He considered that it was really objective, and not subjective, and was due to some illumination in the planet or its atmosphere, and thought it not unlikely that electricity might in some way be concerned in its production; or that, as Arago suggested, the planet's atmosphere may occasionally be pervaded by a luminosity analogous to that which in the earth constitutes the Aurora Borealis.

A large number of papers were taken as read, and Mr. Gill addressed the students on the distances of the planets.

USEFUL AND SCIENTIFIC NOTES.

Vegetable Albumens.—Do vegetable albumens constitute as good a diet for man as those derived from the animal kingdom? In a paper contained in the *Zeitschrift für Biologie*, Dr. Rutgers asks the above question, and gives the following reply as the result of his experiments. First, vegetable albumens are capable of supplying the place of the ordinary albumens we are accustomed to consume as food without causing any disturbance of the nitrogenous balance in the economy; secondly, beans and peas overcharge the alimentary tract, not only owing to their solids, but to their disposition to develop gas, whilst meat and rice cause no disturbance, and therefore contrast favourably with them. There are consequently various contra-indications to an exclusive vegetable diet. The acidity of the stomach, as well as of the urine, are much less upon an exclusively vegetable than upon an ordinary mixed diet. Milk, if not taken as an exclusive diet, can be very perfectly digested by an adult.—*Lancet.*

THE following curious paragraph has been "going the rounds" as if this were the "big gooseberry" season:—A curious kind of wood occurs in Nevada, which possesses several unique properties. The trees do not grow large, a tree with a trunk about a foot in diameter being much above the average. When dry, the wood is nearly as hard as boxwood, and, being of very fine grain, might, no doubt, be used for the same purpose to which boxwood is applied. It is of a rich red colour and very heavy. When well seasoned, it would form a fine material for carved cabinet work. In the early days it was used for making boxes for shafting, and in a few instances for shoes and dies in quartz batteries. Used as a fuel, it creates intense heat. It burns with a blaze as long as ordinary wood would last, and is then found—almost unchanged in form—converted into charcoal which lasts twice as long as ordinary wood. Unfortunately, it burns out stoves faster than any kind of fuel. In price, a cord of the wood is about as dear as a ton of coal.

AT Southampton an engine driving a dynamo and giving electric light is being supplied with steam from a boiler heated by the waste heat from a refuse destructor. Mr. Bennett, the borough surveyor, is of opinion that town refuse might be made to do a good deal in this way.

SCIENTIFIC NEWS.

THE death is announced of the famous traveller and explorer of New Guinea, Miklukho-Maclay, at the premature age of 42 years. A few months ago he returned to Russia to write an account of his travels, and also to found, if possible, a Russian colony among the Papuans. He was unable to obtain any official patronage of the latter scheme, and it is feared that he has left the account of his travels only half completed. Miklukho-Maclay was of half Scotch, half Cossack descent, and after completing his education in Germany, started on his career as explorer in 1866.

Herr Anton Stecker, the African explorer, who lately travelled in the service of the Berlin Geographical Society; and Prof. Wroblewski, the well-known naturalist of Cracow, are also dead.

By the death of Mr. Henry Pryer, of Yokohama, at the early age of thirty-nine, another of those amateur naturalists who do so much good work has been lost. Mr. Pryer was engaged in business pursuits, but devoted nearly all his spare time to the study of the Japanese fauna, and became a recognised authority on all questions connected with the birds, butterflies, and moths of that country, while he had an extensive knowledge of other branches of its zoology.

In a paper on the comets of Feb. 1880, and Jan. 1887, contributed to the Royal Society of Tasmania, Mr. A. B. Biggs refers to their "headless character," and says that if they were really headless, he cannot conceive of their pursuing any rational path in space; but their apparent orbital motion would indicate that they must be ponderable matter. It is not, then, he thinks, an unreasonable supposition to regard both bodies as the main body of a stream of meteoric matter whose orbit intersects the Ecliptic not very far from the position of the earth at the time of appearance (Jan. and Feb.), such stream being rendered visible by its compactness, illuminated by sunlight, and by its nearness to the earth.

Sir William Stokes has promised to deliver the Cavendish Lecture before the London Medico-Chirurgical Society on the 1st of June.

A Universal Cookery and Food Exhibition will open on the 23rd inst. at the Duke of Wellington's Riding School, Knightsbridge, and will remain open until the 28th.

At the Royal Institution to-day (Friday), Sir W. R. Grove discourses on Antagonism, and next Friday, 27th inst., Mr. J. Wimshurst will lecture on Electrical Influence Machines.

Last Friday Prof. Flower lectured at the Royal Institution on the Pygmy Races of Mankind, and in the course of his remarks stated that the various classical authors who referred to the existence of races of diminutive human beings were correct in placing them in the interior of Africa and southernmost parts of Asia. It is still, however, he said, an open question whether these old stories may not be classed, with innumerable others, as the offspring of the fertile invention of the human brain, the potency of which as an origin of myths is sometimes too much underrated. Prof. Flower then went on to describe the pygmies actually known to exist, and referred to the Andamanese, who, however, average more than 4ft. 6in. in height; the Negritos, the bushmen, the Negrillos, and the Akkas, who rarely attain a stature of more than 4ft., and are probably the smallest people.

Writing on the scientific work of the Fishery Board for Scotland, Prof. Cossar Ewart says:—To admit of even the present small sum voted for fishery inquiries being economically and judiciously spent, it seems to me to be imperative that something should be done soon. Even if the present constitution of the Fishery Board remains unchanged, much would be gained by the formation of a scientific and technical fishery department or commission which might consist of two or more members. This department once in existence, development in various directions would be at once possible. There are already English and Irish fishery inspectors, and the English Marine Biological Association is engaged, at the public expense, in fishery inquiries at Plymouth. It is extremely desirable that those engaged in fishery work should be in touch with each other; that there should be, in fact, sufficient co-operation to prevent overlapping of work, and the consequent waste of public money. This could be readily secured were representatives from England and Ireland united with a Scottish scientific department to form a committee or commission of fishery experts, who might meet once a year, or oftener, to arrange as to the work in the several countries, and deal with any questions referred to them for consideration.

The new chemical laboratory at Cambridge, which has been built at a cost of some £30,000, will be ready for occupation during the Easter term. It is stated that Dr. Anningson and Mr. Robinson will organise a class in Practical Hygiene, to be held in the new laboratory during the long vacation. The course will include the analysis of air, water, and food, and the demonstration of sanitary models. The Professor of Chemistry also announces a laboratory course in pharmaceutical chemistry, suitable for candidates for the second M.B. examination.

The next meeting of the Institution of Mechanical Engineers will be held in London on May 3 and 4. The annual dinner will be on the 4th. The report on friction of a collar bearing will be read, and a description of the emery testing machine by Mr. H. R. Towne. A supplementary paper on "Petroleum Refuse as Fuel for Locomotives" will be read by Mr. T. Urquhart.

The new warship *Victoria* will cost the country over £800,000. Will one well-directed torpedo sink her?

One of the American electrical papers says that the electric motor for driving power in place of steam is attracting much attention in St. Louis, Mo., where there are now eleven different establishments using electro-motors. We presume the current-creating machines are driven by water-power.

The system of electric welding which has been developed in the United States—at all events, into the appearance of a company—is said to be attracting much attention, and that orders await the erection of the workshops from manufacturers of all kinds of metal goods.

A vigorous effort is being made to create three or four centres of technical education in the South of London. In view of the number of artisans who live across the water, it is highly desirable that technical instruction should be provided for their children, and the Charity Commissioners have offered to give a pound for every pound subscribed. It is proposed to plant one school in Battersea, another somewhere about the Elephant and Castle, and a third at Deptford or Bermondsey. It would, however, be interesting to learn what is meant by "technical instruction" in this connection? If it will resemble that given at the Finsbury Technical College. four centres would be better than three. If it means merely teaching the use of tools, or how to make something at a low price, it is not wanted.

Profs. Victor Meyer and Riecke suppose the carbon atom to be a sphere surrounded by an ether shell; that the atom itself is the carrier of the specific affinity, while the surface of the ethereal envelope is the seat of the valencies. Their hypothesis is said to be the "germ of a grand generalisation."

A medical paper says that "a solid and highly-nutritious meal ought to begin the day's work; an equally solid and equally nutritious meal should end it." That is exactly the opinion of the bricklayers' labourers, who commence work breakfastless; but it is not the opinion of physiologists.

The question as to the best means of promoting technical education is being discussed in Russia. A Congress, summoned by the Permanent Committee for Technical Education, is about to meet at St. Petersburg for the consideration of the subject. The sum of £500 has been granted by the Government for the expenses of the Congress.

Amongst curiosities now "going the rounds" is the statement that a new glass recently invented in Sweden is capable, when made into a lens for a microscope, of "enabling us to distinguish the 204,700,000th part of an inch."

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, *332, Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

⁂ *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

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AMERICAN CRITICISM ON THE LICK OBSERVATORY — BOOKS WORTH READING — VELOCITY OF THE EARTH IN HER ORBIT—ORDNANCE DATUM—THE PLANETOIDS—TELESCOPE—ADJUSTING EYEPIECE.

[28634.]—IT would appear that an article headed "Costly Blunders in the Building of the Lick Observatory," which has been going the round of the American papers, has excited the indignation of a well known correspondent of the ENGLISH MECHANIC, Mr. J. A. Brashear, as he has devoted more than a column and a half of the *Pittsburg Dispatch* of February 27th, to the refutation of the accusations—some of them ridiculous enough—which have been made against the huge pile on Mount Hamilton, and all that therein is. He deals in succession with attacks on the trustees, on the selection of the site, on the mechanical efficiency of the dome, on the movable floor, on the stability of the great telescope, and winds up in these words:—

"My own opinion, though it may be unfounded, is that the writer of the article was some unsatisfied person who failed of getting one of the contracts, and takes this short route to condemn the work of men who have done their duty and have given to the astronomer an observatory and an equipment second to none in the world."

Ars probat artificem—"the proof of the pudding is in the eating," and it only remains for the staff of the Lick Observatory to justify Mr. Brashear's chivalrous defence of them, and the Cyclopean instrument under their control, by speedily adding to our knowledge of the celestial vault by its aid.

I have just been reading two books on widely different subjects indeed, of sufficient excellence and interest to prompt me to recommend them strongly to my brother-readers. The first is entitled "In Pursuit of a Shadow," and is written by Miss E. Brown, the lady astronomer who went to Russia as a deputation from the Liverpool Astronomical Society, to observe the total Solar Eclipse of 1887, August 19. Unhappily, as everyone who will see these lines knows, her long and toilsome journey was unsuccessful, and one extremely transient glimpse of the eclipsed sun was all that she enjoyed. In the charming little book of which I am speaking, she gives just such an account of her expedition and adventures as any intelligent and cultivated lady would do in conversation at a dinner-table, without a suspicion of that word-spinning and "fine" writing which disfigure so many books of travel, and make their perusal a weariness of the flesh. Everyone who wishes to gather an idea of the aspect, physical and social, of Norway, Sweden, and Russia in the course of one evening's reading, should get this little book. Trübner and Co. publish it. The other volume to which I am referring is, as I began by saying, on a widely-different subject indeed. Its title is "Practical Microscopy," and its author is Dr. Maurice N. Miller, of the University of New York. Ostensibly written for students and practitioners of medicine, this excellent work seems to me to be the very model of a manual of instruction for every incipient microscopist who is interested in the study of that department of the science which shows how indeed and in truth we are "fearfully and wonderfully made." The technological part of the book is particularly good. Nothing can be plainer or more intelligible than the directions for section-cutting, staining and mounting objects, &c., and profusely illustrated as they are by photographic reproductions of the author's own pen-drawings, they are really almost as effective as actual laboratory demonstrations. Even the method of setting a razor on a hone for section-cutting is described and illustrated by a woodcut. I have, so far, met with no work on the subject in which the instruction is at once so exceedingly simple and intelligible. Such books may exist, but I am unfamiliar with them myself. By the bye, I do not know on what authority Dr. Miller names the section-cutter described and figured on p. 12 as *Stirling's* microtome. It has been in use on this side of the Atlantic for many a long day: in fact, I (under the nom-de-plume of "A Member of the Microscopical Society") drew and described it myself on p. 12 of Vol. IV. of the ENGLISH MECHANIC.

Lest "Esne Catalita" (query 64937, page 114) should get confused between the reply I gave to him in the concluding paragraph of letter 28581, p. 122, and that furnished by "E. L. G." on p. 135, I will just give here in more detail a mode of calculation by the aid of which your correspondent can satisfy himself of the correctness of my figures. Taking the solar parallax adopted in the *Nautical Almanac*, 8·848", the mean distance of the earth from the sun must be 92.392,450 miles, and the circumference of her orbit 580,518,930 miles; an orbit described in 31,558,145 seconds, or one sidereal year. Hence her orbital motion per second at her mean distance = 18·3952 miles. When in aphelion she travels through 57′ 12·3″ of this orbit in a day (*N.A.* p. 112); when in perihelion, through 1° 1′ 11·7″ during the same interval (*N.A.* p. 202). Two rule-of-three sums will do the rest. [This was, of course, written, and, I presume, in type, before the appearance of "E. L. G.'s" addendum on p. 153.]

I regret my inability to inform "A. I. E. E." (query 64971, p. 136) at what precise part of the Mersey the Ordnance Survey Datum was originally fixed.

I should like to say, in connection with a remark by Dr. Cane, in letter 28612, p. 144, that I fear that his study of the orbits of the 273 planetoids must have been of a somewhat perfunctory character, if he has succeeded in satisfying himself that by any conceivable possibility they could ever have formed portions of one larger one.

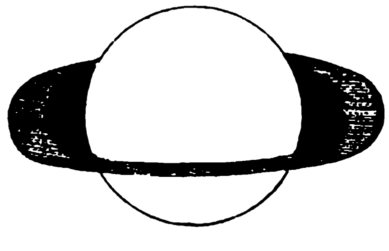
I am sorry that I have no means of access to the figure on p. 36, referred to by "H. H." in reply 64424, p. 150, at the place whence I write, but would just say here that if a flint lens with one face plane and the other convex were fitted into a crown lens of corresponding concavity, with one plane face too, then that the positive refraction of the flint lens would overcome the negative refraction of the crown one, with the result that, albeit the external surfaces would be parallel, a lens of very long focus would be the result.

If "Amateur" (query 65020, p. 155) has obtained his object-glass and eyepiece from a competent optician, the lenses of each are already properly centred, and if my querist possesses, as he alleges, the needful mechanical skill, he can, of course, turn the tube of his instrument and the smaller focussing one so that the axes shall be coincident. The only adjustment then to which he will have to devote his attention is that of the coincidence of the optical axes of the objective and eyepiece. This he must test by fitting on his object-glass (without screwing its cell tightly to the main tube) and the eyepiece, and directing the telescope to a star. When the star is approximately in focus, it will be seen as a point of light with a few rings round it. Now, if these rings are strictly concentric with the central dot of light, the telescope is in adjustment; but if they appear on one side of the tiny disc, the object-glass must be gently tapped in towards the eyepiece on the side on which the rings appear. A raw-hide mallet answers well for this. This process must be repeated until the rings are concentric with the central star disc, and then the instrument will be in adjustment, and the cell of the objective may be screwed up to the main tube.

A Fellow of the Royal Astronomical Society.

SATURN.

[28635.]—M. ELGER et moi (L. 28582) nous sommes loin d'être aussi en désaccord que pourrait le faire croire notre petite discussion; nous n'avons l'un et l'autre qu'un seul but—la recherche de la *vérité*; c'est pourquoi nous nous associons pour provoquer des vérifications nombreuses au sujet des détails délicats qui sont à la limite de visibilité dans le système de Saturne, et surtout à l'aide des plus puissants instruments dont on dispose aujourd'hui. Ma lettre va prouver que je n'ai pas de parti pris dans la question et fournira peut-être le moyen de soumettre le véritable aspect de l'anneau C à une épreuve concluante.



Le 5 avril, 1888, de 8h. 20m. à 9h. 35m., j'ai soumis Saturne à un examen minutieux, à l'aide des grossissements de 250, 280, 420, 470, 560, 650 de mon équatorial de Grubb, et jamais je n'avais obtenue une image aussi belle avec les grossissements les plus forts: l'amplification de 650 fois elle même donnait une image irréprochable et pleine de détails. J'ai fixé mon attention surtout sur l'anneau obscur, sur la division Cassinienne et sur l'ombre du globe. Contrairement à ce que j'avais observé le plus souvent cette année, l'anneau C était cette fois mieux limité dans l'anse occidentale et son bord interne était *évidemment* rendu confus dans l'anse orientale par une cause dont l'existence n'était pas douteuse, mais dont la nature reste mystérieuse; *jamais* non plus je n'ai *soupçonné* avec plus de confiance l'existence de dentelures au bord interne et de détails dans l'anneau C et dans la division de Struve; celle-ci, par une interversion semblable, se montrait mieux cette fois dans l'anse occidentale. Pour procéder en toute impartialité, je figure ici le bord interne de l'anneau obscur tel que je *crois* l'avoir vu avec les grossissements de 450, 560, et 670. *Peut-être d'autres observateurs ont ils figuré des dentelures aux mêmes places et indépendamment à la même heure, et fourniront ils ainsi une preuve décisive.* Il me semble aussi résulter à l'évidence de ces faits que l'anneau obscur tourne dans son plan et assez probablement tout d'une pièce, et si nous ne saisissons pas ce mouvement avec évidence, ce doit être à cause de l'extrême difficulté avec laquelle ces détails délicats se laissent *suivre*, étant données les conditions si souvent défavorables qui empêchent d'employer les grossissements suffisants pour les voir.

J'ai fixé mon attention sur la division Cassinienne, qui avec le 560 et le 650, était d'une admirable netteté, et surtout sur l'anse orientale, et je n'y ai remarqué, *avec certitude suffisante*, aucune dentelure.

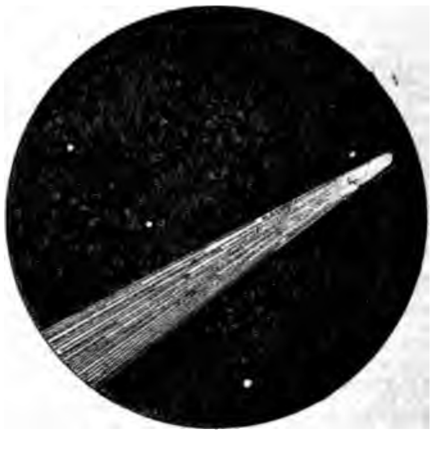
L'ombre du globe, avec ces grossissements, semblait d'une forme assez régulière; son contour, excessivement tranché, ne présentait d'apparence de concavité qu'en raison de l'existence d'une petite pointe, très courte, projetée sur la division Cassinienne.

J'ai la satisfaction de vous annoncer que j'ai commencé la série des observations physiques de Mars et que, grâce à l'excellent et puissant instrument dont je dispose, et malgré la position défavorable de la planète, elles donnent déjà des résultats très intéressants dont j'aurai peut-être le plaisir de vous entretenir bientôt.

Dr. F. Terby.

COMET SAWERTHAL (*a* 1888).

[28636.]—THIS comet was seen here this morning at 15h. 7m., at which time I got the accompanying sketch. It was almost midway between 8 and 31 Pegasi, having its head directed towards *a* Pegasi. It was an easy object to the naked eye. The small star near to its head must have been passed over by the coma at about an hour previous to the time when the drawing was taken. Its nucleus appeared stellar with powers 25 and 40; but 100 gave it an elongated appearance, and with 250 it was strongly suspected of being granular. It bears magnifying well. The tail was straight, and could be seen the full length of the field of my low-power e.p. (which, by the way, is one of my own make, and has a very large field). This eyepiece showed the tail nearly as long again as shown in the drawing. Close behind the nucleus, and for fully half a degree, the tail was very bright compared with the rest of that appendage.



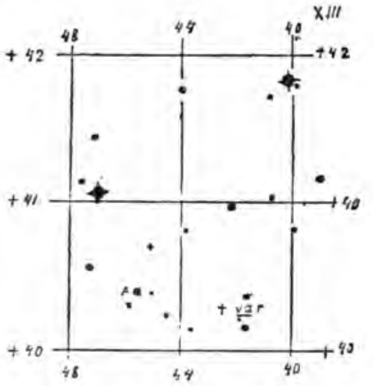
Before I finished the observation the topmost of the two small stars seen through the tail was clear of the tail, or very nearly so, and I was very much impressed by the apparent difference in brightness whilst immersed and when free from the tail. I have tried to show the apparent brightness of the stars in the drawing by their difference in size. There were other small stars in the field. A faint pair midway between the bottom star in sketch and the star near the head of comet were just upon being enveloped in the tail; but dawn put a stop to further notes being taken. This last mentioned pair are not shown in drawing.

David Booth.

26, Servia Mount, Leeds, April 10th.

CIRCULAR No. 19 OF THE WOLSINGHAM OBSERVATORY — THE SUSPECTED NEW VARIABLE STAR IN CANES VENATICI.

[28637.]—MR. SADLER has kindly called my attention to a slip in Circular No. 19 where the minutes of R.A. are printed as 24 instead of 42. Perhaps the inclosed sketch may help those of your readers who have not equatorials to find the suspected variable. The two largest stars are—



		h.	m.	s.	°	′	
D.M. + 41° 2424	xiii.	40	6	+ 41	48·9	5·7
„ + 41° 2434		46	59	+ 41	3·7	6·7

Now, if two imaginary lines be drawn—the first from β Boötis to α Canum, the second from η Ursæ to υ Boötis—the first of these two stars will be found close to where these lines intersect. The star D.M. + 40° 2701 which lies 2m. 53s. *f.*, and 8′ N. the suspected variable, and is marked A in the sketch, is also orange-red and III. type, and is now only 8·0, though in the D.M. it is 6·9. It may also be variable.

T. E. Espin.

THE SOUTHERN HEAVENS AND A FLAT EARTH—THE MOON'S HEAT—DYING BY EFFORT OF WILL.

[28638.]—I SEE one of my old friends and occasional antagonist was remarking lately upon my having ceased to contribute to these pages. The fact is that I have had to undertake heavy duties, which not only engaged my time and thoughts, but made me unequal to other things, I not having the same energy nowadays as when I used to write so much, and especially when I began to do so some 22 years ago. However, I expect soon to be relieved of the stress, and to be able to return to my literary work and pleasure, and, as a beginning, I may as well notice some matters which struck me in looking over a few recent numbers.

I see Mr. Hampden is at work again to prove the flatness of the earth. Now, will he just answer the challenge I gave him some years ago, to give us a map of the earth on his system which will meet the most simple elementary facts known to everyone who has travelled in the southern hemisphere? Of course, I have seen such maps as are prepared by his co-teachers; but they do not pretend to fulfil the first simple requirement—viz., that the distances between places should obey the same laws south of the equator as they do north of it. We know that a degree of difference of longitude means a certain difference of time equal at all parts of the earth, and that a degree of longitude means a number of measurable miles, varying with the degree of latitude at which it is measured, increasing as we go south towards the equator. But as we go south beyond the equator this number of miles again decreases to exactly the same value as that of equal north latitude. In Mr. Hampden's map it would *have to go on increasing.*

Exactly the same occurs with the stars. Anyone looking at the heavens will see that they appear to rotate in circles around a point in the northern heavens, not far from what we therefore call the north, or pole, star. On Mr. Hampden's plan they should continue to do so when we pass south of the equator. *They do not.* On the equator we see them circling in smaller and smaller circles alike to north and south. At extreme north or south alike we find a point which is apparently the centre of rotation; the only difference is, that near to the northern centre there happens to be a noticeable star, while there is none so near at the south: in all other respects the motions of the stars are identical. The beautiful constellation of the Southern Cross, which happens to have the two stars forming its long axis in nearly the same line of longitude—that is, upon a circle cutting both N. and S. centres—is seen to rotate around the southern centre of motion, always pointing towards it, just as the "pointers" do in the north. Suppose Mr. Hampden would just explain that fact (anyone who has been south will tell him it is the fact) on the assumption that the heavenly bodies travel in rings around the North Pole over a flat earth, of which the North Pole is the centre and the southern ice fields the inclosing circumference.

It is curious to observe the vitality of error—slay it a thousand times, yet it stands up directly for another fight. How many times in these pages has the fallacy been exposed, that there is less heat derived from the sun in the upper regions of the atmosphere than at the surface of the earth? Wherever physics are taught, is it not explained that the heat caused by the sun's rays is greatest at the outer confines of the atmosphere, because as those rays traverse the air the heat is taken out of them by being absorbed in the water contained in the air? Is it not a commonplace fact that Alpine climbers suffer from the heat when exposed to the sun, even when in the region of eternal snow? Does not everyone who studies the phenomena and laws of heat know of a certainty that mountain tops and balloon travellers are cold because they radiate their own heat away, as all bodies do, but, being isolated, receive little heat in return, as bodies do when surrounded by other radiating bodies? Yet we have "Dens," 28611, p. 144, repeating the old fallacy, that "the cold above the snow-line is caused by the thinness of the earth's atmosphere" above, and asking "how can the surface of the moon (where there is no atmosphere) receive any heat, more than space?" Simply because heat is a function of energy and matter; the sun's rays carry the energy. When it reaches and is absorbed by matter, it appears as heat.

"Nemo," 28498, p. 54, puts forth the same erroneous notion. There are two good reasons why the heat and cold of the moon's surface must greatly exceed those at the earth's surface. (1) The absence of atmosphere increases both; it allows the whole heat to reach the surface, and presents no check to radiation when the sun's ray's cease to reach it. (2) The day and night being equal to the 28 of ours (at the Equator) absorption and radiation both go on to a much greater accumulative effect.

There seems to be some confusion of thought in the communications about voluntary death. I remember reading an American tale in which one of the actors comes to the conclusion that he deserves to die, while another asserts that she could not survive him, and the other parties find them dead the next morning. The point of the tale was that no one need live who willed to die—that is, really "dying by an effort of will," which, I take it, is a mere idle tale. But what the various writers have referred to is not dying at all, but a voluntary passing into catalepsy. I do not see the least reason to doubt the possibility, though not prepared to maintain the truth of various apparently well-attested instances of apparent voluntary death and revival among Hindoo fakirs. It is an undeniable fact that the sect of Yogos do cultivate those mystic powers and conditions of which we in Europe know a little under the name of mesmerism to a degree which may well be incredible to those who have not seen it as I have. They undergo calmly what to others would be torture, and evidently do not really suffer. They will vow, and fulfil it, a lifelong fixing of limbs in a fixed posture: they will take up a position and never leave it, living solely on what the charity or piety of their co-religionists absolutely puts into their mouths, never speaking or taking any interest in ordinary life. I have myself seen one who had held an object in his stretched-out hand till his finger nails had grown over it and passed right through his hand. From what I know of natural and artificial catalepsy (that state in which many have narrowly escaped burial, and many have undoubtedly been buried), I fully believe that it could be voluntarily assumed by those who have cultivated the state of absorption and mystic meditation under this influence of fanaticism; but how long they could maintain it and live I have no data to form an opinion about.

Sigma.

THE MOON'S TEMPERATURE.

[28639.]—THE notion of "Dens," p. 141, that the moon's surface may never, even by 350 hours of sunshine, be more warmed than the snow on the Himalayas is warmed by 12 hours, would be quite plausible if her whole face had the same average whiteness as that of Jupiter or Uranus, or as the brighter parts of Saturn's ring, which, we are told, have the reflectiveness of white-lead or glacier-ice, if not of snow, for the luminous or visible part of sunlight. But the mean reflecting power of the lunar materials is found no higher than of darkish sandstone or slate rocks—that is to say, they absorb as much as these do of the coloured rays, and must therefore be warmed by these, even if they can reflect (which is very unlikely) the whole of the unseen or ultra-red heat rays. I cannot doubt, then, on this evidence of mere colour, that whenever the moon's thermometric effect shall be tried with a speculum of silver-on-glass, she will be found to send us decidedly more heat at the second quadrature than at the first, or more at any phase after the full than at an equally bright one before the full, and that we get most heat from her not when full but some time later. It is true that no experiments have yet shown this, but have made her heat seem exactly proportional to brightness, and equal for equal phases, whether before or after the full; but we must remember these trials have all been either with refractors or with the great Parsonstown speculum. Glass can only transmit heat of as small wave-length as the visible colours—that is, only what has been reflected from the moon's rocks without warming them. They must be warmed more or less, but what they then re-radiate is of low refrangibility, and can neither pass through the glass of refractors nor bound off the yellowish speculum metal of Lord Rosse. Both glass and this alloy absorb it practically all; but silver will reflect enough of it, I expect, to make the difference between the reflected sun-heat and the proper moon-heat measurable, and then we may know approximately what the lunar rocks' highest and lowest temperatures really are.

E. L. G.

ILLUMINATION OF THE ECLIPSED MOON.

[28640.]—I THINK it is impossible to read Mr. Ranyard's instructive letter (p. 144) without feeling that there is still much to be learned respecting the cause or causes of the variation in the light of the eclipsed moon. With a view, therefore, to elicit discussion, I ask the insertion of some further remarks.

In the first place, I wish to call attention to a fact which may be observed, as I believe, in all total lunar eclipses—viz., that the depth of the darkness in the shadow-cone increases from the circumference to the centre. When totality has just commenced the part of the moon last immersed is much brighter than the rest, and when totality is about to end a relatively bright arc indicates very clearly the part which will first emerge. Similarly, all through the eclipse a preponderance of light may be observed in that part of the moon's limb which is nearest to the edge of the shadow, and I believe that in this way it is generally possible to say from observation on which side of the centre of the shadow the moon's path lies. I cannot understand how it has come to pass that this fact, which must have been very generally recognised, has received so little notice, unless it be that a false analogy of terrestrial experience has led to the idea that no explanation was required. It may have been thought to be a matter of course that the deeper the immersion in the shadow the denser would be the darkness; but a little consideration will show that, in the case of the earth's shadow, special explanations need to be given—not only of the fact that some light falls within the shadow, but also of the fact that the light in different parts of the shadow varies in amount, according to the distance from the edge. It is clearly necessary that this regular or normal variation should be borne in mind in the observation of any less regular or comparatively abnormal variation.

With regard to the source of the light that falls within the shadow, whatever view may be taken as to the influence of the solar corona in the shadow generally, I cannot but think that the corona must at least be an important contributor to the light that falls just within the shadow; for here, it must be remembered, will fall the rays from the very brightest part of the corona—that immediately contiguous to the sun's limb. It may or may not be that the refracted solar rays will be also very bright at this point. Complicated considerations are involved in that question, which I will refer to again immediately; but, at all events, the brightness of the corona, as seen from points just within the umbra, can hardly admit of question.

The relations between the refracted solar rays and the different parts of the earth's shadow-cone involve difficulties which are beyond my power to solve with satisfaction to myself. I can do little more than indicate the points which seem to me to require more consideration than they have hitherto received, and throw out a hint which may possibly contain a germ of truth within it.

It is very important to remember, as Mr. Ranyard reminds us, that the solar rays which are refracted through the lower strata of the earth's atmosphere will converge to a point in the shadow considerably within the distance of the moon, and

r. Ranyard's calculation that no rays will reach e moon but such as are refracted through atmo-heric strata at least 2½ miles above the sea-level ems fatal to Sir John Herschel's idea that the riation of light might be due to variations in e amount of cloud. I fancy it also disposes of e universally-accepted notion that the redness of e eclipsed moon is occasioned by the passage of e sun's rays through the earth's atmosphere. his point must be referred for settlement to ose who have had opportunities of seeing the n rise or set from balloons or mountains at an titude of 2½ miles; but in the mean time I may allowed to say that, in the probable event of being shown that the atmosphere at that height s not the property of reddening the sun's light, way will be opened for the suggestions in my st letter that the moon, like most other objects, s a colour of its own.

If I am not mistaken in my views of this rather mplex question, the laws determining the pro-rtion of light received in different parts of the rth's shadow from the refracted solar rays may expressed as follows:—

1. The purity, and therefore intrinsic brilliance, the light will be greater in the more distant rts of the shadow than in those which are nearer e earth, because the more distant parts will re-ive the rays which have passed through the gher strata of the atmosphere and have under-ne the least refraction.

2. For the same reason, at any given distance m the earth, the purity and intrinsic brilliance the light will be greater near the edge of the adow and less towards its centre.

3. The proportion of the sun's disc from which racted rays can be received will be reduced as e distance increases, the diminishing angle of fraction shutting off more and more of the rved parts of the disc.

4. For the same reason, at any given distance e proportion of disc available will be least near e edge and greatest at the end of the shadow.

The tendency of law 3 will be in opposition to at of law 1; the tendency of law 4 in opposition that of law 2. What will be the net result of ese conflicting causes, I am unable to say; but I ink it may be worth while to suggest the possi-lity of some part of the variation in the light of e eclipsed moon on different occasions being due the moon's varying distance from the earth. A riation of over 30,000 miles in the distance of e moon must involve an appreciable difference the height of the atmospheric strata through hich the rays reaching the moon must have ssed, and if we suppose law 1 to be only par-lly neutralised by law 3, the illumination of e moon should be greater in an eclipse occur-g near apogee than in an eclipse occurring near rigee.

As a step towards the practical testing of this pothesis, I may mention that in the eclipse of rch, 1848, which has often been cited as a iking example of a bright eclipse, the moon was thin three days of apogee, and that in the re-rkably dark eclipse of October, 1884, the moon s within three days of perigee. I am willing to ow that these may be only misleading coin-ences, and, indeed, I must admit that in the ipse of February, 1877, when the moon was thin one day of perigee, its disc was, neverthe-s, plainly visible. On the other hand, the ipse of August, 1877, supports my suggestion, it occurred on the day of apogee, and was a ght eclipse; and our experience of the recent ipse, which happened nearly midway between gee and perigee, and may be considered to ve been of average brightness, is also fairly sistent.

If I might criticise the view which Mr. Ranyard vours, that dark eclipses may be explained by the th being enveloped at the time in a cloud of teoric dust, I would urge the objection that if h a state of things prevailed in October, 1884, night be expected to have been followed by a ious and general precipitation of the material, ereas, notwithstanding that many observers re on the watch (stimulated by the Krakatoa ption and the sunset glows), the results of their ervations were insignificant. I am inclined to nk, also, that the collision with the earth's osphere of an infinite multitude of minute teoric particles would be attended with pheno-na of combustion not less striking in their way n those which attend the collision of a single ge meteor.

George F. Burder, M.D.

lifton, April 16.

E GLACIAL PERIOD AND ITS END.

28641.]—THE two facts that there has been a cial age, and that all lands have been deluged an arrival of water from external space, seem lly the sole two whereon Mr. Cane builds up a ance of endless errors, contradicted by physics geology at every conceivable point. Even the r of these two he inverts, for if the Deluge ed the glaciation, it must have *preceded* the glaciation; and he might as well maintain the chalk strata preceded the coal. The problem raised by a glacial age has never been what caused or began it, but how it ended, or what altered the glacial into the present state of things. I cannot conceive how Mr. Cane has escaped the knowledge of enough physics to see that the diluvial addition of as much water, suddenly, as now stands above the 100 fathom line, instead of having any tendency to increase glaciation, is exactly such an event as would most certainly put an end to a glacial period, or convert a glaciated world into the present one.

When he speaks, at the end of letter on p. 144, of steam at the top of the atmosphere that "could hardly be superheated," is he aware that "superheated" or dry steam is practically the only kind present in the atmosphere at all—certainly the only kind at any considerable height? Steam not superheated is *wetting* steam, wherein no surface (not warmed above it) can remain a moment dry; and such an atmospheric state is extremely seldom found, even at sea-level. In the next line, he supposes vapour that has become rain *then* to become snow, an impossibility. Snow is not frozen rain; the rain must re-evaporate before it can form snow. This is the kind of stuff whereon he builds throughout, which Mr. Godden would miscall "science of fifty years ago," and "dead, buried, and decomposed"; but, of course, this has never been the case with *science*, however old. Whatever is dead and decomposed never was science at any time, but some sensational romance or guess, like the exploded fragments of the burst planet.

If we imagine the earth with somewhat less of one or of both her fluids—say, 90 per cent. only—of either the present water or the present air, her condition would be as glacial as we infer, from gravel-beds, that it was in the time of mammoths and flint-folk. Now, if Mr. Cane did but look into true physical laws, as far as now well known, he would find that a sudden addition of as much water as is now above his hundred-fathom line would bring climates to their actual state, and at the same time leave the anomalies in plant and animal distribution that baffle Darwin and the Darwinites, the obvious non-survival of the fittest on any land disconnected from Asia, and leave all the actual known diluvial effects; but *not* those his imagination is now inventing. There is no trace of any animals being "frozen to death," nor "inclosed in snow," nor "slowly carried down by glacier action." He will find in Howorth's mammoth book that no bone or relic has ever been found in ice or snow. They were in either deluge-gravel or deluge-mud. When this is in Europe or a mild climate, bones alone are found; but in North Siberia the eternally frozen mud keeps the animals whole, with flesh and hair. They are as often far from rivers as near them; a remark that Darwin equally made about the South American victims in his first work (twenty years before the "devil's gospel"), when he thought it unlikely any section could cross that continent without cutting some of their skeletons. I never suggested, as Mr. Cane implies, a difficulty as to the *long preservation* of the Siberian carcases, but their being so *suddenly frozen*, with their faces turned southwards (as they always are), struggling against the mud-torrents that had swept them from the temperate zone. But this difficulty, I should have seen, vanishes on considering that our temperate regions had then been for ages as glacial probably as Greenland is to-day, so that the diluvial waters, even if they fell boiling, had to melt glaciers enough rapidly to cool them.

Asking, if they fell hot in one climate, what temperature had they in another, is really like asking the same about aërolites. The heat, being due to arrested motion or to condensation, was quite independent of sun or of latititude. We know that meteors, reaching the ground in white-hot fusion, were a few seconds previously as cold as frozen mercury. Equally cold we must suppose the aqueous matter in its cometic state, till the last few seconds before reaching ground. Assuming it to *overtake* the earth, there was but little orbital speed to be checked; but in those few seconds her gravitation gathered the fine snow mist into liquid balls, whose outer layer would vaporise (as happens even to stony meteors), and the residue fall scalding hot, a detail that the Parsee and Jewish stories have preserved.

E. L. G.

ORGAN MATTERS.

[28642.]—SINCE the appearance of my letter in your issue of 23rd March, No. 28553, page 83, a reader of the "E. M." has kindly sent me an extract from the great work of Rimbault and Hopkins on the organ, showing that in the invention of Mr. Clark, and in that of myself (identical with that of Mr. Clark) we have been completely anticipated many years ago by the elder Gray, who applied the very same means, in every respect, of meeting the swell-box difficulty, to the organ of St. Martin's-in-the-Fields, London. Both Gray and his work, however, might have been quite forgotten but for the record of it in the above book, which may be found at page 93 in the third edition.

Possibly Mr. Clark may have been, like myself, unaware of Gray's work, as described in the extract alluded to; but now that attention has been called to it, it is to be hoped Mr. Clark will refrain from appropriating, by patent or otherwise, an invention the credit of which, presumably, belongs to the elder Gray.

No doubt anyone may now, after such a lapse of time, *copy* Gray's work; but surely his name and memory should always be honoured in connection with its reproduction.

I inclose a copy of the extract from Rimbault and Hopkins's book, in case you should deem it of sufficient interest to your correspondents, or to your readers generally to warrant its insertion:—

"*The Echo and Swell.*—Some of the old swell-boxes were furnished with a wooden tube, not unlike a wind-tube, projecting from the back of the box and passing out into the tower of the church. This was the case with the organ at St. Martin's-in-the-Fields, built by the elder Gray. The end of the tube attached to the swell-box was furnished with a trap which opened when the swell was closed, and closed when the swell was opened, by which means the subdued effect of the swell, when shut, was increased on account of an outlet being thus afforded for the sound.

"This contrivance suggests a method of overcoming a difficulty with regard to the larger swells of modern organs. If the swell is much used without being opened, and the shutters fit accurately, the atmosphere within the swell-box becomes increased in density by the great quantity of wind that rapidly passes through the large pipes into the circumscribed area of the box, which has the effect of flattening the pitch of some of the pipes. If, on the other hand, a little leakage be allowed, the escaping air, by carrying some of the tone with it, renders the softened effect of the swell less perfect. By adapting a tube as above, there would be free ventilation within the swell-box when closed as well as when open, whereby the freedom of speech of the large as well as the small pipes would be better secured: the pipes would not be thrown out of tune by being smothered, and the fullest contrasting power of the swell would be better preserved.

"If the swell were likely to be exposed to *two* temperatures—a second and lower one from the tower—when the shutters were closed, this might be rectified by placing a small gas-jet at a safe distance from the mouth of the tube. In his Exhibition organ Mr. Willis secured a free circulation of air by putting the swell bellows inside the swell-box."—(Page 93, 3rd edition.)

Isaac Stammers.

8, St. Domingo-grove, Liverpool, April 10.

MICROSCOPICAL.

[28643.]—THE letter of "T. F. S." (page 146) suggests some interesting questions, and one is this—Is there in microscope magnification anything equivalent to the "100 to an inch of aperture" in telescopes, and, if so, where is the practical limit? For instance, "T. F. S." gives the magnification with four E.P.'s of his objective of six millimètres focus. Roughly this is about the same as an English ¼in., yet by the deepest eyepiece this is forced up to a power of 1,368 diameters. As the E.P. magnification is 27, that of the objective must be about 50 (50 × 27 = 1350), and the proportion of one to the other is therefore $\frac{27}{50}$. Take, again, a Smith and Beck, $\frac{1}{40}$, which is about one-tenth the focus of the Zeiss. The highest magnification is given as 10,000 with the No. 5 E.P., which I make to be of the power of 25. Then, as we have 400 for the objective, the ratio is $\frac{23}{40}$, which does not greatly differ from the $\frac{27}{50}$ of the former case. Taking a kind of average of these two, we may say the E.P. magnification as an extreme is about $\frac{1}{16}$ that of the objective. Now take a $\frac{1}{40}$ objective, and use it to get the 1,363 diameters, and we only need an E.P. of 3·4, which brings us, so to speak, to the other end of the scale, and suggests the question, Where lies the happy mean; what, in fact, is the best proportion (all things considered, and assuming objectives of the highest class) of E.P. to objective?

Here is another point that "T. F. S." may be able to throw light on. In Zeiss's list a higher price is quoted for objectives to be used with the longer tube of the English instruments, which suggests that for these the objectives are more carefully worked and corrected. Now, if we use one of the objectives corrected for the long tube with the short tube, do we find its performance better or worse than that of the objective corrected for the short tube only?

This question bears on the use of the draw-tube for increasing the power, because if objectives require to be specially worked to enable them to be used on a longer tube, it would seem to follow that the use of the draw-tube must be injurious to the performance of any objective. As we do not find this to be the case with an English objective and a moderate extension of the length of the body, it appears that our own objectives are able to bear with impunity a strain that breaks down foreign objectives, unless the latter are specially worked and charged for accordingly. What is "T. F. S.'s" experience in regard to this, more especially with Zeiss's apochromatic series?

In reference to "T. F. S.'s" comment as to opticians not giving the true powers of their objectives, Dr. Carpenter, in "The Microscope and its Revelations," makes a remark which is not very complimentary to the opticians; but I suspect in many cases the differences arise from minute errors in working the lenses rather than from any intentional desire to deceive their customers.

In what way the focal lengths of small lenses are measured in the trade seems to be a jealously-guarded secret, which I have in vain endeavoured to penetrate.

Lastly, has such a thing as a pancratic eyepiece ever been applied to the microscope? I have been making a few experiments in that direction with promising results, an arrangement with three lenses seeming more satisfactory than with any less or greater number. **A. S. L.**

MICROSCOPICAL DRAWINGS.

[28644.]—PERHAPS this little device for drawing with the microscope may prove useful to some of your microscopical readers:—Take a small portion of the silvering from the back of a mirror, about $\frac{1}{16}$in. in diameter (there must be a thick coating of paint on the back of the amalgam to support it, or it will not break off). This small reflector is to be mounted with cement on the edge of a piece of watch spring at the proper angle. The spring is bent round and fixed to a brass tube fitting over the eyepiece, so that the reflector stands about ¼in. from the eye-lens and central with it.

On looking into it the object on the stage of the microscope is seen, and appears to be projected on to the paper spread below. I believe that steel mirrors are used for the same purpose; but the amalgam has a very good surface, costs nothing, and can be renewed in a very short time. It is better than the "neutral glass plate."

M. T. D.

HYDROSTATICS AND STRESSES ON IRON CISTERNS.

[28645.]—"M.I.C.E., Bath," says $\frac{120^4}{120^4 + 96^4} \times \frac{96^2}{\cdot 1875^2} = 94{,}700$; and he invites me to check his calculation. I find it erroneous. The true answer is 92982. Unfortunately, in my last letter I missed one figure in pointing off decimals, and put the answer at 9298. But this clerical error does not in the least affect the mode of calculation which I adopted, and well know to be correct: nor does it change the general outcome of those calculations which was, as I stated, that the floor would need girders to sustain it.

I have pleasure in stating, as requested by "M.I.C.E.," my authority for the formula which he thinks he has discredited. He will find it in "The Elements of Machine Design," by W. Cawthorne Unwin, B.Sc., M.I.C.E., page 72, Section V. The exact words are as follow:—"A rectangular plate, of thickness t, length l, and breadth b, is encastré at the edge, and loaded uniformly with p lbs. per sq. in. The greatest stress is $f = \frac{1}{2} \frac{l^4}{l^4 + b^4} \frac{b^2}{t^2} p$."

The author adds this footnote:—"Some experiments by Mr. R. Wilson (*Engineering*, Vol. XXIV. p. 289) appear to show that the ultimate resistance of flat plates is considerably greater than that obtained by putting f = the breaking stress in the above formulæ. These formulæ are strictly applicable within the elastic limit only, and Mr. Wilson's plates may have been dangerously strained long before giving way. They did take a large set."

"M.I.C.E., Bath," has brought himself to believe that for a $\frac{3}{16}$in. iron plate 10ft. by 8ft. fixed to a beading round its four edges, and having no intermediate support, to give way under a weight of water 1ft. deep would be an "absurd result." I am not responsible for Mr. Unwin's formula. But I believe in it, and am so far from converted to believe it "absurd" that, though I should enjoy seeing "M.I.C.E., Bath," sitting under that plate when the water was poured on, I should by no means enjoy sitting there myself, and I feel certain "M.I.C.E." would not enjoy it either. But that would be his affair!

Sunderland. **Frank Caws.**

[28646.]—ON page 127 is a letter headed as above, signed "Frank Caws." There are some things therein stated as facts which seem "things new" indeed, and which would puzzle students who "think out for themselves" sorely. Centre of pressure does *not always* occur at ⅔ the depth from the water line.

First, what is the centre of pressure? It is that point in the surface bearing the pressure of the fluid, which, being supported by a single force, that single force will support the whole pressure on the surface, and keep the surface at rest. In many cases to obtain the position of the centre of pressure the help of higher mathematics is required.

For example, in a plane surface of which top (a) and bottom (b) are parallel, but of different widths, the centre of pressure is got from the formula—

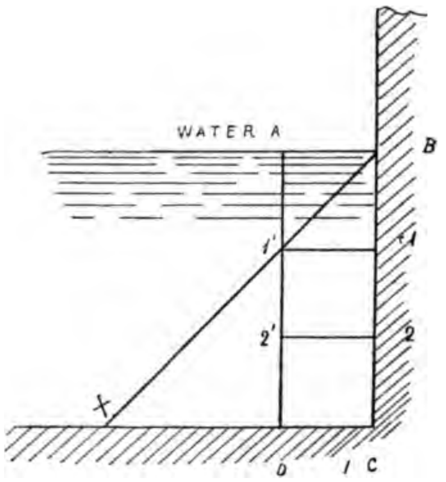
$$\frac{h}{2} \times \frac{a + 3b}{a + 2b} = \text{distance from top;}$$

h = height or distance between top and bottom. This is a very simple case.

In a rectangular plane the centre is ⅔ the depth, and if Frank Caws had confined himself to this he would have been right; but he did not. Secondly, his "reason why" which "thousands of persons" don't know, which is well for them, is at least very funny. To make the bewilderment of the "younger and less informed" complete, he goes in for—not a three-card trick—but a three-cornered cistern, to make his fallacy still more specious.

As before stated, the centre of pressure is not always at two-thirds the depth, so that the reasoning on which he bases this assumption need only be noticed briefly. The width of the ocean does not influence the pressure on a sea wall, nor does the width or volume of water in his upper or lower halves influence the pressure on the cistern's side, or in any way affect the centre of pressure.

Pressure depends on depth only. Water is influenced by gravity, and distributes pressure equally in all directions, and is for all practicable purposes incompressible. With this data it can be seen why the centre of pressure on a rectangular surface is at two-thirds the depth.



A B C D is a sectional elevation. A B 1 1′ represents a cubic foot; therefore, on 1 1′ is a weight of 62·5lb.; this is also the pressure on the square foot of wall B 1. At 2 2′ is 2 × 62·5; this, therefore, is the pressure on square foot 1 2. On D C is 3 × 62·5; this, therefore, is the pressure on 2 3. So that the total pressure on foot length of wall (or cistern) is (1 + 2 + 3) 62·5 = 6 × 62·5. The centre of pressure is that point which has equal pressure above and below it. $\frac{6 \times 62 \cdot 5}{2} = 3 \times 62 \cdot 5$, which is half the pressure, must be above and also below the centre.

As on B1 is 62·5lb. pressure, and on 1 2, 2 × 62·5lb. pressure, the sum of these two being 3 × 62·5, which is half the total pressure, and which comes above point 2, the other half must come below this point, therefore, point 2 is centre of pressure, and it is two-thirds depth in this case.

To show the distribution of pressure on the wall draw C X = C B at right angles to C B, and join X B, and the triangle B C X shows pressure varying from nil at B to 3 × 62·5lb. at C.

E. T. B.

POLISHING AND NICKEL-PLATING.

[28647.]—WILL "Engineer, Govan," please read what I did write? I fail to see where I stated that "the Gramme type of dynamo is not suitable for electro-plating." If I relied solely on what S. P. Thompson has in his book I might have written differently; but as I have not seen this (no doubt valuable) work, I have written solely as my experience dictates. But what does "Engineer's" letter mean? To me, simply this—that he admits the difficulty I mentioned does exist, and gives "several ways of overcoming it"! Now, that's funny, because if running a Gramme
dynamo requires a varying speed of engin
mulators, resistances, and shunts, then "Eng
is doing a work of charity in supporting th
although by so doing he has made the w
more prominent. Does "Engineer" kno
dynamos are made, not of the Gramme ty
will plate a pin or a pinnacle with a c
E.M.F. without using Willans governors,
mulators, or resistances, or shunts. Of c
will excuse "Engineer's" remarks, as he s
think that, having a black, it is easily mad
by adding another one or two.

[28648.]—"ENGINEER, GOVAN" (letter
is evidently not a practical man, or he wo
have written about "Willans governor on
circuit to vary the engine speed." I am an
plate manufacturer, and besides my own pl
do a lot for the trade. Now, to vary the s
my engine would play the deuce with the
ing and spinning-lathes. And in the
platers hiring power it would be an impos

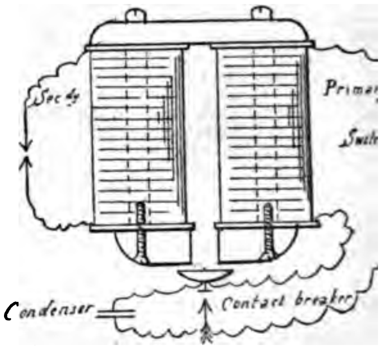
I never heard talk of accumulators in a
shop; besides, what is the use of introdu
these dodges, when a proper plating-dyna
not require them?

I indorse "Bijli's" opinions, and as his
smell so strongly of the shop, I feel sure
practical man. I take this opportunity of
ing "Bijli" for his interesting letters a
criticisms. Pl

DIRECT TRANSFORMERS—INDUC COILS.

[28649.]—WITH reference to my letter
week, I beg to submit a design that will s
show the meaning of my purpose.

An ordinary two-legged magnet, having



yoke and pole pieces of extra thickness of an
Norway or Swedish iron.

To avoid trouble of a separate "
breaker," the otherwise close magnetic cir
slightly broken, which admits of the work
the make and break armature.

Preferably, the primary is wound on o
the secondary on the other, though, of cours
may be distributed on either.

The efficiency will be increased by inclosi
coil in an iron tube. The rounding of e
yoke and pole pieces prevents much "m
leakage."

Scale = ⅓rd would give a convenient
transformer.

April 9th. **W. Perren-Mayc**

GRAVITY LECLANCHE.

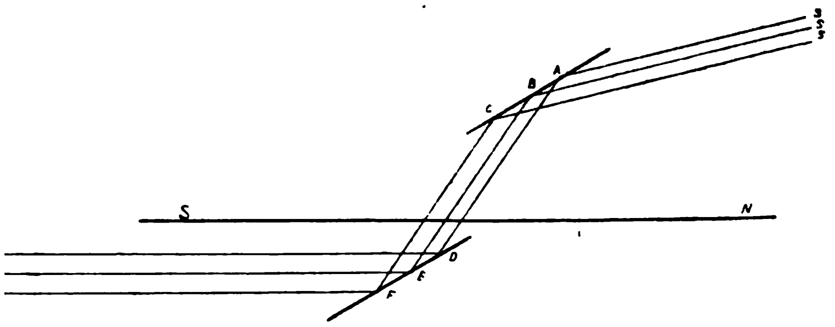
[28650.]—WOULD not the glass water-
used in bird-cages suit (letter 28626, p. 148)
of these are very shallow; or guttapercha o
have seen bottoms of old porous-pots use
similar purpose, with guttapercha-covered
wire. But would not this form be li
polarise very rapidly? **A. G**

HELIOSTAT WITHOUT CLOCKW

[28651.]—I SHOULD be much obli
"F.R.A.S." and others who are well versed
matters would kindly criticise the following
for a heliostat without clockwork.

In the figure, the sun's rays S A, S B, S C,
are for all practical purposes parallel, imp
the mirror A B C, and are reflected in the di
A D, B E, C F, which are parallel. Then, if a
mirror D E F is properly placed, these rays
reflected in the direction D P, E Q, F R,
to the axis of the instrument N S, which is
parallel to the earth's axis.

During the day the rays of the sun are pra
inclined at a constant angle to W S. If, t
mirrors were revolved about W S, we sho
the emergent rays always parallel to th
But the mirrors in revolving envelop
axes are N S. If, then, we replac



ums of right circular cones, so arranged light can pass from one to the other, as in re, we shall have a beam of light emerging to the polar axis all day long.

ɔeam, though constant in direction, will its position; but probably the apparatus arranged so that no adjustment will be y for an hour or two. As the declination ın alters from day to day, the angle of one ɔnes will have to be altered.

e designed apparatus for this, but as it affect the theory of the instrument I will describe it. The rays parallel to the axis reflected in any direction required by a ıe mirror.
Ignotus.

YTICAL SOLUTIONS OF PROB- S v. CONSTRUCTIONAL — TRI- LES.

.]—IN answer to S. Repton (reply 64821, I must ask him to look at my original o the "Measuring Buildings" query, and there see that I particularly mentioned id not put forward 82 as the solution of the but merely showed how it could be done. tter of fact, I only drew the sketch roughly nall scale engraved in the "E. M.," and l off 82 on that. I am surprised that it ıave been anything like so close to the Of course, if I were solving the problem l draw a figure as large as my compasses ɔnstruct.

the time taken in the two methods of solue graphical and analytical—let any reader E. M." try for himself, and I think he will the former will take about a quarter as he latter.

the accuracy obtainable by graphical con-, I may say that as a student in the Royal Academy, Woolwich, I was exercised in ion by this method of pretty stiff prob- *To marks were awarded unless solutions were at least three figures.* So that in this case, ing a figure carefully to a proper scale, it ɔe the easiest thing possible to get the ight to the first place of decimals.

Repton still doubts the accuracy of my on analytical methods, let me give him a to solve. Two planks (homogeneous ɔut) A B and C D, each weighing x lb., and long, rest A B against a wall at an incli- and C D with one end on the centre c of the other on the ground. The limiting resistance at C is θ, and at B ϕ. Required tions and amounts of pressure at D C B. Repton assume numerical values for ϕ in above, and see how long it takes him e answer by the method of calculation. It lem which could be drawn to scale, and ers read off by any draughtsman in under tes. The answer should be correct so far as mbers are concerned. Now, in determin- a problem for any practical purpose, would th while, for the sake of fractions, to wade a page of calculation, seeing that a slight homogeneity in the planks, or of exact ation of θ or ϕ, would affect the question ɔre? Besides, no calculator is infallible, 51 it may be seen that Mr. Repton and ards differ by 1½ yard in their answers, ıey cannot both be right. I think if the querist really wanted the information he ıve found my method, worked on a large nimself, the simplest and surest after all. wer to query 65032, p. 156, I should recom- 'Intending Cyclist" a Rudge Convertible having used one myself for some time excursions with my wife on the hilly roads ınagh. It is not a very fast machine, but great merit of absolute safety from cap- that it is possible to run down hills at peed. It is easily obtained cheap at second track fits the cart ruts in a road (no small when stones have recently been laid d it is a strong make. I found that my ss was liable to catch in the driving chain days, so made a dress guard of very thin wired at the edge, and fastened by screws l chain guard and the mounting step. This did not cost 2s., and is very effective, and adds to the appearance of the machine, as I have enamelled it black. My great difficulty has always been the rubber tires. They will not stop cemented when driven over rough roads, but always loosen in a few days.

T. Preston Battersby, Capt. R.A., F.R.A.S.

SOME LITTLE-KNOWN PLANTS OF THE "FLORA MEDICA."

[28653.]—THE *Aconitum heterophyllum* of Dr. Wallich—*Atees* of the native druggists—is the only non-poisonous representative of this widespread genus. In Wallich's "Plantæ Asiaticæ Rariores" (a very rare and costly book) it was first described and identified, whence my drawing was copied. It has also received additional notice from Prof. Royle, of the North Indian Botanical Gardens. It is a very local plant, though abundant on the lofty mountains bordering on Nepaul, where it is collected and brought down annually to the chief cities of Hindostan. I have purchased it at 6s. to 8s. per pound. The root is composed of two small oblong tubers of light ash colour externally, white internally, and of pure bitter taste. The powder is devoid of any astringency, yields to water 18 per cent., to alcohol 32. The watery solution is not precipitated by ammonia, and does not contain *aconitina*. Sixty grains given to large dogs produced no serious effect. When I and many others were struck down by the peculiar malarial fever of Central India we were attended by the only European medico to be found. From local experience of particular symptoms, he would not administer quinine; five to seven grains of the *Atees* powder were substituted, and appeared to control the violent vomiting and subsequent enlargement of the spleen, so harassing in this febrile disorder, attributable to the exhalations from the black cotton soil. I made many notes on this uncommon drug, and had commenced a correspondence on its valuable properties in all cases where quinine was contra-indicated, with the few medical officers who had tried it. I had also collected samples for transmission to London for definite experiments, when the Mutiny fell like a thunderbolt on all white men: the manuscripts, and nearly all their writers, were destroyed!

Eos.

AN IDEAL LAMP.

[28654.]—THERE are now in the market a superabundance of most excellent, well-made, and perfectly safe lamps for general use, and "W.A.S.B." (28588) exactly "hits the blot" on mineral oil lamps when he attributes nearly all the recorded accidents to "very cheap glass lamps," and I think that every one who has fairly and disinterestedly studied this subject will agree with him.

What the public now requires is a safe, simple, and well-made cheap lamp, that can be used by the poor in perfect security, and which, more ornamentally finished, would serve the wealthier members of the community as a safe bedroom lamp—an article much required. Shortly, then, as a wick will not pull more than about 4in., the ideal lamp should be made of such a form as to bring all the oil as close to the flame as possible. It should be squat-shaped without any stand, to prevent it turning over, heavily weighted at the base, and the base the widest part of the lamp, to secure its coming on this weighted edge should it fall. It ought to have a flat wick, as this is the most economical form, with a collar made of hard wood, vulcanite, or bone to prevent the heat of the fittings extending to the lamp or oil, and good handles on each side.

I will not here reopen the question lately so fully discussed in these pages as to the merits or demerits of vitreous or metallic containers. Each would equally suit this lamp, as it should have an outer case of metal, the intervening space being packed with felt or rough cow-hair. A lamp of this form would be most unlikely to meet with an accident, even if it fell from a height, and if used for bedrooms it should be put on firm, conveniently-placed brackets, with a small rim to prevent it being pushed off.

So much for the lamp; but the great question to be solved is the form of the chimney, and never have I seen so many "square pegs in round holes" as are the forms of the chimneys supplied with flat wick lamps. I maintain that these lamps should have no dome, and that the fittings and chimney should be oval, the latter choked above the sheath in the same way as round-wick lamps, only choked in an oblong shape, and this choke at most half an inch above the sheath. There would, however, be no difficulty in choking a round chimney to an oblong shape, should the exigencies of the fittings require it.

It is almost a rule that even the best lamps are often spoiled by the shape of their chimneys, which do not properly cause all the products of the oil to be perfectly consumed, and nowhere in town have I seen a choked chimney that was not at least from ¼ to ½in. too far from the sheath. This lessens the whiteness of the light, and often causes the flame to dance and burn unsteadily. This suggested lamp could be easily made for 1s. and retailed for 2s., well within the reach of the class that suffer most from unsafe lamps.

I do not know if this form of lamp and chimney have ever been tried. If any maker should wish to utilise these hints, I will only be pleased if they should be of any service in producing a lamp fulfilling the conditions expressed in the beginning of this letter.

J. B.

CREMATION AND BURIAL.

[28655.]—I SEND you the latest improvements in burning the human body. Italy has advanced in this line beyond all other countries.

"The practice of cremation prevails in all the chief towns of Italy. Last Friday a crematorium, worked with gas, on Signor Venini's plan, was opened at San Reno, when the body of a young German lady was, by her own directions, reduced to ashes. The body was taken to the place in a coffin. The iron tray on which it was to be placed for burning was studded over with terracotta pegs, about 6in. in height, which had round, smooth heads. In form and length they exactly resembled the iron bolts used for railway chairs. The body was removed from the coffin and carefully placed on these pegs. The plate with its burden was then run on wheels into the oven, and the door was shut. The gas flames did not envelop the body. The body was put in head first; and as the jets of gas were at the far end of the furnace, they only reached that extremity. The principle of the process is to utilise the gases generated by the body itself for its combustion. Not all at once, but bit by bit, thus the body was consumed, the fire gradually advancing from the head to the extremities. In one hour and a quarter the cremation was over. Two hours afterwards the plate was extracted, and all visible on it was a little fine dry white dust and pink-brown coloured pieces of bones. These were collected, and weighed about three kilogrammes. The cost was 9s. 7d. The cost of a gas crematorium on Signor Venini's principle is from £800 to £1,000, and the Milan tariff for cremation is 50 francs (£2). At Milan about twenty bodies are cremated every month."

When I was at Naples a few years ago, the townspeople had actually forgotton the "dead pits," so graphically described (I think, by Washington Irving). There was one for every day of the year, to which all but the wealthy dead were consigned, merely subterranean rot-heaps. America goes into the other extremes of dressing her female corpses, when the family can afford it, in the most expensive costumes. A lady traveller has told us lately that £150 is a common price for the fashionable apparel of defunct beauty, and then the magnificence of their mausoleums and monuments reads like that of barbaric ages. The R.C. Bishop of Salford has recently spoken in bitter terms on the subject of cremation, saying, "It has been brought forward by those who detest Christianity," quite ignoring the historic fact that the new religion in the first and second centuries disposed of its dead according to the rule and custom of the Roman Empire—viz., by the funeral pile! A clever engineer, writing in favour of burial not very long ago, suggested a very original and sanitary method of thus honouring the departed without endangering the living. He would take a quadrangular plot of ground marked out with graves; when this is filled he would pour concrete over the surface, and leaving a few feet of this plinth all round at an exact distance, he would commence a fresh layer of coffins, cemented over as they are deposited. Proceeding gradually in the same method of building up, till the apex of the pyramid is attained, when the vast towering necropolis would be coated with some imperishable cement. Perhaps, too, these erections could be utilised as sea-marks for shipping, and beacon-fires in case of foreign invasion. I think the great merit of the suggestion rests on the small amount of land required for future interments.

In the East, scented oils—usually sandalwood, combined with clarified butter—are poured over a winding-sheet of the finest muslin, this accelerates the process of incineration. I have assisted at the ceremony as a friend of the deceased. I think if the body clothes are saturated with some odorous combustible—of which there are many—that the reduction of a body to ashes will be performed more thoroughly and quickly; and in cases of demise from malignant diseases would diminish the perils of contagion during transit. Those who have travelled or resided in tropical lands have witnessed all the horrors of speedy decomposition. The rapid transition from blooming beauty to the foulest corruption — swollen, rotten, and discoloured, loathsome and repulsive, all in a few brief hours—has converted many a delicate Englishwoman to the preference of purifying fire and its cleanly ashes. I know of one case where a solitary lady in a remote dwelling had to keep watch over her husband's corpse during the whole night with a boar spear in her hand, the putrescent effluvium having attracted a horde of rats into the bed, while her servant had gone to summon a doctor. Legions of hideous insects soon discover the promised banquet, unless some friendly foresight has barred their inroads with carbolic acid or chloride of lime; the flesh flies and carnivorous ants are only so repelled, and hasty interment follows.

An exhumation in the Tropics is a most sickening transaction to all concerned, as might be expected. Again, a battle field in the hot sunshine is a place which ought to be visited by the opponents of cremation, where dogs and pigs are acting resurrectionists as long as putrescent flesh remains in the ground, to be shared by the flights of vultures and carrion crows when brought to the surface! The Hindoos avoided these uncleanly results by speedily consuming their slain brotherhood on hastily-constructed piles—much to my admiration. Those "Towers of Silence" at Bombay, where the Parsees expose their nude dead to be devoured by birds of prey—the bones dropping through a grating till a general collection is made —filled me with disgust. In France and Italy the municipal authorities sternly insist on a corpse being put under ground within 24 hours of decease —a practice which has assisted crime and frequently led to premature interment. I give you an instance of the *grave* leading to the ridiculous.

"Burials alive are far more common in hot countries, where the burial takes place within twenty-four hours after death, than they are here, where one gets, as a rule, a week's grace. In Spain the body is frequently removed to the undertaker's shop a few hours after death. In one of the largest of these establishments in Madrid, some years ago, an extraordinary sight was witnessed. A gentleman was brought in his 'casket' one afternoon, and placed in the room set apart for that branch of the business. The proprietor lived over his premises, and on this especial evening he was giving a grand ball. When the ball was at its height, a gentleman in full evening dress suddenly joined the company. He danced with the wife of the undertaker, and he danced with the undertaker's daughter, and seemed to be thoroughly enjoying himself. The undertaker thought he knew his face, but didn't like to be rude and ask him his name; but by-and-by all the guests departed, and the strange gentleman was the only one left. 'Shall I send for a cab for you?' asked the host at last. 'No, thank you,' replied the gentleman; 'I'm staying in the house.' 'Staying in the house!' exclaimed the undertaker; 'who are you, sir?' 'What, don't you know me!—I'm the corpse that was brought in this afternoon.'

"The undertaker, horrified, rushed to the mortuary room and found the coffin empty. His wife and daughter had been dancing with a corpse. An explanation, of course, followed. The gentleman, who had only been in a trance, had suddenly recovered, and, hearing music and revelry above, and having a keen sense of humour, had got out of his coffin (the Spanish coffin closes with a lid, which is only locked previous to interment) and joined the festive party. He was quite presentable, as in Spain the dead are generally buried in full evening dress."—(Dagonet.)

In Bavaria the open coffin is placed on trestles, a string leading to a bell is fastened to the wrist of the corpse, which is left till it shows unmistakable evidence of mortality. The crematorium of the future will, I think, attain some more refined and rapid process of incineration. I believe that a stream of flame from an oxyhydrogen gas reservoir (where expense is not considered) will prove the best. A bar of the purest steel submitted to this heat-producing combustion vanishes in fluid drops. Prosser forged sword-blades by this intense fire.

Eos.

OVERWORK.

[28656.]—THE theories of Mr. Sutherst and Mr. Stretton as to overwork are probably derived, far more than the writers are aware, from the workman's principles, that the more men employed the better, and that no man ought to be allowed to earn more than another. Of course continuous employment of mind or body for eighteen, or even thirteen, hours a day is not and cannot be practised to advantage; but the emergencies of business, extra traffic, illness of a mate, &c., will occasionally require extra work, and why not? Be it remembered that it is not the men, if they are paid for the extra time, who object, but their so-called friends and protectors.

As to cruelty to the men and danger to the public, are railway men so inferior in stamina to sailors that they cannot stand what a sailor would take as a matter of course? In thick or stormy weather—viz., about one voyage in five—a captain making for the English Channel will be on the bridge, with 500 lives in his hands, for 24 hours—often longer—allowing, perhaps, two hours off for eating and putting on dry clothes; and often the first officer will be on the bridge too. Is that also to be the subject of legislative interference, and if not, why in the other case? Let me tell Messrs. Sutherst and Stretton that one hour of exposure to wind, rain, and sea on the bridge of a steamer is more trying to mind and body than several hours in a snug signal-box, or even on a sheltered engine-plate.

In an ENGLISH MECHANIC some time ago was a complaint that two men had been on an engine for 34 hours, with only eight hours off. Now it happened that shortly before this I had had a disagreeable passage in a yacht, the particulars of which I will briefly relate by way of illustration. We got under way from Plymouth before 7 a.m., to do which the men must have been at work soon after 5. I do not remember, but from my knowledge of their habits I am sure the men would be on deck during all the morning, except at dinner time, when I took the helm for half an hour. At 5 p.m. the weather began to change, and by 7 o'clock it was necessary to reef. At 8 it rained in torrents, and the men were at work in the wind, rain, and sea till near 10 o'clock, before they made all snug, and brought us under a close-reefed mainsail and storm-jib. Of course on a night like that all hands would be on deck; but towards morning the wind moderated, and when I came on deck at 6 we had two reefs out of the mainsail, and the watch—viz., half the men—were below. After breakfast all hands were on deck making sail, &c., and, to the best of my belief, they were on deck nearly all day until we reached Southampton at 4 o'clock; so that by the time they had rowed us ashore, tied up the wet sails, &c., it would be 5 o'clock. Therefore, for 36 hours, no man had been four hours below; but though of course they would not (nor should I) like such nights to come often, no one of them thought that they had done anything extraordinary, and they would have been indignant if anyone had suggested that they were unable to stand such work when necessary. But these poor fellows had no one to explain to them how ill-used they were, and what an oppressor I was.

London, April 9. **A Yachtsman.**

BRITTLENESS after corrosion is exhibited by all kinds of iron and steel, and is more marked if a plate of amalgamated zinc be connected with the iron so as to form a couple in the solution and that it cannot be ascribed to accidental flaws in the metal employed. If two iron wires are made electrodes in a bath of sulphuric acid, the anode will be much attacked, but will be scarcely affected in regard to brittleness, while the cathode will become bright on its surface, but will be extremely brittle. Hughes and Robert ascribe this effect to the occlusion of hydrogen by the iron. The author after a long series of researches, finds that the character of iron and steel is always altered if exposed to influences which occasion an evolution of hydrogen upon the surface, and that contact of the iron with zinc intensifies this effect, so that a shorter time is necessary to produce it. The resistance to flexure, as well as the transverse strength, is always diminished, as is the extensibility under tension, while the modulus of rupture is practically unaltered, unless in some cases by the excessive corrosion itself. Heating the metal suffices to remove the brittleness, and placing it in a dry place for some time may have a similar effect in this direction. The Journal of the Society of Chemical Industry says: "Cast iron is not influenced, or is less so than wrought iron, by superficial hydrogen development. Four samples of corroded iron heated [illegible] in pure dry nitrogen gave off 0·0021 to [illegible] per cent. of hydrogen respectively—numbers which the author thinks cannot represent quite the whole of the hydrogen actually present."

THE new engines of the Boston and Albany Railroad carry 175lb. of steam. This is the same as that carried for a long time by the London and North-Western compounds.

IT appears that the new steam heating arrangements now being tested on American lines passed through the recent blizzard in a perfectly satisfactory manner.

REPLIES TO QUERIES.

⁂ *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[64547.]—**Problem.**—If the condition is merely that a man must not again have the follower he had at first, the first three results of "Reymond" are readily seen to be insufficient. Instead of the party of two having but one arrangement, they can be 1 2 or 2 1. The three can be 1 2 3, 1 3 2, 2 1 3, or 3 2 1. The four can be 1 2 3 4, 1 3 2 4, 1 4 3 2, 2 1 4 3, 2 4 1 3, 2 4 3 1, 3 1 4 2, 3 2 1 4, 3 2 4 1, 4 1 3 2, 4 2 1 3, 4 3 2 1—twelve changes at least. In a circle there is no difference between 1 2 and 2 1, and I can make but two variations of the three, or four changes of the four.—E. L. G.

[64669.]—**Sight Feed Lubricator (U.Q.)**—The oil passes in drops up through water and flows over on to bearing. I do not think any water passes over with the oil. The above refers to Schönheyder's patent; it can be seen at work at an engineer's shop opposite the Mansion House Station.—PRINCIPIA.

[64680.]—**Rags.**—Rags are not imported from the Australian Colonies: it would not pay!—T. J.

[64691.]—**Portable Gas-making Machine.**—This query is incomprehensible, and certainly unanswerable, unless one can see the apparatus.—SELIM.

[64692.]—**Pepper Decorticating.**—Any of the recognised makers of machines of the kind would supply "St. Mungo" with the appliances he requires; but if he wants to make "white pepper" cheaper than other people can do it, I suspect he will have to invent the process himself.—NUN. DOR.

[64693.]—**Hardening Bicycle Springs.**—Why does "Subscriber" want to harden his "cradle spring"? However, he can do it easy enough by raising it to a dull red (by daylight) and dropping it into water. For much information on hardening and tempering (the latter very important in a spring), the "Subscriber" may be invited to look up those back numbers which he doubtless has by him.—NUN. DOR.

[64695.]—**Steel Bronzing Gas-Fittings.**—Of what metal are the gas-fittings that it is required to "steel bronze"? There are many recipes in back volumes, to which it is a pleasure to refer a querist who omits an important part of his query. —M. P.

[64696.]—**Biunial Lantern.**—I should think this "Lantern" had better buy what he wants. Why is the "lining" to be of "tin" (*sic*), and why is the mahogany to be fixed "to the same"? —JEHU.

[64706.]—**Carbon Transmitter.**—"W. R." will no doubt get over his difficulty by using a return wire.—E. M. F.

[64708.]—**Boiler.**—If this querist will supply some of the details of his "steam cooking boiler" with the chain arrangement, he may possibly get an answer to his question. It is rather unsatisfactory work endeavouring to answer such conundrums.—K. J.

[64719.]—**Winter Electric Machine.**—I do not think you can do better than you say. The ring should be about the same size as plate, and a ⅜in. iron wire ought to do well; but as to length of spark, much depends on other parts.—E. M. F.

[64726.]—**Stamping Out Bells.**—As you have found, stamped steel is not good for bells. I do not think any kind of steel will stamp into a really good bell.—JEHU.

[64733.]—**Incombustible Black Pigment.**—Will plumbago answer the requirements? If not, try the black produced by calcining chromate of copper in contact with air, or calcining a mixture of bichromate of potash and nitrate of copper. It is intensely black, and is unalterable.—NUN. DOR.

[64739.]—**Soft Type-Metal.**—Will not lead with a little tin and antimony do? What is the object in view?—NUN. DOR.

[64775.]—**Defective E.M.**—If "Bolt" will furnish fuller particulars as to requirements of magnet, I shall be pleased to send him working-drawing and details. Is the magnet required to attract the iron armature through any considerable distance, or is it required to hold it against a pull? What is the shape and size of the iron armature? —W. PERREN-MAYCOCK, A.S.T.E.

[64783.]—**Welding Steel (Errata).**—A few errors occur in my reply on p. 130. "Fluid," in line 31, should be "flux," while "ammonium," in line 79 should be, of course, "ammonia"; and in the 86th line the word really should appear before "means,' or else means should have been italicised.—PERCY W. STANLEY, 5, Billson-street, Poplar, London.

[64840.]—**Science and Art Exam.**—Can Mr. Isader give a test for morphia in the presence of salicylic acid? All the tests given by him are in the books which most students possess, and in my hands do not answer always in the above case. —J. H. BURTON.

[64847.] — **Fuller's Battery.**—I, like the querist, use these for bell ringing. The secret is a thick porous pot, well greased top and bottom, filled with water only. I find form of zinc immaterial. It must be well amalgamated at first, keep some mercury at bottom, and when solution gets thick, siphon out and fill up with water. Any bichromate solution will do for outer cell.—A. G. H.

[64847.]—**Fuller's Battery.**—You have practically exhausted your battery by short-circuiting it too long a time; you have also too much acid in it. I have a great number of these at work. The following is the way: I charged one cell for domestic purposes about five months ago. In outer cell, 4oz. of bichromate of potash, sulphuric acid, and water 1 : 8; in porous cell, clean water; and left it standing for one whole night. Did not short-circuit at all, as I do not approve of such a process. It has worked splendidly since with but little attention, only adding a little clean water in porous pot occasionally, as it sinks. If you will completely charge yours again as above, you will not fail to obtain satisfaction. Of course, when the battery does get weak, refresh it with a few drops of acid and a little potash occasionally. Should be glad to give you further assistance, if required.—ELECTRICIAN.

[64847.]—**Fuller's Battery.**—If "Septentrion" substitutes sulphuric *vice* hydrochloric with the bichromate, and zinc sulp. instead of chloride, the cell will be a Fuller. The base of the zinc is the more acted on because the bottom of porous pot rests on the bichr. crystals: ergo, paraffin it well, as also the top edge. Instead of paraffining the pot in strips all round, paraffin all but one strip about ¼in. wide, and let this face the carbon plate. If this is done, the difference in internal R, between the cell with paraffined pot, and same cell with unparaffined, will be little; but if the unparaffined strip face right away from the carbon, it will make very nearly an additional 1 ohm resistance. Fuller's cells for lighting should be large, say, outer cell 1ft., diameter 7in.; but this depends on number of lights. Of course, "Septentrion" knows that it is necessary to have an ounce or so of mercury in each porous cell, covering the foot of the zinc. Or the zincs may be short, but of large diameter, hollowed out at top to hold mercury, and suspended in the porous pot: the zinc is less acted on then, for when the bichromate diffuses into the porous pot, it does so more at the bottom than at the top, obviously.—W. PERREN-MAYCOCK, A.S.T.E.

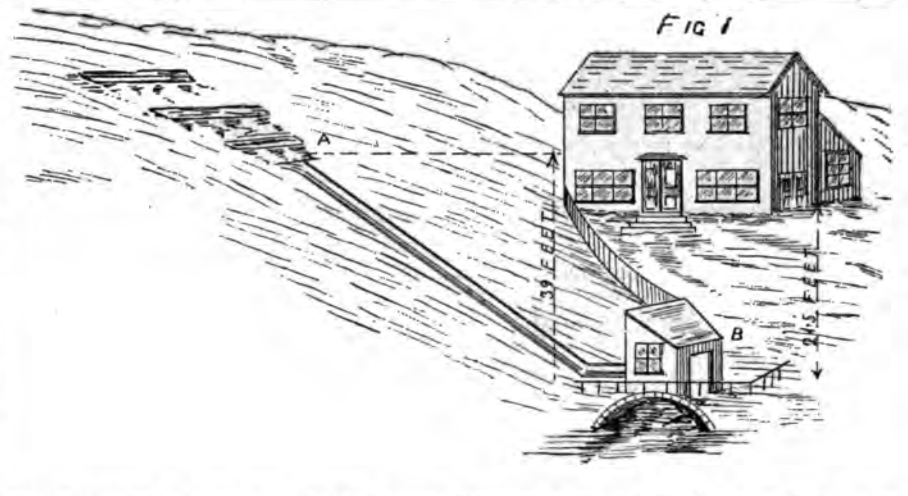
[64881.]—**Commutator.**—This must be made of hard rolled copper segments: cast will not do; is not solid enough, and sparks and forms flat in a trial working. The ends of these must be bevelled and held by a vulcanite ring supported by a brass sleeve on the armature shaft. Each segment to be insulated from the next with talc. I find that I cannot fully describe and illustrate this within reasonable limits, so have advertised my address, and if you send me post-card with the number of segments and diameter the commutator is to be, I will send you tracings of some I have made.—ALBAN.

[64900.]—**Blast Fan.**—The following corrections of misprints are necessary:—The decimal point, line 15 from top, is wanting, and should read 0·5236. In table, the last three sets of figures of column 6 want the integer 1, in place of the 0 before the decimal point. On line 31 read sum, instead of same. For g^2 and g, lines 9 and 10 from end, read variation sign δ^2 and δ. I may add that the fan-case should have the form of the archimedean spiral, the starting point of which should be $0·159\,a_1$ (height of throat), from a vertical radius line dropped from centre of spindle measured towards the outlet, close to periphery of blade.—MARIENBERG.

[64904.] — **Llandudno Pebbles.**—"S. M.'s" reply to the above (page 133) is very misleading. The pebbles referred to found on the shore are carboniferous limestone, which always effervesces when touched with acid (hydrochloric acid, HCl, is the kind used by geologists), and the holes are bored by a species of shellfish. I have before me a piece of limestone from Llandudno showing the shells in situ, and if "G. H. C." will break any of the larger pieces he picked up, no doubt he would see them himself; showing that limestone should not be used for sea walls or pitching, where this shellfish is found.—T. S. K., Willesden.

[64906.]—**Electric Clocks.**—The clock is evidently drawn to one-fourth of the original size, and on this assumption the coil of the electro-magnet is 2¼in. long and 1¼in. diameter. The size of wire is regulated to the power of the battery. In the description referred to a dry zinc-iron cell is mentioned of E.M.F. 1 volt, but the resistance is not mentioned. However, in a later issue of 2nd December, "Industries" mentions another cell of somewhat similar description, but a "wet" one, and this is quoted at E.M.F. 1·3 volt, and resistance ·2 ohm. Perhaps Mr. Bottone will calculate for you the required particulars? If the Ediior wishes, I will make a sketch of the clock, the good time-keeping of which entirely depends upon the uniform power of the battery, and upon no intrinsic property of the clock itself. I should consider the clock worthless for general use.—VINDEX.

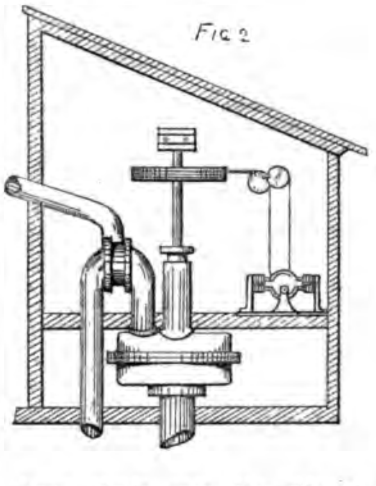
FIG 1



[64911.]—**Electric Lighting.**—This is a case in which the use of secondary batteries would be advantageous. Supposing the power to be constant enough to give a steady E.M.F., which is very doubtful, the obtainable c.p. would only be, say, 160 to 200, or enough for a dozen lights. On the other hand, using a dynamo of lower E.M.F., and therefore giving a larger current, your batteries, in parallel, could be charging all day long, and at night would supply sufficient current for lighting the whole place. "E. P. S.," Elwell-Parker, or Drake-Gorham, are reliable types of British cells; but as you say, the cost of carriage would be great. W. PERREN-MAYCOCK.

[64911.]—**Electric Lighting.**—According to promise, we send sketches of the installation mentioned in last week's issue of "Ours." Fig. 1 shows a general view of the arrangement, the watercress beds A being 39ft. above the turbine in the shed B. The overflow from the beds is conducted through ordinary 12in. glazed drain-pipe, down the hill, and just sunk below the surface, so as to prevent damage by walking upon or over it. Quantity of water, 15·5c.ft. per minute.

FIG 2



The house stands upon the side of the hill, 21½ft. above the turbine centre, and is an ordinary ten-roomed country cottage. The two parlours were filled with electroliers with five 10c.p. incandescent lamps on each, and two 10c.p. lamps in hall, four 5c.p. lamps in the kitchen, and one 10c.p. lamp in each of the four bedrooms, and three 10c.p. lamps in the study or library, and one 10c.p. lamp on the staircase. Of course, these are not all in use at once. Lately, the turbine has been used in the daytime for driving a lathe, drilling machine, &c., in a small amateur's workshop, and then, of course, the dynamo is disconnected. When the light is not required, the release of a lever from a catch situated upon the staircase enables the tension of a spring to close the sluice and divert the water to the opposite limb of the branch pipe, thereby stopping the turbine. The communication between the lever and sluice is made by means of a No. 9 B.W.G. galvanised iron wire running on grooved pulleys alongside the fence. The current is conducted by $\frac{3}{16}$ cables, insulated with g.p. tarred and taped, and laid underground in teak trough filled in with asphalte. Fig. 2 shows the method of arrangement within the turbine shed, and explains itself.—F. WALKER AND HYDE, 4, Little Moorfields, E.C.

[64916.]—**Cementing Bicycle Rubbers.**—Where "gas" or "irons" are not available, tires may be put on as follows:—Put the cement in an old gallipot and place it near the fire until it is just sufficiently hot to run; take hold of the pot with a cloth, and pour the cement all round in the bottom of the hollow rim, which will so cool it as to prevent its running off. Take a piece of cord about ¼in. diameter, dip it in benzoline or turpentine, tie it loosely round the rim so that it can be easily removed, and set fire to it; by the time the spirit is burnt out the rim will be just hot enough to put on tire, and press well down all round.—SIMPLEX.

[64939.]—**Enamelling Cycles.**—Before putting on the enamel all the work should be carefully cleansed from dirt or grease. It is usual to polish the work, though not so fine as for burnishing. Hammer marks or rough file marks show through the enamel. At least two coats are required. For putting on the enamel a ladle may be used, or, if there is sufficient work, a large bath may be used, and the work dipped, but where little enamel is needed at one stoving a brush will do. One will be needed for spokes. A tray similar to a basting pan should be made, the bottom sloping to the pan in the centre, into which the enamel may be poured, to be afterwards taken out with the ladle. Over the tray should be placed rods provided with hooks, on which to hang the work to drain before putting in the stove, the tray itself being large enough for a stoveful. The heat for ordinary work is 350° for three hours; for soldered work, as hubs of front or back wheels, less heat, say, 250°, for a longer time. For plated or other work not to be enamelled, a composition of soft soap and whiting may be laid on with a brush; this will afterwards come off easily. The sketch of stove shown is of one in daily use; it is about the average size. Fig. 1 shows the front of the stove, a square hole is cut in one door, to which is fixed a piece of plate glass through which to see the thermometer placed inside the stove, the thermometer registering to 500° or 600°. The frame of the stove is built of 1½in. angle iron, including the bottom, which beds on the brickwork; sheet-iron of 30in. width is riveted on, the gauge about 12 B.W.G. Flat iron 1½in. width, $\frac{3}{16}$in. thick, will do for round the doors, &c. On the top of the stove a chimney is built with a slide for draught. If the floor of shop is of wood, it will be well to lay two courses of brickwork for floor of oven, otherwise one course will be sufficient. I would recommend the bricks to be laid with a slope; and a channel made to allow the waste enamel to run away, instead of remaining within the stove, where it is likely to catch fire. Upon the floor courses may be laid three courses round, of single bricks, upon which to rest the stove; the connection between stove and bricks being filled up with mortar. The pipes for heating are placed a little above the floor bricks; the ends of the pipes being brought just outside the front bricks. Fig. 2 is an arrangement of pipes for heating; the feed is 1½in., into which are screwed eight ½in. cocks; the pipes within the stove are 1in., having about thirty ⅛in. holes drilled in the length within the stove; the back-end of

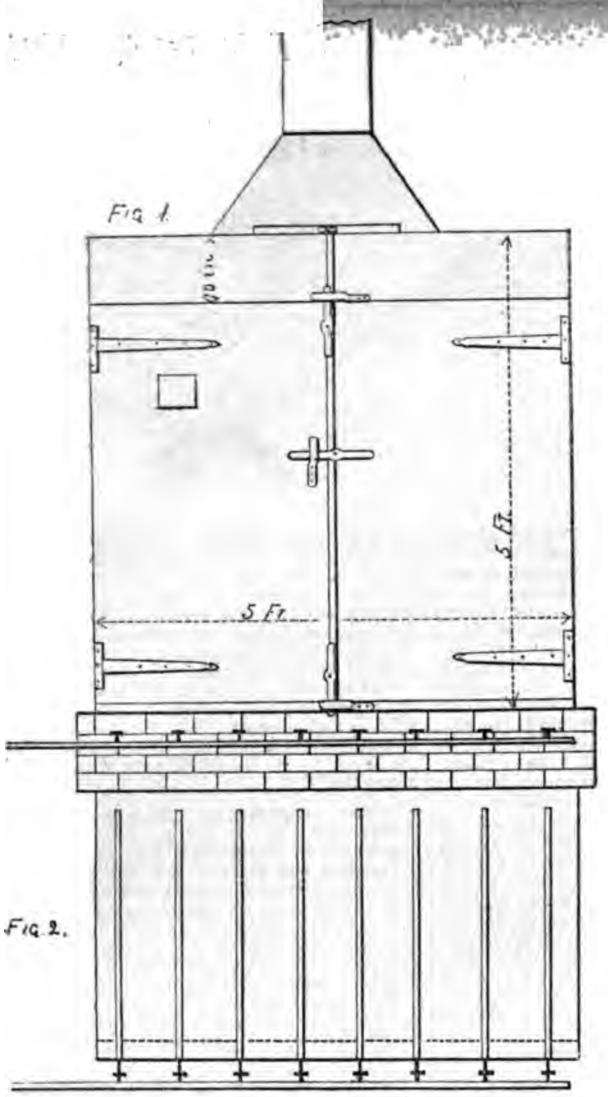


Fig 1.

Fig 2.

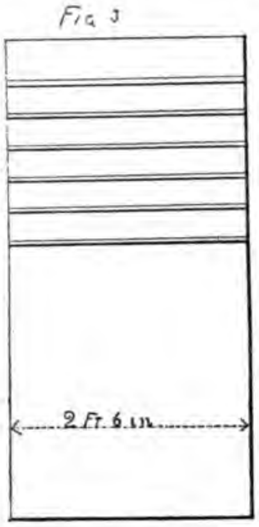


Fig 3

pipe is stopped up. The heat should be put on gradually. The gas-cocks should be a little away from the pipes in stove. Fig. 3 is the side of stove, to which are riveted several pieces of ¾in. angle iron, to support the ends of the rods upon which hang the work, the rods to be supplied with hooks of ⅛in. wire; the rods may be of ½in. gas-barrel, or ⅜in. round iron, having the ends flattened. The stove will also be found useful for melting cement after putting on tires; very little heat is required, the rubber finding its proper place in rim much better than by placing a hot iron or gaslight under rim.—A. M. M. A.

[64944.]—**Chemical.**—What does "Sm." mean when he says chlorate of potash may be fused? Chlorate of potash is decomposed by heat into oxygen and potassium chloride, as he may see for himself in Roscoe's primer of chemistry. I should strongly advise him to buy this book; it only costs 1s., and contains an enormous amount of information in elementary chemistry. It can be obtained from any bookseller, and is published by Macmillan and Co. Potassium chloride fuses easily.—CHEMIST.

[64955.]—**Chloride of Zinc Soldering Fluid**—If any correspondent would like to try the new German fluid, which claims to be free from all the annoyances inseparable from above, I shall be glad to send recipe free by post.—PERCY W. STANLEY, 5, Billson-street, Poplar, London.

[64957.]—**Chain Pump.**—Messrs. Warner and Sons will send you a drawing of chain-pump on application, or I will do the same, and give you particulars, if you will advertise your address.—BROSCENICUS.

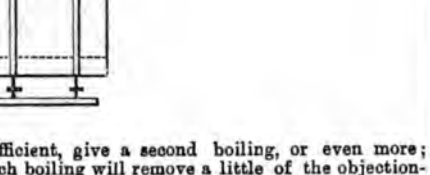
[64958.]—**Cleaning Diatoms.**—After washing away every trace of acids the flocculence can generally be removed by giving the diatoms a boil in a very weak solution of soap, say a piece the size of a pea to 8oz. of water. This, as it cools, slightly gelatinises, holding the flocculent matter in suspension, whilst the diatoms sink to the bottom. Notes.—Trim the soap from all adherent matter before adding it to the water. If the diatoms are very minute, use a weaker solution, and vice versâ. Wash the diatoms in plenty of water so as to give them a chance of getting away from the flocculence. If one boiling in the soap solution is insufficient, give a second boiling, or even more; each boiling will remove a little of the objectionable flocculence. Of course, all trace of soap must afterwards be washed away. If diatoms are dried off too quickly in the cover glasses, they are nearly certain to dry in lines and ridges. The water (not spirit by any means) must be evaporated very slowly. There are also other dodges in connection with this subject, but which are difficult to explain on paper without verbosity.—DIATOM MOUNTER.

[64963.]—**Water Power.**—Even had you a proper supply of water, you could never get the light to run satisfactorily with a varying water pressure, so my advice is, Don't attempt it.—W. HAMILTON.

[64965.]—**Halse's Battery.**—It is a modification of Smee's. Try Judson's corrugated carbon cells, which are by far the best. These cells are, for most purposes, superior to the chloride of silver cells used.—W. HAMILTON.

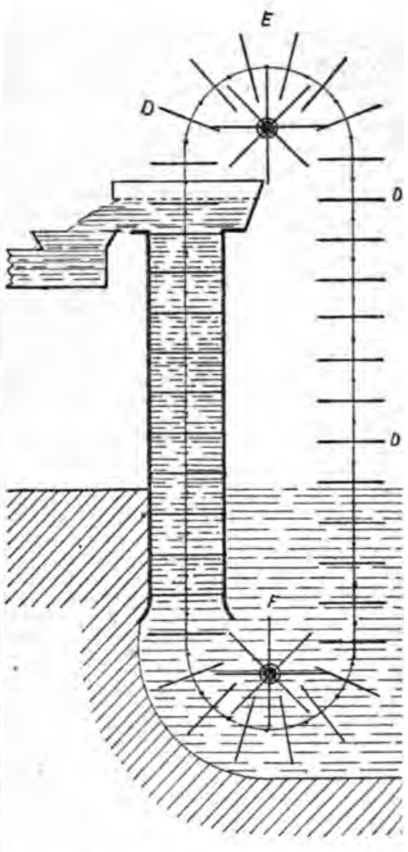
[64966.]—**Enema.**—Nothing more easy than to fit the small additional conductors into the sliding box case in which the Pulvermacher chain-band is sold. I have explained more than once that an electrical current produces defecation by exciting peristaltic action, and thus inducing normal evacuation. Many drugs may do the same; the more drastic eventually producing diseases; whereas electricity strengthens the functions of the internal organs, and removes the temporary paralysis causing chronic constipation.—EOS.

[64967.]—**Telephone.**—One-eighth of an ounce of No. 30 s.c. wire on each bobbin will be ample. Annexed is sectional sketch of telephone, showing



position of magnet, bobbin, plate or diaphragm, and connection to binding-screws.—S. BOTTONE.

[64957.]—**Endless Chain for Raising Water.**—For simplicity, little expense, and general efficiency, "Gwalia" cannot do better than em the old-fashioned chain-pump as per sketch. consists of a succession of links of metal revolving like an endless rope over two wh E and F. Between each joint is fixed a flat pie wood D D which is supported and kept in pos by the arms of the wheels E and F, which freely move. The wheel *e* is worked by a w handle, causing the whole to move, one side scending, the other ascending. The ascen series of plates is made to pass up a pipe, one



of which is under the surface of the wate near the bottom wheel, the other end nearly ing the upper wheel. The plates should fit pipe pretty closely. In passing up the pip water is drawn up with them, and can be em into any suitable vessel. The plates are us square; but I should advise "Gwalia" to them circular, as, if his pipe is metal he could rim of indiarubber round each of his plates, thus obviate the difficulty of leakage.—J. A.

[64968.]—**Old Indiarubber Balls.**—If " keeper" will heat the balls before the fir roll them quickly between his hands, I thin will be able to get them back to their former ness.—J. M. WELLWOOD.

[64968.]—**Old Indiarubber Balls.**—I been told that soaking for some time in l ammoniæ will restore softened indiarubber. I never tried it. It would cost but little to t liquor ammoniæ is very cheap; but look ou your eyes and nose when you unstopper the b —S. BOTTONE.

[64972.]—**Ventilating Church.**—I am obliged to Frank Caws for his prompt reply t question. The lower ends of inlet tubes a 20ft. below the ceiling, but being on a level the floor line only 13ft., which, however, do improve matters, but rather the reverse. It then, that both inlet and outlet openings adequate as well in area as in height of the and that improvement must be directed to although I remember the correspondent wh posed this system of ventilation, several vo of "Ours" back, stating that we need only p for inlets, and that the escape of vitiated air take care of itself. This is evidently not th but rather must the escape openings or exceed in area those of inlets. If, howe have to proportion inlets according t rules of ventilation, allowing 15c.ft minute for each person, 8c.ft. for gas-burner (of which there are 8), and 1, for stove, we should require (80 × 15) + (+ 1,000 = 2,264c.ft. per minute (ave 28·3c.ft. per person), the inlet tubes, if vel not to exceed 180ft. per minute in the inflow have to be 2,264 ÷ 180 = 12·5sq.ft. in tot instead of $6^2 \times {\cdot}7884 \times 3 \div 144 = 0{\cdot}5937$s t present. It would, in fact, require an opening ll along the whole length of the room of 12·5 ÷ 40 = 0·8ft. in width, whilst the outlet would probably ave to be 20 per cent. greater. (How much greater I cannot say, and I should be obliged if "F. C." would estimate, and show the increased volume due to passage through the thus occupied pace.) I need scarcely say that this would be all but impossible in the case under notice; but I fully realise from "F. C.'s" hints that, and in what direction, improvements must be made. I should like to learn if, by the employment of a cowl, and of what kind, on the top of outlet shaft, a greater current would be induced through the inlet tubes? —M.

[64978.]—**Motor for Dynamo.**—You can get a simple, cheap, and steady-running gas-engine consuming, for ½H.P., 22 cubic feet of gas per our) for £35. These engines should be better known to amateurs, as an ordinary labourer can attend to them.—W. HAMILTON.

[64974.]—**Battery Connecting.**—Connect all n series, and you can get 20c.p. in a lamp. For solution, see back numbers. You cannot satisfactorily repair broken carbons. New ones are cheap enough.—W. HAMILTON.

[64975.]—**Soldering Fluids.**—See reply 64955. PERCY W. STANLEY, 5, Billson-street, Poplar, London.

[64975.]—**Soldering Solution.**—Will not rosin do? If your plates are small, scour, dry, and dip into a pot of melted tin. Put some resin in before the brass. The tin should not be hot enough to fire the resin, or will spoil both tin and work. Write again, if not what you require.—BROSCENICUS.

[64975.]—**Soldering Solutions.**—Try the new liquid soldering sold in half-pint stone bottles at 6d. each. For the delicate brass works you mention I use fusible solder and a spirit-lamp, my bit being a little flat bar of copper, well tinned halfway. I frequently use wire ties to secure my pieces in place. At this manageable flame I can tin a large surface of metal. Of course, the thinner the sheet, the easier to do.—EOS.

[64976.] — **Brass - Casting at Home.**—Get sand direct from the pit, break all the lumps on a piece of board with a piece of stick or rolling-pin, but not too much, or you will make the sand too tough; do not put any mixture whatever; when filling the box ram very evenly all round, but not very hard. Do not use grease, but parting sand —that is, burned sand, between top and bottom; smooth the mould well and dry it, and wash over with equal parts of china clay and French chalk as thick as whitewash; put on a good coat, smooth and dry again. The runner or pouring hole, as you call it, should be as large as can be admitted; there is no riser (second hole) required, unless the casting is very large. You should use (unless you have a sound chemical knowledge of scrap brass) the proper parts of copper and zinc, or tin, as you want. Pour as quick as possible, keeping well away for fear of explosion. There is no metal will run in plaster of Paris that I know.—E. L.

[64979.]—**Soldering Joints.**—You can do these very well with any ordinary oil-lamp and candle and blowpipe. There are special lamps for the purpose; but unless you have a large number to do it is not worth the expense.—ALBAN.

[64980.]—**Electric Bell.**—Make magnet core of ½ round iron, softened, 6in. long, and wind it with 4 covered wire till it is 4½in. diam. My address is advertised, and if you like to send me yours, I will send you drawing of a 12in. works bell.—ALBAN.

[64981.]—**Heating and Lighting a Church** —Say length and width of floor, also if any galleries. I can then get at number of lights required, and answer your question fully. How, and by how many lights, is it now lighted?—ALBAN.

[64981.] — **Heating and Lighting of a Church.**—It is quite practicable to light the church by electricity, and also to heat the same by means of hot air from the boiler furnace, supplemented by the exhaust steam from the engine. There would be no economy in forcing said exhaust steam back into the boiler, as the heat would have been abstracted from it if the pipes were properly arranged, and consequently any method of utilising the spent steam in the manner suggested would result in wasteful expenditure. We should suggest that a good hot-air furnace would be the best plan to adopt for heating purposes, and, if possible, a gas-engine should be employed for driving the dynamos for lighting. If accumulators are used, a smaller generator and engine may be employed; for if, by direct application a 2H.P. gas-engine will light a building where the light is required for six hours, a 1H.P. gas-engine running for 12 hours will charge accumulators sufficiently to do the same amount of work. This is merely approximate, of course, but serves to illustrate the advantages of accumulators. If, however, you cannot apply a gas-engine for this purpose, a steam-engine and boiler is the best, utilising the products of combustion, and also the exhaust steam for heating the church. You are scarcely explicit as to the area. You say, "a cubical area of about 2,500 yards." If you can give us particulars of length, height, and width of the interior, we can give you an idea as to power of engine, size of dynamo and boiler, number of lamps, and probable cost.—F. WALKER AND HYDE.

[64983.]—**Rust in Kitchen Boiler.**—I have not the number in which the query replied to in your last impression appears, but may mention that I have recently been advised by one of our greatest living experts that in many cases softening the water will cure the evil, and am myself about to apply this remedy. The water I refer to comes from the greensand. Before commencing, I advise that Mr. C. E. Gittins' offer be accepted. —ROSICRUCIAN.

[64986.]—**Electrical.**—Not only possible, but economical. You could get far more light than you want. Cost, about £30.—W. HAMILTON.

[64986.]—**Electrical.**—It will be better for you to use six 5c.p. lamps, requiring about nine volts to render them incandescent. You will require a small dynamo (see Mr. Bottone's list) giving an output of 14 volts and 10 ampères, with proper driving gear; five cells of any good form of storage battery, with a capacity of about 65 ampère hours, leads, switches, clamps, and holders. Cost about £15.—F. WALKER AND HYDE.

[64986.]—**Electrical.**—You can light your house very well as you propose, but had much better not use lamps of less than 8c.p. You will require a storage battery of 9 cells and 5 plates per cell. This will give you 100 amp. hours of 18 volts. Your lamps will take 16 volts, but the battery must give more than this to cover resistance of wires, switches, &c. You require: Dynamo, 10 amps., 20 volts, shunt wound—about £10; battery, 20s. per cell—£9. Wire according to distance, and fittings according to taste. £20 to £25 should make a really first-class job.—ALBAN.

[64987.]—**Tractive Power.**—By the formula

$$\frac{D^2 \times P \times S}{W} = T$$

Where D = diameter of cylinder in inches,
P = pressure of steam on piston per square inch,
S = length of stroke,
W = diameter of driving wheels,
T = tractive force on rails in pounds.

T = 42·1lb. in your case.—F. WALKER AND HYDE.

[64988.]—**Fastening Velvet to Wood.**—Get some good glue, and melt it with enough water so that it will run off the brush easily. Then before putting the box together glue the surface of the fretwork on the inside, and place carefully on the velvet. Take care that you do not move the wood about on the velvet, or the glue will spoil it. Do not put the glue on too thick.—SMUT.

[64988.]—**Fastening Velvet to Wood.**—I made a similar article which looked very well indeed, but I did not fasten the velvet to the fretwork. It is better to have a piece of plain wood at the back of the fret, to which you may glue velvet with thin glue and then fasten the fret to it with small screws. It is then much stronger and not so liable to have holes poked in it.—J. H. BURTON.

[64988.] — **Fastening Velvet to Wood.**—I learned from Chinese and Indian workmen to use rice paste. Merely rice slowly boiled till sticky, then beaten to a mass in a mortar. Being colourless and adhesive, it is well suited to all surfaces free from grease, where velvet or silk are employed; but there is a new fish glue, which was brought out at the Fisheries Exhibition, said to beat everything as a holdfast.—EOS.

[64991.]—**Hardening Drills.**—For drilling tool steel we make the drill as hot as possible without burning, and then stab it into a piece of yellow soap; keep moving the drill to fresh places; or use soft soap. Drill with lemon-juice.—BROSCENICUS.

[64997.]—**Test for Mercury.**—Inasmuch as calomel is insoluble in water, the method of testing given by "Metallurgist" is quite useless.—WM. JOHN GREY, F.C.S., Analytical Chemist, Newcastle-on-Tyne.

[64997.]—**Chemical.**—Heat the pill, together with a little carbonate of soda, in a test tube or a piece of glass tubing closed at one end, when any mercury will volatilise and condense on the upper portion of the tube as a grey ring, which may be rubbed into a distinct globule.—J. H. BURTON.

[64997.]—**Chemical.**—The process recommended by "Metallurgist" (p. 155) for the detection of calomel in pills is not practicable, because mercurous chloride is insoluble in water, though, by prolonged boiling with a small quantity of hydrochloric acid, sodium, or ammonium chloride, the following reaction takes place: $2HgCl = HgCl_2 + Hg$. In this case the sodium chloride would not precipitate the mercury from the solution. Perhaps the following process, which I have found effective, would answer: Crush one or two pills as fine as possible in a mortar, boil with water to disintegrate them, and add a little potassium hydrate; on boiling them again they will turn black, owing to the liberation of mercurous oxide, thus—$2KHO + 2HgCl = 2KCl + Hg_2O + H_2O$. The precipitate is to be well washed, and heated with a little nitric acid; it is then filtered, diluted, and tested, thus—Potassium iodide, a yellow precipitate becoming red, and soluble in excess; potassium hydrate, bright yellow; rubbed on a piece of bright copper, the piece becomes covered with a silvery coat of metallic mercury, which, on heating, disappears. And, in conclusion, why take the pills at all?—PRINCIPIA.

[64995.]—**Fretsawing Attachment to Foot Lathe.**—The best way for E. Stonehouse would be to see a prize Holly fret machine, and make his like it. The way to connect it with the mandrel is to get a disc of iron (*c*, Fig. 2) about 2½in. in diameter, bored and tapped so as to fit on the mandrel like any common chuck. Into this screw a round piece of steel about 1½in. long at the place indicated by *d* (Fig. 2) that will fit into the slot *a* in the arm *b* (Fig. 1), and move along it. When the mandrel revolves you get an up-and-down motion of the fretsaw.—SMUT.

FIG 1

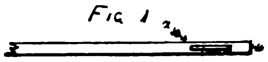
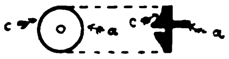


FIG 2



[64998.]—**Ice Cream.**—Five fresh eggs, 1 quart new milk, ½lb. powdered loaf sugar, 1oz. fresh butter; whisk all together, pour in a pan, place on slow, clear fire; keep stirring until it gets to boiling-point and becomes thick; but it must not quite boil, as boiling would spoil it. Lift it off and strain through a fine hair-sieve; stand it aside until quite cold. Essence of Vanilla will flavour it, and 1 drop of saffron water makes it look rich. Pour mixture into the freezer, place it in the tub, fill up space between tub and freezer with ice broken in pieces about 1in. to 1½in. in diameter, and from 2lb. to 3lb. of coarse salt; fill up to within 2½in. of top of freezer; proceed to turn round, at first by handle on top of the cover, until mixture adheres to sides of freezer; then with the spatula scrape frozen mixture from sides and bottom, and mix it in the body; turn it round again rapidly as possible, scraping it from sides and bottom every few minutes. In a short time action of pan will become free; then take cover off, and by merely holding spatula to side of pan you may turn as fast as you like, the faster the better. When spatula will stand upright in contents of freezer it is ready. I have mentioned plant required, and know one who supplies it, together with valuable information concerning all ices.—W. H. PALMER.

[65001.]—**Grinding Gauge Cocks.**—This has been given several times. First remove carefully by means of a smooth file any ridges on the plug, and then proceed to grind in same, using grindstone dust and water or fine sand and water. Do not use emery, even if it is the quickest.—T. C., Bristol.

[65004.]—**Poultry Hopper.**—I have used for a long time a long box with swing front opening inwards, connected with a treadle extending the whole length, balanced in such a way that the weight of the fowl on the treadle opens the swing front inwards, thus exposing the food. The fowls soon learn the trick.—ROSICRUCIAN.

[65005.]—**Bicycle Making.**—The best way to do this is to bore out flanges and turn spindle, taking care to get a good tight fit, and then sweat them on with soft solder, using chloride of zinc as flux.—CENTRE SECONDS.

[65007.] — **Isochromatic Dry Plates.**—The use of all the eosin dyes in the conjunction with ammonia is patented, and if the ammonia or other alkali is omitted, the action of the plates is very much slower. The following is the formula given by Mr. Bothamley in the *Photographers' World* of 15th December, 1887. Ordinary dry-plates are placed for two or three minutes in a bath of ammonia, strong, 1 part; water, 99 parts, and then for two minutes in erythrosin (aqueous solution 1 : 1000), 1 part; ammonia (10 per cent. sol.) 1 part; water 8 parts, drained on blotting paper and dried in complete darkness, develop with alkaline pyro, using as little alkali as possible. A yellow screen on the lens is required to give good effects. A film of collodion dyed with aurantia stripped from a glass plate and gummed to the stop of the lens is most convenient. The exposure required is two or three times as long as with unstained plates, and without a screen.—B. SC., Plymouth.

[65009.]—**Porcelain.**—According to Regnault, the composition of the paste used at Sèvres for ornamental purposes is as follows:—Washed kaolin, 62 parts; Bougival chalk, 4; Aumont sand, 17; quartzose felspar, 17. These ingredients are carefully levigated, and then thoroughly incorporated. As, however, the composition of the kaolin varies, the proportions of the other materials is necessarily varied likewise, so as to obtain a porcelain of uniform composition.—PRINCIPIA.

[65009.]—**Porcelain**—Is made of the following materials: China clay, 30 parts; Cornwall stone, 15 parts; calcined bone, 35; felspar, 20; well mix in water and sift. The above makes a clay of which parian or porcelain figures and ornaments are made. It contracts very much in drying and firing. The small articles would have to be made and fired first, and then fitted into the moulds. Perhaps the enamels given to "A. T." (64894) would be best.—POTTER.

[65010.]—**Eccentrics.**—Put engine on dead centre and set valves with a little lead, and pull engine to the opposite centre and see if the lead is the same; if not, make it half the difference. Repeat to see if correct. This should give the proper travel of valve, but eccentric may require shifting to give the desired amount of lead. Of course, you can set both valves at once. Now put link to opposite end, repeat above, and adjust eccentric and rods until they agree with former setting. The rods should be crossed when both eccentrics are nearest cylinder.—T. C., Bristol.

[65011.]—**Lathe-Fitting.**—The easiest way is to fit gap-piece in the gap—a sliding fit. Now drill down the joint on front right-hand and back lefthand for a taper pin to drop in to keep gap-piece in place. If you wish to fit a bolt to centre you can do so, but above is generally sufficient. The $\frac{3}{16}$ thread and $\frac{1}{16}$ cut will count as 3, each $\frac{3}{8}$in.—that is, 3 to $1\frac{1}{8}$in.—T. C., Bristol.

[65012.]—**Battery for Sewing-Machine Motor.**—TO MR. BOTTONE.—The best battery to use for this purpose is a chromic-acid battery. At least six cells, containing each one gallon of solution, should be employed. The elements should be of the sandwich form, one zinc between two carbons, about 7in. by $3\frac{1}{2}$in. The elements must be lifted from the solution when not in use. The chromic-acid battery does not smell at all. —S. BOTTONE.

[65013.]—**Marine Boiler.**—Does this querist use a salinometer? If not, he will probably make a heavenly visit. For draught, put a blower in chimney.—T. C., Bristol.

[65013.]—**Marine Boiler.**—It is not so much the salt held in solution in sea-water that hurts a boiler as the salt that is deposited when the water becomes supersaturated. Get a salinometer (which only costs a few shillings) and blow out whenever the water gets salter than $\frac{2}{32}$ or $\frac{3}{32}$. This wastes a great deal of coal, of course, but is cheaper than burning your firebox crown or tube-plate.—BANKER.

[65016.]—**Gramme Dynamo.**—A well-made Gramme dynamo, capable of lighting six 20c.p. lamps of 48 volts cold resistance, can be easily driven by an engine giving $\frac{1}{4}$H.P. indicated. I should recommend a steam-engine as being the most economical.—S. BOTTONE.

[65019.]—**Gas Engine.**—I should say the engine would work if you get over the difficulty of successful ignition. At the same time, my experience of gas-engines is slight, and I hope another correspondent will reply suitably.—T. C., Bristol.

[65021.]—**Precipitated Iron in Metallic Grains.**—Pure iron, in a very finely divided form—so fine, indeed, that it will catch fire if poured in a fine stream from the containing tube—may be prepared by passing hydrogen gas through a moderately heated tube containing oxide of iron.—S. BOTTONE.

[65022.]—**Aciertype.**—I doubt whether it is easy to get such a thick coating as you mention. Solution consists of a mixture of iron and ammonia chlorides. Cleanliness is everything. Current density about $1\frac{1}{2}$ ampère per square feet of cathode.—W. PERREN-MAYCOCK.

[65022.] — **Electro-Deposition of Iron.**—Solution: Double chloride of iron and ammonia; soft wrought-iron anode as pure as possible, 10 volts. Frequent scratch-brushing. Generally difficult to work.—BIJLI.

[65022.]—**Electro-Deposition of Iron, or Aciertype.**—You will find directions for the above in Sprague's "Electricity," pp. 306, 1875. Briefly, a solution of ferrous chloride is made by dissolving clean iron wire in hydrochloric acid, keeping the iron in excess. For every 58 grains of iron dissolved add 53·5 grains of ammonium chloride (sal-ammoniac). Start the deposits with a rather high voltage, say, three or four Smees in series, and then continue the deposit with one cell, the size of which must be controlled by the size of the cathode. The anode must be quite as large as the cathode.—S. BOTTONE.

[65024.]—**Induction Coil.**—The proportions of wire proposed are fairly good. Not many people will care to take a shock from a coil containing 1lb. No. 38 wire on the secondary.—S. BOTTONE.

[65024.]—**Induction Coil.**—I should not put on at the outside more than three layers of No. 16 for the primary. You are wasting a fair amount of your battery power in this way. If you want it for a shock coil, 1lb. of No. 38 will be plenty for the secondary, but if you want to get a decently large spark I should put on slightly more (say $\frac{1}{2}$lb.).—S. N. C.

[65024.] — **Induction Coil.**—If "Lancashire Amateur" will look in the "Letter" column, he will see a description and drawing by me of a new type of induction coil, or, as I prefer to call it, "Direct Transformer." If he has not gone too far with his to undo it and reconstruct after the pattern I show, he will get much better results.—W. PERREN-MAYCOCK.

[65025.]—**Model Dynamo.**—TO MR. BOTTONE. —Put about 3oz. No. 24 double silk-covered copper wire on the armature, and from 12oz. to 15oz. of the same wire on the fields. Connect up as a shunt machine. You will get sufficient power to light two fives of 6 volts each, or one 10c.p. lamp of 12 volts.—S. BOTTONE.

[65026.]—**Nickel-Plating.**— If "A Would-be Plater" is using a double sulphate of nickel and ammonia solution, it should be neutral; certainly not acid. Blackness is caused by (1) an acid state of solution; (2) not enough E.M.F.; (3) too much E.M.F.; (4) impurities. Ammonia cures the first; second and third obvious; fourth, most likely a nickel anode with 25 per cent. of iron in it. If this is so, it would work well for a time, but eventually the iron gets into solution and is deposited with the nickel, giving a dark, patchy appearance that feels like emery-cloth. If your anode is honeycombed you may be certain this is the case. Cure: Sell the anode to another would-be plater, and get a pure nickel one. Then work all the iron out of solution, use a cathode as large as anode, couple on battery, and leave it till it deposits bright.—BIJLI.

[65027.] — **Perspective.** —"Art Student" apparently thinks that the picture or delineation on a plane surface should be the same as the impression in his eye. It should *not* be so: it must be something that will *produce in his eye* the same impression as that of the actual object represented. If the picture is on a plane, every straight line in the actual object must be represented by a straight line in the picture.—E. H.

[65027.]—**Perspective.**—This is a case of what is sometimes called parallel perspective, where the eye is supposed to be fixed, and the line of sight at right angles to the picture plane, as in all perspective; while the latter is parallel to the front of the houses opposite, the picture being limited to the base of a cone, whose apex at the spectator's eye is an angle of 60°. Theoretically, even the short horizontal sky-line would trail away to the right and left, as its extremities are more distant from the eye than is its centre. For the same reason the vertical lines would incline, skywards or earthwards, according to the observer's position, low or high. Consequently, if he were low, a square building would assume more or less a pyramidical form; if high, that of the same form inverted; if midway, that of a haystack. So much for theory. In reality, these inclinations are so insignificant that the eye cannot perceive them, and consequently no attempt is made to represent them in practice. In short, the vanishing points of these lines are at an infinite distance. If "Art Student" will look at the houses under the above conditions, and not allow his eye to wander to the right, left, up, or down, he will satisfy himself that the curved outlines suggested by theory have no practical existence, and he may rest assured that should he attempt to indicate them, the resulting picture will satisfy neither his own nor anyone else's eye.—G. G. B.

[65027.]—**Perspective.**—The question asked by "Art Student" is interesting, and has no doubt been a difficulty to others. Perspective is neither more nor less than a faithful copy of nature, and is really founded on actual observation. It is true that optics mathematically applied ought to agree with observation; but if we should find that some "rule" or "principle" in perspective is at variance with facts, then the rule must be wrong, or misunderstood. The truest representation of nature (so far as perspective goes) is, and must be, the photograph. Now what do we observe? The photograph of a straight horizontal line at right angles to our line of vision (as, for instance, the top of a row of houses all of the same height, opposite to us) is also straight and horizontal. No bending downwards to right or left; no curve. It may be replied, But the row of houses referred to is near the spectator, just across the street. No photographic camera could take in so wide a view. Just so. Therein lies the explanation. Neither can the eye take in so wide a view at a single glance. In order to survey the whole row of houses, the head would have to make a sweep of quite 90°; and in the course of such a revolution the eye would take in, not one picture only, but a score. Perspective relates to one picture only. If an attempt is made to delineate more than the eye can take in at a single glance, the work becomes a panorama, in which constant compromises have to be made with the rules of perspective.—F. S. S.

[65028.]—**Varnish for Motors and Dynamos.** —If mixed with good colours, such as Chinese red, white hard varnish does very well. But I use a good bit of the ready-prepared varnishes, known as "Scollik's enamels."—S. BOTTONE.

[65029.]—**Brightening Brass, &c.**—Oxalic acid.—W. M. J., Dublin.

[65029.] —**Brightening Brass.**—The better the surface the easier it is to polish, therefore never use emery, Bath brick, or other scratching materials. Try the crocus composition advertised in Sale Column.—BIJLI.

[65030.]—**Fistula on the Gum.**—Go to a good dentist, who will not only give you the necessary treatment, but also all the information proper to the case when he sees it.—DENS.

[65031.]—**Tandem or Sociable Tricycles.**—As I have ridden both tandem and sociable, I speak from experience when I say that a tandem is the easiest and best hill climber you can get, for you will find that if you are facing a wind and going up a very steep hill it would be impossible for a lady and gentleman to get up on a sociable; and not only that, it covers a great deal more track than a tandem, and is much more difficult to ride on a bad road.—C. H.

[65032.]—**Tandem or Sociable Tricycles.**—I should advise a front-steering tandem tricycle, with 36in. side wheels geared up to 56in. or 58in., with 26in. front wheel; cranks 7in., capable of adjustment. The lady to ride in front. The rear rider to have perfect and sole control of the machine as far as steering and brake go. A tandem is far ahead of a sociable for many reasons; the first is that it takes up less room on the road, and therefore a better track is secured.—C. BURMAN CALLOW.

[65033.]—**Hair-Dye.**—Will "Virgo Dolorosa" kindly say how the preparation from the rind of the walnut is prepared, as I have always found the expressed juice lose its staining power directly it is expressed? Also say where I could obtain some for use before the fruit comes in again?—A. L.

[65036.]—**Force and Energy.**—Force is that which promotes or tends to promote, or which resists or tends to resist, motion in a body. Energy may be kinetic or potential. K.E. is the work (i.e., force overcome) a body is capable of doing by virtue of its motion. P.E. is the work a body can do by virtue of its position.—W. PERREN-MAYCOCK, A.S.T.E.

[65036.]—**Force and Energy.**—If Mr. Clodd has really defined force and energy in the curious fashion quoted by the querist, he must be exceedingly ignorant of mechanics. Force is usually stated to be that which moves or tends to move matter. It is measured by the product of a mass by the acceleration produced in the mass; hence its dimensions are—

$$\frac{ML}{T^2} \text{ or } MLT^{-2}.$$

Energy is a quantity of an entirely different character; it is power to do work, and its dimensions are the same as those of work—i.e., force multiplied by distance, or—

$$\frac{ML^2}{T^2} \text{ or } ML^2T^{-2}$$

WM. JOHN GREY, F.C.S., Analytical Chemist, Newcastle-on-Tyne.

[65037.]—**Model Dynamo.**—TO MR. BOTTONE.—Certainly. See my advertisement in "Sale Column." The constant bichromate cell is made precisely like a Bunsen—viz., carbon in porous cell with bichromate and sulphuric acid mixed, zinc in outer cell with dilute sulphuric acid. The chloride-of-silver cell consists in a carbon or silver rod wrapped in a paste of chloride of silver, and separated from the zinc by moistened blotting paper, or the zinc may take the form of a rod surrounded by blotting-paper, then silver chloride paste, and then silver. —S. BOTTONE.

.]—**Varnish for Motors and Dy-** —Shellac varnish; shellac dissolved in ted spirit.—BIJLI.

0.]—**Steam-Engine.**—"Cut off as early as " is rather indefinite, nor is it stated condensing or non-condensing; but sup- t is non-condensing, the water consumed t be less than 30lb. per indicated horse- er hour.—W. M. J., Dublin.

).]—**Steam-Engine.**—"Cut off as early ible" does not convey much information. gine is economical it will use about 22lb. of water per hour for each indicated horse- In the case given this will be 9 × 30 r, say, 300lb. per hour, and require about coal per hour. Unless the engine is in d order it will probably use more. Above sed to be for condensing. If high-pressure, at ⅓rd.—T. C., Bristol.

.]—**Iron Roof.**—It is very difficult to condensation when openings under the not permissible. Even then the sudden of temperature on both sides of the roof se sweating. Wooden sheeting is perhaps remedy.—W. M. J., Dublin.

8.]—**Jensen Bell.**—There is no special winding: the same as any ordinary coil. your bell connections are insulated in the laces. The armature and hammer-piece ork freely on the pin, but without side Plenty of battery power required.—W. -MAYCOCK.

.]—**The Jensen Electric Bell.**—There cial method adopted in winding the coil of l. You say nothing about the battery The fault is either (1) insufficient battery 2) a too strong spring, or else improperly , (3) a short circuit in the winding; and three I should say it is most likely the Read what I have said about adjusting Article III. page 425 of last volume, and other try. If not then successful, let us ain, mentioning the battery power used.— LLSOP.

.] — **Sealing Battery Tops.** — Pitch lone, melted in ladle, afterwards trimmed a hot iron. Don't omit the vent holes.— REN-MAYCOCK.

.]—**Sealing Battery Tops.**—I have itch will do very well for this, and do not requires any mixture with it. Plug up of the cell with paper, melt the pitch in a tin can, and pour it carefully on.—PRIN-

.]—**American Wire Gauge.**—No. 18 in n wire gauge is ·0403in. diameter. No. 19 is nearest (·042), and near enough for that -NUN. DOR.

5.]—**American Wire Gauge.**—No. 18 is ·0403in., and No. 19 S.W.G. is ·040in., st exactly equal to 18 A.W.G. No. 18 lies between 19 and 20 B.W.G., 19 being l 20 ·035in.—H. C. HAYCRAFT.

.]—**American Wire Gauge.**—Lock- Handbook of the Telegraph," an Ameri- lication, gives A.W.G. No. 18 bare copper ft. to the pound weight, and B.W.G. No. . to the pound. "Prescott's Electricity" s:—

.	Size of each number in decimal parts of an inch.	Difference between consecutive numbers in decimal parts of an inch.
	·0403	·00495
18	·042	·009

I cannot give the difference between the and the new standard wire gauge.— C.S.

.]—**Chatterton's Compound.**—Prescott, ives the following:—Stockholm tar, 1 part; part; and guttapercha, 3 parts—all by -M.M.I.SC.S.

.]—**Chatterton's Compound.**—There is Chatterton's compound. Stockholm tar, ., in proportion of 1:1:3.—W. PERREN- K.

.]—**Chatterton's Compound.** — The g is the recipe given in Hospitalier's laire Pratique de l'Electricien": Stock- , 1 part; rosin, 1 part; guttapercha, 3 .C. ALLSOP.

.]—**Blowpipe Solder.**—One part tin, s lead. Will melt freely under the flame ipe.—F. WALKER AND HYDE.

.]—**Dye for Leather.**—Mix lampblack ts of turpentine to the consistency of stiff en mix 1½ gill of turps and one pint of copal varnish, and add this mixture to the before-mentioned black paste till thin enough for use. It should not be too thick when applied to the leather. Two or three coats will be found sufficient, and as it dries very quickly the last two coats may be applied on the same day.—F. WALKER AND HYDE.

[65060.]—**Pewterer's Repairs.**—A suitable solder may be made thus:—Two parts bismuth, four parts lead, three parts tin.—F. WALKER AND HYDE.

[65061.]—**Medical Indicators.**—I think it was our old friend Mr. W. J. Lancaster who called these deceptometers. They merely consist of a string fastened to the end of the tube that is drawn from over the wire core of the coil, passing up to and fastened round a pulley that is connected with the finger on the dial face. You will readily make one from the above suggestion, I think.—M.M.I.SC.S.

[65063.]—**Sealing Leclanche Tops.**—Unless the cells are to be moved about, do not seal the tops at all: they work a lot better without, besides, it permits what the inventor always insisted on—"letting the carbon breathe."—M.M.I.SC.S.

[65064.]—**Bunsen Batteries.**—Are your zincs amalgamated? Three 16c.p. lamps, if distributed. No.—W. PERREN-MAYCOCK.

[65064.]—**Bunsen Batteries.**—It's not much use you trying to work a lamp by batteries; you will find that you will have to recharge them quite twice a week to have a current strong enough to light it properly. If you amalgamate your zincs you will find that it will preserve them and keep them from turning black (that is, rub them with quicksilver and sulphuric acid). I should think that you will want quite a 20 or 25c.p. lamp to have any light worth speaking of; and you ought to be able to get a current strong enough from the batteries you speak of. You will find that your batteries will last longer if you take your zinc out of the solution when you are not using them.—C. HYDE.

[65065.]—**Fan for House Fire.**—A portable fan is made for fumigating purposes for gardeners. Any large ironmonger would probably procure one for you. The fan arrangement for household use is very old. An old friend of mine made one many years ago.—T. C., Bristol.

[65065.]—**Fan for House Fire.**—I have had a Clarke's blower, such as that seen by "Fan Blast," in use for nearly 40 years. I think I have seen them for sale, but very rarely. A larger kind is in common domestic use in the counties of Carlow and Wexford, where it is required for the slack fires used there, and is sold by all ironmongers in that neighbourhood. They are most effective, and far surpass the ordinary "puff and go" bellows. The larger kind is preferable, as it allows the operator to be further from his work and its results —C. E. BISSET.

[65066.]—**Une Idee.**—About ten years ago a Mr. Terry exhibited a toy boat propelled in this manner, we think in the old Polytechnic, but in this case the "tuyeau" was cranked so as to pass along the keel to the stern. A receiver or exploding chamber was provided inside the vessel, and a very ingenious automatic make and break allowed of a spark passing into said receiver at intervals of about thirty seconds. As regards the practicability of the scheme, it is evident that the battery power necessary to decompose sufficient water to produce gas for propelling even a small canoe would be applied with more economy and advantage through a good electric motor.—FREDK. WALKER AND HYDE.

[65066.] — **Une Idee.** — The principal effect would be to make the boat jump up vertically; if there were any forward movement, it would probably be followed by a reaction in the same manner as the vertical motion.—BANKER.

[65066.]—**Une Idee.**—J'ai lu, et j'ai etudié soigneusement, l'idée de M. Jancrarski, et parler sans contrainte, je suis faché de lui dire que je pense qu'elle ne vaut rien. On a déjà tenté plusieurs fois de faire avancer des canots par une méthode semblable, et toujours sans avoir de succès. La methode indiqué exigerait beaucoup de l'energie, et je ne puis voir qu'elle serait mieux que celles qui ont déjà manqué de succès. J'espère que M. Jancrarski pourra comprendre cette réponse.—WM. JOHN GREY, F.C.S., Analytical Chemist, Newcastle-on-Tyne.

[65066.]—**Une Idee.**—Cette idée, pour en dire le moins, est très ingénieuse, et mérite de la considération. Il est impossible de nier, que dans les conditions nomées, un mélange des gaz hydrogène et oxygène dans les proportions voulus pour former l'eau, sans l'action d'une étincelle électrique, entrerait en combinaison, avec la production d'une explosion, laquelle par éffet de la réaction, ferait marcher le bateau. Mais il ne faut pas oublier que pour liberer un quantité suffisante des gaz, on a besoin d'un grand courant d'éléctricité, ce qu'on n obtiendrait pas moyennant la seule bobine de Ruhmkorff.—S. BOTTONE.

[65068.]—**Electric Bell Earths.**—If you have another line wire you can connect up to instead of the usual earth, you can soon test it. Measure the resistance of the circuit when joined to earth and wire respectively. "Lockwood," p. 240, says, though, "a defective earth connection may often be found by searching without testing at all." On p. 194 he says, "We are aware that it has been common to ridicule the idea of insulating the ground-wire; it is, nevertheless, true that a terminal ground-wire should always be insulated." Do not fill the glass jars of Leclanchés up to the top; they work much better by being two-thirds full, besides there is less risk of corroded terminals and creeping over of salts. I notice stoneware jars cause far less creeping than glass ones when put in the same place and tried under exactly similar conditions.—M.M.I.SC.S.

[65069.]—**Atmospheric Pressure.**—Unless the copper was very thick indeed there would be no likelihood of the globe being "entirely exhausted." It would collapse utterly long before a perfect vacuum was reached.—W. M. J., Dublin.

[65069.]—**Atmospheric Pressure.**—Supposing the ball was made strong enough, and being a sphere, it would not be altered in shape in the least; on the other hand, if it was thin it would simply be crushed flat. There is an experiment (a favourite one with lecturers) of partly filling a cylinder with water, boiling it until the cylinder is full of steam, and pouring on water to condense the steam, when the vessel is crushed flat by the atmospheric pressure.—PRINCIPIA.

[65069.]—**Atmospheric Pressure.**—Are all the data for this question stated? What supports the copper sphere? If it is floating in a fluid of its own density, it would seem that it would retain the spherical shape (the normal pressures meeting at the centre), assuming the diameter of the sphere to bear so small a proportion to the height of the column of fluid that the pressure may be taken as the same all over. If the pressure is taken to vary from the top of the sphere to the bottom, the problem is beyond me.—BANKER.

[65070.]—**Income-Tax.**—If the owner of land, who is also the occupier, reaps no profit, and his income from all sources is less than £150 a year, he can get a drawback on applying to the Commissioners in proper form.—B. SC., Plymouth.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

Since our last, "Principia" has replied to 64669.

64433. Grinding Machine, p. 564.
64448. Bass Flute, 565.
64456. Linseed Oil, 565.
64478. Church Bells, 566.
64479. Bearing Surface, 566.

64685. Cardew's Voltmeter, p. 42.
64688. Magic Squares, 42.
64697. Raising Air to High Temperatures, 42.
64703. Varnish, 42.
64713. Gas Engine, 43.
64717. Private Tutor, 43.
64722. Iron Casting, 43.
64723. Vanishing Lady, 43.
64729. Shiny Brown Leather, 43.
64738. Storage Battery, 43.

American Hams and Lard.—The *New York Herald* of the 26th ult. contains an interesting account of the manufacture of "prime sham lard" from diseased and smothered hogs. One witness, who stated that he had only gone out of the business because he could not deal honestly in it, admitted that he had cut hogs into hams, &c., well knowing them to be diseased. The use of cotton-seed oil and stearine in the production of refined lard is well recognised, but we commend the above disclosures to the careful consideration of housewives who extensively use American hams and so-called lard.

SPAIN must be credited with being the first nation to make it, by absolute legislation, obligatory on managers of theatres in Madrid to light those buildings by electricity, to the total exclusion of gas. Six months are allowed in which to carry out this most important reform. All dynamos, engines, and motors of any kind are to be completely isolated from the main building, and minute rules are laid down for their safe installation. The supplementary lights are to be oil lamps. Persons employed behind the scenes are prohibited from using unprotected lights.

QUERIES.

[65072.]—**Embossing Ink**.—Will any reader please explain the proper way to make ink for embossing stamping press, and the mode of application?—CHEMICAL.

[65073.]—**Microscopical**.—Would any reader kindly tell me the best way to mount Infusoria, Entomostraca, &c., as I can find no information either in Wood's or Davies's books?—NO NAME.

[65074.]—**Induction Coil**.—I have an induction coil wound with ¾lb. 16 B.W.G. c.c. wire and ¾lb. 36 B.W.G. s.c. wire, and a battery of 4 cells potash bichromate. Can anyone tell me whether I have got battery power enough, as I cannot get a spark from coil?—AMMETER.

[65075.]—**Fly-Wheel for Lathe**.—In the purchase of a 3½in. back-geared lathe for amateur purposes, which do you recommend, a turned flat face fly-wheel or a grooved one, and, if any choice, your reason for the same?—E. C.

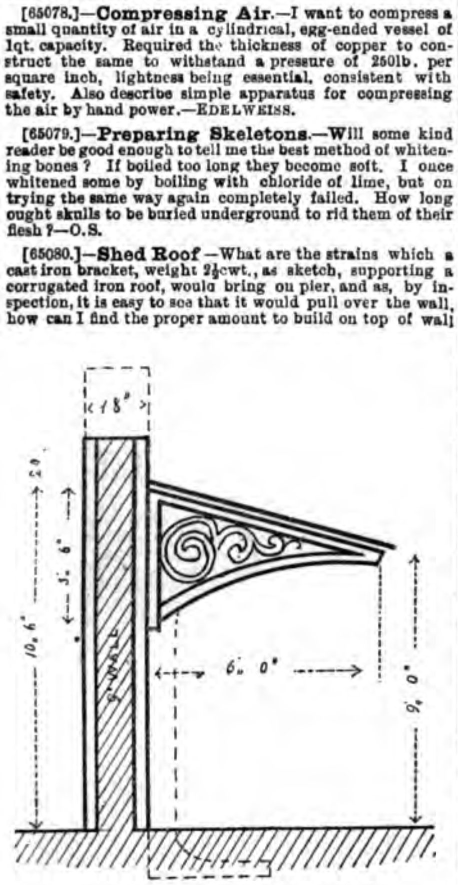
[65076.] — **Gold Extraction — Testing and Assaying**.—Will some of your readers kindly inform me the very best and cheapest way to gain a thorough practical knowledge of the above? Is there any institution teaching it for a small fee? Would give three or six months' time gratis to any good firm in this business. —C. M. T.

[65077.]—**Bunsen Burner for Oil-Gas**.—Will any gentleman who has had some experience of burning oil-gas in a burner constructed on Bunsen's principle kindly say how it may be successfully done? Burnt in an ordinary Bunsen, oil-gas gives a luminous flame which deposits carbon on articles placed in it. This is what I want to avoid.—B. N. S. N.

[65078.]—**Compressing Air**.—I want to compress a small quantity of air in a cylindrical, egg-ended vessel of 1qt. capacity. Required the thickness of copper to construct the same to withstand a pressure of 250lb. per square inch, lightness being essential, consistent with safety. Also describe simple apparatus for compressing the air by hand power.—EDELWEISS.

[65079.]—**Preparing Skeletons**.—Will some kind reader be good enough to tell me the best method of whitening bones? If boiled too long they become soft. I once whitened some by boiling with chloride of lime, but on trying the same way again completely failed. How long ought skulls to be buried underground to rid them of their flesh?—O. S.

[65080.]—**Shed Roof**.—What are the strains which a cast iron bracket, weight 2½cwt., as sketch, supporting a corrugated iron roof, would bring on pier, and as, by inspection, it is easy to see that it would pull over the wall, how can I find the proper amount to build on top of wall to resist this, and as an alternative how to find the dimensions and projection of foot as dotted lines? Wall is a 9in. brick wall with piers 18in. by 18in. every 9ft. One bracket at every pier.—J. R. G.



[65081.]—**Microscopical**.—Will any reader give me a list of resins, with their refractive indices, capable of being used for microscopic mounting? I want a medium with a much higher index than Canada balsam. Colour is no object. How can I remove cinnamic acid from tolu, and what test is there of its complete elimination?—CROSCO.

[65082.]—**Angleberried Horses**.—Would any of your kind readers inform me if it is possible to have angleberries taken from a brood mare otherwise than by an operation, that are hanging from her ribs and flanks?—A SUBSCRIBER.

[65083.]—**Injector**.—We have a non-lifting injector which feeds well at or above 60lb. pressure, but would like it to feed, say, at 30lb. Can any reader inform us whether any alterations to the nozzle will effect this? Nozzles are all fixed?—B. G.

[65084.]—**Spark Coil**.—Will some one kindly inform me how to construct a spark coil for gas-lighting purposes? Some of the lighters are about 30yd. from the coil, and four Leclanché cells, 6in. by 1in. porous pots, are used for the battery. I wish to know what quantity of wire (26 s.c.) will be necessary. Also size of core, and any other particulars that will be of assistance to me.—E. A. B.

[65085.]—**Dynamo**.—TO MR. BOTTONE.—I intend making a motor of the description given in the "E. M.," p. 118, Vol. XLVII. If instead of using it as a motor it is used as a generator, series wound, would the same gauges of wires and lengths be employed in both cases? Am I right in supposing that the greater the length of conductor cutting the lines of magnetic force the stronger is the current generated?—CHUMP.

[65086.]—**Barlow Lens**.—I have a telescope, 2in. o.g., 60in. focus. Would some one tell me if I were to place an achromatic o.g. (1¼in. diam., 22in. focus) about 5in. in front of my field glass would that fulfil the advantages of a Barlow lens? Which position will give the highest power upon my instrument?—ACHROMATIC.

[65087.]—**The Gramophone**.—1. Referring to description of above on p. 529 of No. 1,193, "E. M.," would any reader kindly give me dimensions of the principal parts of the instrument to suit ordinary purposes? 2. Is ferrotype plate used for diaphragm, and does it require a magnet and coil like telephone? 3. At about what rate should the drum be revolved to suit ordinary conversation?—X. Y. Z.

[65088.]—**Coffee Maker**.—Can anyone kindly oblige me with directions for using a small brass coffee-making machine, containing two strainers, a pipe entering near bottom, and continued outside to the top, and having a lid fixed on with a clamp and thumb-screw? It contains about half-a-pint.—SHUNT.

[65089.]—**Brake**.—TO "T. C., BRISTOL," OR OTHERS. —Will you kindly work this problem out for me? An iron strap is used as a brake on wooden curbs whose diam. is 7ft. to a drum letting trams down and up on an incline plane. The speed of the drum is 10 revs. a minute. To work this brake is a lever, the longer arm being 8ft., and the short one 1ft., or a leverage of 8, with a weight 120lb. on it. The width of the strap is 6in. If that has anything to do with it, what is the friction in pounds?—ITHEL WYN.

[65090.]—**Launch Engine**.—A double high-pressure launch engine, 5½in. by 5in., makes 160 revs., with 60lb. steam working condensing without vacuum. What increase of power or number of revolutions would an air pump and vacuum give? Also what size should the air pump be? 2. What increase of power would be gained by substituting a compound engine with vacuum for the present high-pressed one, the boiler remaining the same, but which may be worked up to 80lb. or 90lb. pressure, and what size should the compound engine be? The object is to increase the power, not to save coal.—VACUUM.

[65091.]—**Zither**.—Would any musical reader acquainted with the construction of this instrument kindly say how to make it? The one referred to is not the common triangular toy, but is really very useful, extending over four complete octaves with flats and sharps, produced by 31 strings—viz., five melody strings for the left hand, and thirteen each accompaniment, and bass strings for the right hand. It appears very simple.—CROTCHET.

[65092.]—**Electric Bell Work**.—I am about to put up electric bells in a large hotel, and intend to connect all the return wires on each story together, and run one wire to the next landing below, and so on through the building; so before I lay the wires I should like to know if this would be a safe method to adopt. Which is best, to couple up the indicator and bell on the out current or on the return current?—T. J. O. C.

[65093.]—**Engine**.—Would any of our correspondents kindly say how to find power of boilers for a boiler 30ft. by 8ft.; 2·75ft. flues, two of them? Would this rule be correct? $\frac{8 + (2{\cdot}75 \times 2) \times 30}{5{\cdot}73} = 70{\cdot}68$H.P. If so, would this be nominal or greatest power of boiler? How many such boilers would be required to work a condensing engine, cylinder 48in., stroke 9ft., double-acting, 16 strokes per minute, absolute steam pressure 50lb.? Also what would be power of this engine? In finding total heat in steam one work gives formula $= 1082{\cdot}4 + {\cdot}305\,(T - 32)$, while another gives $1082{\cdot}4 + T \times {\cdot}3$. Which would be right for exam., as there is a slight difference? Thus steam at 273·6 total heat $= 1082{\cdot}4 + 273{\cdot}6^\circ - 32 \times 305 = 1156{\cdot}088$, and by the other it gives $1082{\cdot}4 + 273{\cdot}6^\circ \times {\cdot}3 = 1164{\cdot}48$. How many pounds of coal would be required to raise 200lb. of water from 60° Fahr. to 212° Fahr.? How many pounds would be required to keep this quantity boiling at 212° Fahr.? Would it be any advantage for cooking to pass the steam from the boiling water into a separate vessel containing the flesh, as it would heat a good quantity of water to boiling point; but would it save any coal by doing so, and how?—NOVICE.

[65094.]—**Electric Lighting**.—I am contemplating fitting up a house of ten fair-sized rooms with the electric light; but before commencing operations, I should like to get some information on the following points from reliable sources. Would it be best to use 10c.p. or 20c.p. lamps throughout the rooms (I intend to run them direct from the dynamo), and how many volts and ampères would each lamp take, and which would be the best make to employ? What power would be required to run 20 lamps requiring 50 volts and 1 ampère each, supposing the dynamo to be about 80 per cent. efficiency? I thought of fixing the electric lamps in the present existing gas-fittings by screwing in the lamp holders in place of the burners in the chandeliers, &c.; but perhaps it would be better to suspend them from the ceiling. Knowing the length and breadth of a room, how can the c.p. necessary for its proper illumination be determined, supposing the lamps be hung at a distance of 8ft. from the floor?—AN AMATEUR ELECTRICIAN.

[65095.]—**Sand Blast**.—I understand that a new method of sanding rails by a combination of air and steam for propelling the sand has lately been introduced, by which great advantage in way of adhesion has been obtained. Particulars of this and also of the sand blast for sharpening files would oblige. I want, if possible, to adopt it for file sharpening in connection with an existing sand blast apparatus for shading glass. This latter is, at present, effected by air from a fan through a nozzle of 40in. in length by 9-16in. in width, using about 1,700c.ft. of air per minute, at a pressure of 12in. of water, or about 7oz. per square inch. This represents about 3·21H.P. in the air, and if fan be taken to have a useful effect of 30 per cent. it requires 10·11H.P. to drive it, and is thus expensive in working cost. A still higher blast pressure, say 20in. of water or about 12oz. per square inch, would be preferable, but cannot well be attained by fan. Is it possible to employ direct superheated steam in combination with air for this purpose and thus avoid the fan altogether? The apparatus is capable with the higher pressure of operating about 700sq.ft. of glass per day.—M.

[65096.]—**Star Maps**.—Would "F.R.A.S." or other correspondent oblige with answers to the following queries? 1. Is there a planisphere which presents at one view all the stars visible to the naked eye at Greenwich, and extending therefore to 40° south dec.? I know of one such map published by an Edinburgh firm, but the positions of many of the stars are inaccurate, or have become so through lapse of time. 2. Is there a recent star catalogue which gives the R.A. and decn. of all fixed stars which lie within the Zodiac and are visible to the naked eye? If the catalogue is not recent, could you give me some rough method of applying the correction for precession? 3. Is there a good star map showing all stars visible to the naked eye and extending 40° N. and S. of the Equator, the latter being represented by a straight line? 4. Is there a map of the Zodiac arranged according to long. and lat. and extending 8° or 10° on either side of the Ecliptic? 5. Are there any tables in existence for the ready conversion of R.A. and decn. into geocentric long. and lat., and vice versa?—FINSBURY.

[65097.]—**Coppering Carbons**.—"Sigma," p. 103, of his "Electricity," says:—"Connect a wire to the carbon by a screw clamp and insert in a copper solution, arranging at first for a quick deposit to prevent entrance of moisture into the pores of the carbon." Will some one capable of advising kindly tell me how to arrange for this quick deposit? Should several cells be connected intensity fashion or for quantity to obtain the desired result? I have an idea that it is battery strength that is referred to, because on p. 292, in his Electro-Metallurgy section, paragraph 348, he says, in reference to depositing copper:—"It is better to use a rather strong battery at first, to secure deposit all over the surface." I think I have somewhere read, though, that if the battery current is not suited to its work a muddy or, perhaps, brittle, granular deposit is the result, so as I am waiting to do the carbons prompt suggestions will much oblige.—M. M. I. SC. S.

[65098.]—**Engine and Dynamo**.—Will some one give the H.P. of a single slide-valve cylinder, internal dimension of which is 4in. diam. and 5in. long, crank 2¼in., making 4½in. stroke, steam pressure 60lb.? Would it be powerful enough to drive a Gramme pattern dynamo—24lb. No 20 on fields, about 7lb. No. 16 on armature (laminated punchings)? Armature to revolve at 1,500 revs. per min. If not powerful enough, what H.P. at 50lb. pressure (giving internal sizes of cylinder and throw of crank) would be required to successfully drive the above machine?—S. T. HAMPTON.

[65099.]—**Deflection of Girders**.—Can Frank Caws (who so kindly replied at such length to my query on cisterns) give me a formula for the deflection of girders—more especially rolled joists and T iron, as I am at a loss to know how much they will deflect under loads which I calculate are within a safe margin? Such cases as, say, 6in. deep by 18ft. span, where the depth bears but a small proportion to the span. In ordinary girders I would make the depth about one-twelfth of the span, and the deflection would then be about 1-40in. for every foot of span. Also for such cases as where the 6in. girder is fixed at one end into wall, and projects 6ft. outwards.—J. R. G.

[65100.]—**Medical Coil**.—What type of medical coil must I use (in connection with a quart size bichromate of potash battery) to give a current, with regulator quite out, of rather greater strength than one person would care to take? Must I use one with primary and secondary currents, or would one with primary only do?—J. N. AYRES.

[65101.]—**Engine and Boiler**.—Having just completed a horizontal engine, 2in. bore and 4in. stroke, I wish to work it successfully from a good boiler. I have a boiler, 17in. high and 10in. diam., riveted, with two 2in. tubes through it, used as a vertical; but this will not make steam fast enough. It will only run the engine about 3 minutes at 60lb. per square inch; then it is all gone. Will some kind friend say the best sized boiler for me to have, and give the thickness of material, size of tubes, how many, fire space, &c.?—C. P. S.

[65102.]—**Noises in the Head and Ears**.—Could any of your correspondents tell me what is the cause of noises in the head and ears and if there is a cure for it, and what is the cure, and whom could I apply to? I should be very glad to hear any information or any suggestion, or any advice your correspondents could give on the matter. I am suffering from very annoying and distressing noises in my head and ears and from deafness, now more than two years. The noises never stop day nor night—two and three sounds all going the same time. There are times when it is not very bad, and again there are times when it is very loud. I should like very much to get some relief.—SHON-Y-GOF.

[65103.]—**Forced Draught for Boiler**.—I wish to apply forced draught to a double-flued steam boiler, 7ft. diam., 28ft. long, each flue 32in. diam., and shall be glad if any experienced reader can favour me with particulars to enable me to do so, my object being to be able to burn gas coke. I purpose using a blast fan, and wish to know the diameter of the revolving disc, revolutions per min., and pressure of blast. Also dimensions of horizontal steam-engine to drive the above fan, the boiler pressure being 60lb. per square inch. I shall also be glad to know what is the pressure of the blast used in an ordinary blacksmith's fire when supplied by a fan driven by power?—J. W.

[65104.]—**Manchester Dynamo**.—Will Mr. Bottone kindly give me the sizes of a No. 2 Manchester dynamo to generate an E.M.F. of 60 volts and current of 15 ampères, stating diam. and length of F.M. cores, quantity and thickness of wire? Also most suitable armature for running arc lamps, and dimensions of same, the number of coils most suitable, and size and quantity of wire required for each coil, together with speed of machine. I have a thorough knowledge of mechanics and good tools for constructing, and would like to make a serviceable machine, one not likely to overheat or spark, and would deem it a favour if you would give me any information as to the best parts to employ wrought iron, the size of commutator, the most effective arrangement for holding and ıe brushes, and what kind of brushes?—

-Pressure.—I require at the bottom of a pit ›f 1100lb. per square inch. A column of water which is 350yds. deep, gives me a pressure of quare inch. I propose to obtain the balance ıeans of a pole or ram worked by an engine the surface of pit, the ram to act direct upon ıead of column of water. The steam pressure ı 50lb. Will any of your readers kindly say ıter the engine should be to give the pressure . H. W.

-Motor.—TO MR. BOTTONE OR OTHERS.— simple electro-motor described in No. 1,202 be gh to drive a canoe, weighing under 80lb. and carrying two persons, at the rate of from 4 to hour, and if so, what battery power would be ır the purpose? Could a Gramme ring be sub- ith advantage for the ring armature described, d.c.c. for the No. 16 Am.W.G. used in winding l F.M.'s?—J. H.

—American Motor.—Can the motor in "Ours," April 6th, be worked as a dynamo? c.p. will it give, and what power will be re- Is the American wire gauge the same as that ? If not, what size will No. 16 wire (American) l with? Would field magnets and armature be if cast in good soft iron?—J. W. O.

—Tram Engine.—Will some of our corre- kindly inform me as to the best way to put sheaves on the crank-shaft of a small vertical Also how to make any gauges or templates that quired for the purpose. The engine is for a and is required to run both ways. Please give urther information, as to setting slide-valve, lead, &c., that would enable me to finish the M ENGINE.

—Steam Launch.—Will some practical what size engine and boiler should be to propel he following dimensions at a speed of five miles Length, 15ft.; beam, 4½ft.; depth forward, 2ft., The boiler to be a tubular vertical, and to work ressure. Also size and pitch of propeller.—

—Mouthpieces.—Will any kind reader in- ıow to polish vulcanite, horn, and amber mouth- Also how are they tapped, and what tools re- pipe repairing?—CYMRO.

—Razor Setting.—Will any reader kindly w are razors sharpened at the cutleries? Do ıone? If so, how do they manage to get them —E. M. R.

—Watch Repairs.—I have a lever watch in e ruby pin in balance is loose. I have tried t in with tissue paper round it and several other ut cannot make it keep firm only for about two ould any practical watch maker tell me the right k it?—CENTRE SECONDS.

— Shafting Rollers for Wringing ıes.—Will any correspondent give a description d of shafting rollers for wringing machines and t shafts from old rollers? The large wood maul give blow heavy enough, and sledge injures bar. g worked by screw, or is such apparatus to be UBLIN SUBSCRIBER.

]—Screw Cutting.—The lathe I work just wheel on mandrel of 30 teeth. Guide screw two inch. What is the rule for finding the wheels use this wheel on the mandrel? I have several t in most cases I find what wheel on mandrel I The lathe is so constructed that I must use four r all pitches.—HOPEFUL.

]—Voltmeter.—Can I measure the E.M.F. of a machine, alternating, for 85 lamps, 45 volts, with ıry voltmeter, same as I can a compound-wound ? If not, how can I measure the number of volts the lamps?—CLOUDY.

]—Indiarubber Solution for Water- g.—Will "Eos," or any of "ours" kindly say he best solvent for indiarubber? Also whether need be inserted in the solution to cause it to uickly on being applied for the repairing of for wading.—BARROW, Torrington.

]—Draught for Boiler Furnaces.—What the usual or proper flue tension of draught in water in well-proportioned furnaces of different boilers, such as plain cylindrical, Cornish, ver- l horizontal tubular, water tubular, and loco- oilers?—M.

.]—Flower Pots.—Will some of your readers best way for cleaning used or dirty flower-pots enhouses, &c, and also how to tell best kinds of hey vary a good deal in quality?—BRADFORD.

.]—Horsehair Manufacture.—I have a ıantity of horsehair I wish to mix and mat , so as to make it suitable for filling cushions, es, &c.? How is this done, and what plant do I ?—TECUMSEH.

.]—Metal Disc.—Will any reader please tell mean thickness of disc, 7ft. diam., ⅝in. thick at in. at edge, with regulator taper throughout, and for working same?—J. W. R.

.]—Small Finder.—Will some reader kindly ıe with particulars for constructing small finder o.g. 36in. focus?—SIMPLEX.

]—Sheep Dip.—Will any reader kindly give ipe for making a good sheep dip—liquid pre- J. M.

.]—Accumulator.—Would Mr. Bottone or ıer kind electrician inform me how to construct ıulator to maintain a 2½c.p. lamp for two hours? late, &c., and one that does not infringe any patent I. HENRY.

.]—Farrant's Solution.—How is the solution arrant's—for microscope work in mounting circles made up?—GARCON.

.]—Japanning.—Will some reader inform to japan small articles, materials used? Also for colouring a light or dark brown, and what sort of oven I require, heat, &c.—F. W.

[65126.]—**Harmony.**—In Vol. XIII. of "E. M.," a series of articles on harmony was contributed by Mr. Edwin Evans. On p. 76, he gives the triads in C major and C minor. They stand relatively thus:—

C major.	C minor, flats B, E, A.
C, E, G, major.	C, E, G, minor.
D, F, A, minor.	D, F, A, dimin.
E, G, B, minor.	E, G, B, major.
F, A, C, major.	F, A, C, minor.
G, B, D, major.	G, B, D, major (acc.).
A, C, E, minor.	A, C, E, major.
B, D, F, dimin.	B, D, F, dimin.

I am not at all clear how the several chords in either mode receive the designation of major, minor, and diminished. Doubtless the reason is to be found in the articles referred to, although I fail to perceive it. Perhaps Mr. Evans or some of your musical contributors will assist me out of this difficulty.—MAJOR.

[65127.]—**Rotary Engine**—Would some kind reader inform me the dimensions of a ½H.P. rotary engine? A rough sketch would also oblige.—HAL.

[65128.]—**Strength of Soda Lye made with Caustic Lime and Soda Crystals or Soda Ash.**—What are the right proportions to get the same strength? Which is cheapest to use at present market price of crystals and ash?—HAMMER.

[65129.]—**Condenser for Steam Launch.**—I have a steam launch, 40ft. long, with a pair of high-pressure cylinders, 6¾in. bore, and I want to try and reduce consumption of coal by adding a condenser. I also wish to reduce the boiler pressure, as I fear the boiler is not perfectly safe at 60lb. pressure. I have no room for an air-pump, and want to have as simple an apparatus as possible that will give the best results for the least possible outlay. I have heard a good deal about exhaust injectors as being valuable for this purpose, and I will feel much obliged for information on the following points:—Is an exhaust injector of suitable size for the existing 2in. exhaust pipe, capable of condensing all the steam from the engine? Will it reduce the back pressure in cylinders? If so, to what extent? Will it perform the double functions of a condenser and boiler feeder, or would it be preferable to have a separate injector to each cylinder with arrangements made for either to feed the boiler? Would I get any vacuum by placing a valve on the delivery, or would this be necessary in either case? What height should delivery be above water line?—B.

[65130.]—**Acoustic Telegraphy.**—Which of the two different tones or sounds properly represents the "dash" on the "bell," the "double sounder," and the "single needle" (the latter instrument, I believe, being generally read by sound in the post-office, two tin sounders of different tone replacing the original limiting stops or pins)? I have seen several needle instruments which represent the "dash" by the lower sound, although I have always been accustomed to an instrument on which the "dash" was represented by the higher tone, and the "dot" by the lower. This would undoubtedly appear to be the most sensible arrangement, as, for instance, if we compare the pedals of the "bell," "double sounder," and "needle" to the keys of a piano, the depression of the right-hand key would naturally produce a sound higher in tone than that of the left-hand key. I should like the opinion of some telegraph engineer or experienced telegraphist on the subject.—PERPLEXITY.

[65131.]—**Regulator.**—TO MR. S. BOTTONE.—I have made a regulator for 2½c.p. lamps, which appears to me to be much better than any I have seen for like purposes. I use a piece of ordinary steam-gauge glass about ⅞in. in length, which I fill with finely-powdered carbon, in the top part of which is a screw for compressing the carbon dust. It can be disconnected by unscrewing the screw until it leaves the carbon. I find it quite as easy to regulate the lamp by this means as it is to light the gas. I have not seen anything of the sort before—have you?—J. J. RATHBONE.

[65132.]—**Cooling Water for Engine.**—I have a 20in. cylinder engine by 42in. stroke, 70 strokes per minute, 60lb. pressure. I wish to compound it, but my difficulty is with the water for condensing, as I am surrounded with buildings on all sides and have only a small yard about 30ft. square. I think I have seen or heard of an apparatus for cooling water from engines and using it over and over again, which to me would be of the utmost importance, as the water is costly. Will any of your readers assist me with the information?—HEMMED IN.

[65133.]—**Locomotive Boiler.**—I intend making a working model of a locomotive engine, ¾in. to 1ft. scale. The size of the boiler is limited to the following dimensions:—Length of barrel, 8⅝in.; diam. of barrel, 3in.; length of firebox casing, 4½in.; depth at forward end, 5½in.; depth at trailing end, 5in.; grade surface, 4in. by 2⅝in.; height of furnace, 4in. Could any of your kind readers give me an idea for the size and number of tubes, and a cheap arrangement for fixing the same in the tube plates? I also want to know if a jet of paraffin oil to feed them from the tender would be a good substitute for coal for good steaming?—NO SIG.

[65134.]—**Cracking Noise in Telephones.**—I have two telephones of an old-fashioned type. They work fairly well for three-quarters of a mile without any battery power (I think the magnets are permanent ones, for the diaphragm is attracted to the end of the magnet). I put some Leclanché cells in the circuit, but it did not improve the sound. Should there be batteries with this kind of telephone, which are about 8in. long; the magnet is ⅝in. in diameter. At the one end is placed a small reel 1½in. in diameter and ¼in. wide (is this not a very small reel for the magnet); the reel is wound with very fine s.c. wire—there does not appear to be many yards of it. When I coupled the cells to the circuit there was some cracking noise, but when coupled the noise stopped. What would be the cause of it—there was no contact anywhere?—NERO.

[65135.]—**Micro. Eyepieces.**—I want to fit up, in an economical way, with microscopic objectives and eyepieces, to give a fair range of from 12 or 15 diameters to 800 or 1,000 diameters. How far can I advantageously depend upon eyepieces? And how far upon varying the length of the body of the microscope?—e.g., roughly speaking, 1·6in. with A eyepiece gives 300, or 2·5in. with C eyepiece, or even ½in. with a deeper eyepiece. Also, the power of 200 with 6in. body drawn out to 9in. or 10in. will give it. How will these arrangements affect (1) definition, and (2) penetration?—MIKE.

[65136.]—**Wood-Burning Furnaces in Steam Boilers.**—What is the usual allowance of grate-area (1) per foot of heating surface; (2) per pound of wood per hour; (3) per pound of water evaporated per hour? What height must be provided between fire-bars and the crown of surface to allow room for combustion? How are fire-bars modified for wood-burning? If I alter an existing coal-burning boiler to burn wood, and leave tube surface the same, how much larger must grate-area be to evaporate as much water as before per hour—neglecting the increased firebox surface?—DIGBY.

[65137.]—**To "Chemist."**—I wish to know how to prepare a deci-normal solution of pure Na_2CO_3 for estimating acids; also a deci-normal solution of HCl for estimating bases and alkalies. Please explain fully.—EVENING STUDENT.

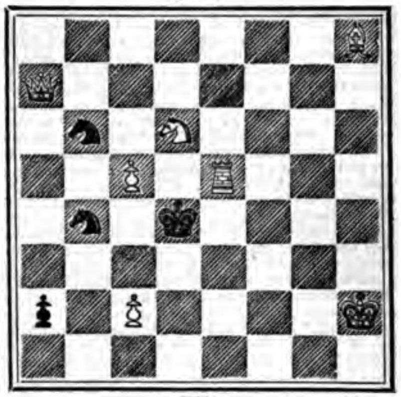
[65138.]—**Plating Dynamo.**—TO MR. BOTTONE.—Many thanks for the reply to my query, No. 64982. Since reading your reply I have decided to replace the present armature with one made up of punchings, 8¼ diam. as you proposed. Will you please say the best size and length of wire to wind it with, number of turns in each coil, and if F.M.'s will require to be rewound—if so, with what size wire.—ANXIOUS.

CHESS.

ALL communications for this department must be addressed to J. PIERCE, Langley House, Dorking.

PROBLEM MXCIII.

Black.



White. [7 + 4

White to play and mate in two moves.

SOLUTION TO 1,091.

White.	*Black.*
1. R-K 4.	1. Anything.
2. Q, R, B, or Kt mates accordingly.	

(Six variations.)

NOTICES TO CORRESPONDENTS.

CORRECT solutions to 1,091 by C. Reader, A. Wheeler, H. Fellows, Sorrel, J. Kistruck, E. W. Barnett, B. Green, R. G. Briscoe, A. Dean, J. Bryden (very clever problem), J. Methuen, Hensing, Black Pawn (very good, but obvious on account of P at Q 2. Pleasing otherwise, and mates neat), H. C. Haycraft, and G. W. Middleton; to 1,090 by J. Methuen (author's) J. Bryden (second), H. Billington (3), B. Green, E. W. Barnett (2), W. Jay, (3), A. J. Moulder, and Hensing (author's).

R. J. POWELL.—Black can't move K to K B 1 because of White's pawn and rook.

A. J. MOULDER.—Your solution was correct and in time, but overlooked.

J. BRYDEN.—1. Nothing is allowed for dual mates in two-movers. 2. In three-movers only the chief variations need be given. 3. If a three-mover has more than one solution, it will be sufficient to send the key moves. 4. Corrections or additional key-moves may be sent up to the time limit of a fortnight.

VICTOR GORGIAS, H. Fellows, and Black Pawn are thanked for their communications.

J. KISTRUCK.—1,090 cannot be done by 1. B-Q 4.

WE should have mentioned that the additional prize that W. Jay has been kind enough to offer is a copy of "Pierce Gambit, Papers and Problems," now in the press.

ZUKERTORT has declined the match with Rev. A. B. Skipworth. Mr. Bird offers to play a match with Mr. Skipworth giving him the odds of Pawn and move. "Mars" does not consider that circumstances justify him in offering such odds.

THE deaths are announced of two of the greatest players of past years of the Liverpool Club—George Stormont Spreckley, on March 24, aged 79; and A. Mongredien, on Good Friday, at the age of 81. Mr. Mongredien was the author of the Cobden Club Prize Essay on Free Trade.

THE *Birmingham Mail* expects a match will come off between Mr. A. Barn and Mr. W. Cook, of "Cook's Synopsis."

THE gold medal and championship of the Victoria Club, Belfast, has been won by Mr. Carey.

IN a match recently played between the Belfast Club and the United Ulster, the former won by 13 to 5, and 4 drawn.

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to Hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, April 18, and unacknowledged elsewhere :—

EPPS AND CO.—Rev. H. Dowsett.—E. P. Alexander.—H. B. F.—M. Isader.—W. S.—E. J. Gannon.—Constant Reader.—Alban.—One in a Fix.—Earcam.—W. M. J., Dublin.—J. M. Wellwood.—Apprentice.—H. Sadler.—W. J. Hamilton.—R. W. F.—H.—Gas.—Frank Caws.—Potter.—A. M. M. A.—F. C. Allsopp.—Young Mechanic.

J. B. (As you have read this paper from its first issue, you ought to know that it would be useless to insert such a query, and we should think, after the advice you must have had, you would not readily adopt what some of our readers might recommend. The best advice you can have is, "Consult a medical man.")—BROSCENICUS. (The wine put last season into a galvanised vessel is not only spoilt, but absolutely poisonous. It is useless; throw it away.)—T. W. B. (Dipping them in a paste of lime is one method; oiling or waxing them another; but you will find several methods of preserving eggs in back volumes.)—OPAQUE. (The blue colour is the indication of the temper, if you mean the natural blue. "Open hearth," as a rule; but it depends on what is wanted.)—SILVER. (Of what are the mirrors made? If of metal, you can silver them by the current from a battery or a dynamo and the usual plating solution; if of glass, the silver is precipitated on them from a solution of the ammonio-nitrate of silver. Full particulars can be found in back volumes, or in Watt's "Electro-Metallurgy," published by Crosby Lockwood and Son.)—G. H. R. A. (We do not see what more can be done. The surfaces should be clean, the flux applied, and then, if the "bit" is hot enough, the solder ought to flow and make the joint; but you must remember hot solder will not stick to cold lead—the latter must be warmed up.)—C. MIDDLETON. (All depends on how much is expended in compressing the gas. We do not think any one has tried such experiments, because the "explosions" of gas must be controlled by a rather heavy flywheel.)—J. H. SILVERS. (Why not procure the catalogue of Barnett and Foster, Niagara Works, 25U, Eagle Wharf-road, New North-road, N.?)—F. W. J. (The Institution of Civil Engineers is in Great George-street, Westminster. To be a "student" you must be a pupil of a civil engineer. M. stands for both "mining" and "mechanical.")—A. C. JOY. (Your query is still incomprehensible. It is as well to study brevity always; but there is a vast difference between brevity and obscurity. Where do you find the question, or what is the connection between the spirits, the ghosts, the substances, and the ancient superstition?)—STEPNEY. (Will you please elucidate your question? What "gradually decreasing scale" do you mean? Has it something to do with the differential calculus?)—E. O. (We do not know of any alloy which melts at 120° Fahr. Rose's metal is said to be equal parts of bismuth, lead, and tin, melting at something below boiling point of water. Another recipe gives 50 bismuth, 30 tin, 20 lead. To get at what you want, add mercury to the above.)—A BEGINNER. (See indices of back volumes. The great advantage of the Wimshurst machine is that it seems independent of the state of the atmosphere around it, starting off at once with long thick sparks.)—FARMER. (The directions given are quite sufficient; but an electro-motor to drive a 5in. lathe would be rather expensive in working. The materials can be obtained from our advertisers. See Hints No. 4.)—MOTOR. (Why use an accumulator? How will you charge the latter—by dynamo or battery? If either, it would be cheaper to use direct in driving the motor.)—MIXED UP. (Why not study the many articles we have published on the subject, or consult one of the textbooks?)—S STRINGER. (We do not know the "name" of that electricity. See indices of back volumes.)—AMATEUR. (Edison's loud-speaking telephone. See indices.)—COUNTRYMAN. (It is usually pressed out by hydraulic machinery, the seeds being inclosed in hair bags. 2. The methods of separating cream from milk were described and illustrated in Nos. 1,152, 1,153.)—LEARNER. (You cannot well prepare it yourself; but apply for particulars to Mr. W. C. Horne, 6, Dowgate-hill, London, E.C.)—W. T. SMITH. (We think you will find it in most of the textbooks dealing with such matters. A good abstract in Newcomb's "Popular Astronomy," for instance. There is no cheap work devoted to it.)—MACHINIST. (Air-gun valve details illustrated in No. 1,094. See indices.)—J. C. SOMERSET. (Any bookseller could advise. Perhaps Butler's "Ventilation of Buildings," E. and F. N. Spon, will suit, or Rafter's "Mechanics of Ventilation," same publishers. It is impossible to answer such questions without some definite information as to what is wanted.)—A CONSTANT READER. (Probably it is made by dissolving 20 grains of sulphate of zinc in *half a pint of distilled (or rain)* water. At any rate, that is a good and harmless eye-water.)—P. W. R. P. (Yes, that is why it would be so injurious to put sugar into a steam-boiler. We wanted to find out where such a thing had been recommended for steam-boilers.)—M. T. S. R. (A. Geikie's "Textbook of Geology," Macmillan and Co.)—J. G. N. (Cannot do better than the works named.)—HO ELECTRO-SOPHOS. (Don't use Greek letters for signatures. A flower-pot may be made to do; but it is better to use the proper porous pots.)—TURKISH BATH APPARATUS. (Much depends on the size; but see what has been said on the subject in back volumes.)—J. J. WADSWORTH, Canada. (Messrs. Chance Brothers, Smethwick, Birmingham, can send the discs safely.)—MOTOR. (Why not make the one described? The measurements have no doubt been worked out carefully, and we cannot spare space for replies to queries asking for machines twice as large down to half as large.)—AMPERES. (Watt's "Electro-Metallurgy," Crosby Lockwood and Son, Stationers' Hall-court, E.C.)—J. J. S. (There is no foundation for the belief about diseases being cured by the magnetic position of the bedstead.)—BEGINNER. (Britten's "Watch and Clockmaker's Handbook," Kent and Co., Paternoster-row, or the author, Horological Institute, Northampton-square, Clerkenwell.)—FELIX. (See indices, or a letter on the Photophone in No. 1,190.)—LUX. (Why should it not be?)—DIDASKALOS. (Mere examination questions. See a textbook on Botany.)—THANKFULL. (Was it not Leotard? There was something about that in back volumes.)—W. G. W. (If you keep on taking it you will probably find that it has been anything but a "cheap" watch. Surely you mean "low priced." However, no one can say what is the matter with it without examining it. Perhaps the mainspring has become unhooked.)—E. A. B. (Only by repolishing.)—H. J. B. (Recipe for making marine glue in many back volumes—one in No. 1,103, p. 231. 2. Nothing better than ticking, according to some plumbers; but others prefer moleskin or fustian about five or six thicknesses. The latter is the best, we should think.)—HAM. (The report on Ramie fibre is "Annual Series, No. 275," and can, we believe, be had of Messrs. Eyre and Spottiswoode, East Harding-street, E.C., who publish all Parliamentary papers.)—PIPE TONGS. (There is not any simple method of testing the purity of well or any other water. See indices. Practically, the Corporation can close the well, because it would not pay you to fight the matter out in the law-courts.)—WM. WATT. (We have had no previous complaint. Summon him for the money in the County Court.)—E. J. GANNON. (You can easily look up the specification at the Government Patent Office. We cannot undertake to illustrate well known patents merely to convince inventors that their ideas are not novel.)—C. R. N. (There is no hard and fast rule as to hours. The custom of the trade governs. Generally speaking, we should say nine hours a day.)—A. R., SCORRIER. (Want of space prevents us from giving any more to band-saws just now. Best thanks for what we have used.)—A. MARSON. (In type.)

Every Man or Woman suffering from any form of nervous derangement, loss of power, debility, or functional disorder, should send at once for "Electropathy; or, Harness's Guide to Health" (copiously illustrated). It will cost you nothing, and if, after perusal of the astounding facts it will bring to your notice, you should be persuaded to stop physicking and try rational treatment, you will assuredly be numbered among the ever-increasing multitude who daily express their gratitude for the priceless benefits derived from mild, continuous currents of electricity generated by wearing Harness's Electropathic Belt. Don't hesitate a moment, but sit down at once, lest you forget it, and write for the treatise, which will be sent you free by post.—Address, Mr. C. B. Harness, Consulting Electrician, the Medical Battery Company, Limited, 52, Oxford-street, London, W. (corner of Rathbone-place).

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Wanted, good back-geared Lathe, gap bed. Exchange DISSOLVING LANTERNS, Jewellery, Bicycle, Tricycle, or part cash, part exchange.—MECHANIC, 47, Fernhead-road, Westbourne Park.

Good Value Offered (cash or instruments) for all kinds of Scientific Appliances.—CAPLATZI, Science Depot, Chenies-street, near British Museum. Estab. 1862.

50in. **Bicycle**, equal to new, ball bearings, plated dropped handles, splendid machine, genuine bargain. What offers in exchange?—CLARK, Temple-street, Aylesbury.

"**Journal of Liverpool Astronomical** SOCIETY," Vols. III., IV., and V. complete, and part of Vols. I. and II. Offers.—CHAFFEY.

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Washing and Wringing Machine (Taylor and Wilson), excellent order, except centre of one roller. Exchange for small harmonium.—JOHNSON, 12, Moxley, Wednesbury.

Wimshurst Machine, 17in. plates, well made, as described by Mr. Wimshurst, what offers? Stamp reply to W. STOREY, Rochdale.

38in. Royal Mail Kangaroo **Bicycle**, hollow rims, forks, Kelsey's patent bottom bearings, Nagel's saddle, cowhorn handle bars. Exchange anything useful to value of £5 15s. or offers.—W., 30, Howson-road, Brockley, S.E.

54in. **Bicycle**, in good order, hollow forks, bell metal hubs, Cradle spring, King of the Road lamp, 40s. or offers. Wanted 3½ slide rest.—SHELTON, Alexander-street, Kettering.

Wanted, 10-hole Indicator, with bell, in exchange for 18ct. Geneva watch.—SILVERS, 45, Frederick-street, Birmingham.

Copper **Gasometer** and Iron Gas Bottle, large Cylinder Electric Machine, with Leyden Battery, &c. Offers.—MEAD, 12, Park-lane, Marylebone, London, N.W.

Will post "**Invention**," "Engineering," or any 6d. weekly for "Nature."—P. E. BATEMAN, Parkside, Tonbridge, Kent.

First-class Model **Horizontal Engine**, by Sheffield maker, ⅝in. bore, 1¼in. stroke, heavy 6in. flywheel, with condenser and fittings same as large engine, massive bed-plate mounted on mahogany base. Part exchange, Rover Safety.—GRUNDY, West Town, Retford.

Launch, new, 26ft. 6in. long, beam 5ft. 4in., depth aft 3ft., midships 2ft. 6in., copper fastened pitchpine plank shaft, bearings and propeller, price £16. Will exchange for Launch Engine Boiler, or anything useful.—JAMES READ, 12, Bridge-lane, Preston, Lancashire.

Dynamo, 120c.p., with ring armature, 16 sections, 3in. driving pulley, adjustable brushes, &c. Offers in small Electrical or Optical Goods in exchange.—Under.

Double-action **Air Pump**, cost £8 8s., maker, Watkins, London; in condition equal new. Offers requested.—G. HARRIS, 17, York-street, Nottingham.

Wanted, a Grooved Flywheel for lathe. Exchance good Steel Cutter Frame or other good exchange.—W. H. MONK, 74, Foregate-street, Chester.

Also wanted, Screwing Tackle. Exchange **Eccentric** CHUCK.—Above address.

2¼in. **Bench Lathe**, back-gear, slide-rest, face-plates, chucks, drills, tools, no flywheel. Offers.—W. BROWN, Lambert-street, Devonport.

Perambulator Fittings, Wheels, Springs, Bodies, Handles, Hood Joints, Rubbers, &c. Exchange joiner's or smith's tools.—LOWE, Orange-street, Nottingham.

¼in. **Spark Coil**, will take in exchange Electrical Apparatus or materials.—J. HUTTON, 35, Talbot-street, Southport.

A good one horse-power Horizontal **Steam Engine** for exchange.—Full particulars of S. H., 20, Castle-street, Reading.

Wanted, Instantaneous Shutter for lens, 2¼ hood. Will exchange central fire REVOLVER, ·320 bore (American make), and cartridges.—F. BURDEN, 8, Birchett-road, Aldershot.

Walking-stick **Air-Gun**, in mahogany case, all appliances complete. Exchange 10 by 8 double dark slides.—F. BURDEN, 8, Birchett-road, Aldershot.

Gold Geneva **Watch**, 18 carat, for 10-hole Indicator and Bell.—SILVERS, 45, Frederick-street, Birmingham.

1-horse **Vertical Engine**, complete; will sell or exchange to the value of £4. Can be seen at work.—G. PUDDIFOOT, Rookery, Watford.

4in. **Bell**, two door or window contacts, small quantity of wire, and two small Leclanché cells. Offers.—Address below.

"**Electrical Review**," complete numbers for 1887. Offers.—Address, W. DAVIS, 114, Hanover-street, Sheffield.

54in. **Bicycle**, balls to both wheels, in good condition. Exchange to value £5.—MUNCASTER.

Phonograph, iron drum, grooves cut in lathe. Exchange to value 35s.—MUNCASTER, St. George's, Salop.

Microscope, beautiful instrument, with stand and lock-up box. Exchange to value £5.—MUNCASTER.

The **Above Articles** in exchange for Camera, Lens, Lathe, Tools, or offers.—MUNCASTER, St. George's, Salop.

The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, APRIL 27, 1888.

EXTRACTS FROM BERGERON.—IV.

THE cause of this peculiarity is easy to grasp. Each time a measurement is taken the calipers open insensibly, and all these openings united cause at last a sensible difference. It is therefore necessary to observe each time if the calipers pass with equal ease, and for the purpose of forming a better judgment they must not be forced to pass, but made to rest upon the work by holding them lightly and leaving them to their own weight. If they pass with equal ease the test may be relied on, yet it will be well to return to the place where a commencement was made.

All these details will appear over-minute to many of our readers, who, in their impatience to turn, will think it quite sufficient to cut the wood passably. Those alone who have acquired a certain amount of skill will see the necessity and importance of them. But as our sole object is to lay down those principles which conduce to perfection, and as we only have in view the instruction of such as have had the least practice, we must follow the line which we have marked out for ourselves. How many people, through neglect of these initiatory principles, who turn numbers of articles, even of a complicated character, in which essential defects are found, know well enough where they fail, and have not the courage to retrace their steps.

The operation which remains in order to finish the cylinder can only be accomplished after sufficient skill has been acquired in the use of the chisel to master it; and that is cutting the two ends at right angles. For this the upper angle of the chisel is used, or one of the two angles of a chisel ground square across; but in this operation a double danger will be met with—hollowing the end, if the chisel held edgewise on the rest incline too much outwards; or rendering it convex, if it incline too much towards the cylinder.

But, in the latter case, the defect of which we have just spoken is not that which is most to be feared. There is, in addition, a risk that the chisel catching the circumference of the circle may meet with considerable resistance, and trace on the cylinder a somewhat deep track in the form of a screw; which may happen even with the most skilful just when the attention is relaxed. It is easy to understand the cause of this accident. A lathe chisel has two bevels, the meeting point of which is in an imaginary line in the thickness of the chisel. Thus, although the bevel which is applied against the end of the cylinder may be in the plane of the circle which is being traced, it is no less true that the cutting edge of the chisel is directed obliquely to the cylinder, and that thus, however slightly the circumference of the circle catches in this edge, the resistance jerks back the tool towards the holder, and the attempt being continued in spite of his surprise, causes him to continue to cut the wood, which can only be done obliquely by the edge of the tool, which, because of this obliquity, traces on the cylinder itself a line in the form of a screw, which is already of some length before there has been time to check the tool. To avoid this mishap, it is necessary first of all to form a chamfer with the chisel on the angle of the cylinder, and with a medium-sized gouge to remove the obliquity left by the saw-cut. In this operation care must be taken, as in the preceding one, to raise the hand which holds the handle of the tool, so that it shall always find itself, right up to the centre of the piece, in the direction of a radius to the circle. This difficulty foils many workmen, who, being unable to use the chisel, take a point tool; but this will not cut wood, but only scrapes it; instead of which, the chisel, skilfully directed, cuts clean and neatly, and even polishes the wood by compressing its pores.

As it is very useful for beginners who wish to learn to turn well to exercise themselves a good deal in cutting wood skilfully, we think that after having for some time turned cylindrical work, they will do well to amuse themselves by turning handles for their tools.

But as there is a risk of spoiling the wood, it is wise only to work upon French woods, like ash, service, maple, and others; and even if it is desired to practise upon birch, lime, or willow, it would be so much better, since nothing is so difficult to turn as soft wood. Let us see in what way we must set about it, so that all the handles shall be uniform. We must have made, or, if we are well supplied with the necessary tools, we must make with a plate of iron, about half-line thick, a gauge of the form represented in Fig. 9, the two points of which determine the length of the handle. A hole must be made in this, in order to hang it against the wall when it is not in use. This uniformity of length is not necessary; but it is agreeable to the eye when the tools are ranged in their rack. The most usual length is 3½in., including the ferrule. There must be cut from a block of wood a number of billets or pieces, about 4½in. long, or thereabouts. These must be cleft with a splitting knife, so as to hold up to the size of the thickest part of the handle. Let them all be trimmed up with the hatchet, and then placed in the dead-centre lathe (for as yet we are supposed to have no other, or that it is not used), and if sufficient skill has not yet been acquired for tracing a circle at each end, it is to be placed between the points as nearly central as possible, and merely by sight. The centre point is first of all to be gently screwed up, and motion is to be given by the descent of the treadle. It will be readily seen whether the centres are true, and if the eye cannot judge, a bit of red chalk can be brought near to see if it mark equally all points of the circumference. If the piece is more to one side than the other, a slight blow of the hammer or flat side of the chisel is to be given to that which projects, and by this means its centre is to be set back. Trial is again to be made, and this proceeding repeated until it runs true.

The work is to be commenced by making with the gouge a kind of pulley, *f*, at one end, eight or nine lines wide, keeping two rims, to receive the cord. For this the least handsome and worst end is to be selected. This pulley and the cord is to be placed near the left-hand centre, as being more convenient. The handle is then to be roughed out with the gouge along its entire length. At the right-hand angle the part which is to receive the ferrule is to be cut, and from this point is to be traced, with the compasses, which should have sharp points, a circle upon the handle near the pulley, and in this way will be obtained a constant and equal length. Care must be taken that the cylinder is of convenient thickness, and the same for all the handles, especially towards the pulley, which has been reserved.

A certain quantity of brass ferrules should be procured. One must be selected. The inside angle of one of its ends is to be chamfered with a half-round file, and, taking with a pair of in-and-out calipers, known as a "dancing master," the exact size of the inside of the ferrule, there will be obtained, at the other end of the calipers, the thickness of the tenon which has to enter it. There must be traced upon the cylinder with the angle of the chisel the length of the ferrule; then, with a gouge of medium size, almost as much of the wood is to be removed as will reduce it to the required thickness. The part against which the ferrule will rest must be cut at right angles, or even slightly hollowed, and lastly, with the chisel, the tenon is to be finished to the required size—that is, a little larger than is indicated by the calipers, so that it will enter with difficulty. Without this precaution, when the summer heat shall have dried the wood, it will be a common thing to find the ferrules on the workbench or on the tool-rack, and readily leaving their handles. It is for this reason that very dry wood ought to be used for this purpose. To turn this tenon with the chisel, it is necessary to have acquired much dexterity with this tool, for should the hand shift a little, or should the workman not be certain to turn the work accurately round, the ferrule will suffer by it, as can be readily seen. Beginners will do well to complete the tenon with a chisel of one bevel—i.e., with such as is used for scraping hard wood and shell. This chisel should be accurately sharpened and presented to the tenon almost radially, slightly above the centre, and a very light cut is to be taken..

If, however, very soft wood is turned, as lime or other, this last-named chisel can never be used. These woods must be absolutely *cut*. The ferrule is to be set on end, the coned part above, upon a stake, anvil, or other hard and flat body. The handle, which is supposed to be of proper thickness, is to be introduced and made to enter by striking the opposite end, and this is to be continued until the ferrule rests equally upon the shoulder of the tenon that has been made.

It is to be returned to the lathe, and if the work has been well done the ferrule ought to run true, or very nearly so. If this ferrule has been polished or ornamented with beadings, and the use that has been made of it has not injured it, it may be left as it is. It is necessary, however, to see whether the part that was placed upon the stake or anvil has not been bruised: if so, a light touch can be given with a point tool at that part to restore the end, and then a light touch of the same tool to take off the sharp angle. As in this operation of fitting on the ferrule care should have been taken not to damage the centres by striking them with the hammer, the piece can be put back into the lathe; and if the strain which it has had to undergo has slightly thrown it out of truth, which will be readily perceived by lightly presenting to it a small gouge, it must be struck with a mallet near the end which is damaged on the part which projects too far. After this the handle can be completed in the lathe.

We cannot here determine the shape to be given to handles for the workshop. That depends wholly upon taste. Some prefer them entirely straight, and others give them a different profile. It appears to us that the form given them in Fig. 10 is sufficiently satisfactory. Besides, the enlarged part that is seen there offers a convenient grip to the hand while the fingers grasp the smaller part.

Suppose, then, that this form is adopted, and that, at the point at which we have arrived, the bit of wood fitted with its ferrule is of cylindrical form of the required size, nothing remains but to give it the chosen shape. With a gouge, all the wood that is in excess is to be removed: it is to be gauged from time to time with the calipers at convenient distances from the ferrule, so that the hollows and swellings may be uniform, and little by little the piece is to be brought by the gouge to very nearly the desired form. At this point the length which is to be given to the handle is to be verified anew with the compasses by placing one of its points in contact with the ferrule, and the other near the bobbin, and it is to be finished to the desired form. If desired, there may be made before the enlargement by the ferrule, and close to it, a little beading which relieves it gracefully. It is made with the chisel as a finish. When the handle has been roughed out by the gouge to nearly the desired shape, it must be completed with the chisel. It is on the hollowed part and on the boss near the ferrule that it is so necessary to be able to use the chisel right or left. Wherever a swelling is to be made, it is the part nearest to the lower angle of the chisel that is to be used, and a complete revolution must not be made at each stroke of the chisel; but the tool must be turned during such revolution, so that at each stroke of the foot or treadle the chisel shall traverse the rounded part. If it is worked in any other way, there will be visible upon the spherical or spheroidal part as many flat places as there have been strokes of the chisel.*

First of all, then, the wood must be cut from *a* to *b* (Fig. 10, Plate II.), because the fibres run downwards; then from *c* to *b* for the same reason, and, except after long practice, the two cuts down to the bottom of the hollow *b* will not be made to meet. Nothing is more difficult. The chisel must then be brought back to round off from *c* to *d*, and with the lower angle of the chisel the spring of the base of the little beading is to be formed, which should not be more than two lines wide, and this spring is but the acute angle formed by two circles touching each other. The beading being of small diameter, should be also cut with the lower angle of the chisel—that is to say, that it should occupy of it no more than a half-line from the extremity of the edge which cuts the wood, and the chisel must always be traversed as the treadle descends. We cannot reiterate the fact too often, that nothing is so difficult as to round off well, and specially very small mouldings. Whatever the work of this nature you may give to a man who calls himself a turner, if he can level a cylinder accurately and round off a beading or an ogee, he has everything proved in his favour: he cuts wood well; but it is necessary to see him work, for very frequently such persons rectify with sandpaper, or other means, the defects which their want of skill has left upon the work.

O. J. L.

THE PRODUCTION OF ALUMINIUM.

ALTHOUGH so many patents have been recently taken out for the production of aluminium, and the Cowles process is being worked extensively, there seems no lack of invention in connection with this metal, which, if it could be put upon the market at a low price, would revolutionise some industries. Mr. Cleaver, of Stockwell, has recently patented a process in which he takes alumina and dissolves it in sulphuric acid, absorbing the sulphate of alumina obtained with finely-powdered carbon. When dry the mixture is highly heated out of contact with air. A reduction of the alumina salt takes place. The material thus obtained is mixed with iron in a divided state such as cast-iron filings, and the mixture raised to a temperature sufficient to melt the metal, when an alloy of aluminium and iron is obtained. Similarly aluminium may be alloyed with other metals. The patentee also employs the ferro-cyanide of aluminium, and obtains an aluminium-iron alloy by highly heating this salt either alone or together with iron and carbon. Copper may be added, and so an aluminium bronze is obtained. As high temperatures are required in some of these operations a furnace is used in which the combustion is urged by a supply of oxygen gas. The patentee prefers to dissolve the alumina in sulphuric acid, so as to obtain a solution of sulphate of alumina, and mixes this solution with finely-powdered carbon (preferably good lampblack) in the proportion of one part of carbon to four parts of sulphate of alumina. Having thoroughly incorporated these ingredients, the mixture is dried and treated in a gas furnace similar to that in use for melting platinum and refractory metals: it is a vessel lined with lime and having an aperture on one side by which a jet of coal-gas mixed in due proportion with oxygen gas is projected into it. The flame fills the chamber and raises it and its contents to a very high temperature. The mixture of aluminium salt and carbon is spread in a thin layer over the lower part of the chamber, and the flame plays over it. The gases supplying the jet are so adjusted that the coal-gas is somewhat in excess, and therefore the carbon is not burnt out of the mixture. When the highest temperature which the furnace will yield is attained the operation is completed; the aluminium in the mixture is then completely reduced, but remains in intimate mixture with the carbon. At the end of this operation the furnace is closed and allowed to get cold. The powder is then mixed with about twenty times its weight of finely-divided cast iron, and the mixture melted, preferably in a pot and furnace such as are used in steel melting. In this way an iron-aluminium alloy is obtained. Sometimes, when a rich alloy is required, the process is repeated several times, the same iron being employed over and over again. In a similar manner alloys of copper are obtained by substituting that metal for iron in the melting operation. The iron or copper may be added to the original charge of the gas furnace, but it is preferable to operate in the manner described. Other alloys may be made by like methods. Sometimes, in order to produce at one operation a rich alloy of aluminium and iron, ferro-cyanide of alumina is used, which is heated in a gas furnace in the manner described and either alone or in admixture with carbon or cast iron, or either of them. As in these operations a very high temperature is required, the patentee prefers to heat the oxygen gas with which the flame is urged by passing it through earthenware pipes heated to a dull red.

ASTRONOMICAL NOTES FOR MAY, 1888.

The Sun.

Day of Month.	Souths.	At Greenwich Mean Noon.		
		Right Ascension.	Declination North.	Sidereal Time.
	h. m. s.	h. m. s.	° ′ ″	h. m. s.
1	11 56 54·80 A.M.	2 36 17	15 17 35	2 39 22·53
6	11 56 25·87 ,,	2 55 31	16 44 10	2 59 5·31
11	11 56 11·41 ,,	3 14 59	18 3 49	3 18 48·08
16	11 56 11·29 ,,	3 34 42	19 15 56	3 38 30·86
21	11 56 24·77 ,,	3 54 38	20 19 52	3 58 13·64
26	11 56 51·06 ,,	4 14 48	21 15 5	4 17 56·42
31	11 57 29·42 ,,	4 35 9	22 1 10	4 37 39·21

The method of finding the Sidereal Time at Mean Noon at any other Station is described on page 403 of Vol. XLVI.

Watch should be kept for the small sunspots, which appear at uncertain intervals.

On and after May 22nd, there will be no real night in any part of the United Kingdom.

The Moon

Enters her Last Quarter at 11h. 47·1m. p.m. on May 2nd, and is New at 1h. 23·5m. in the early morning of the 11th. She will enter her First Quarter at 11h. 5·1m. at night on the 18th; and be Full at 1h. 40·1m. p.m. on the 25th.

Day of Month.	Moon's Age at Noon.	Souths.
	Days.	h. m.
1	20·1	4 43·8 a.m.
6	25·1	8 48·9 ,,
11	0·4	0 21·1 p.m.
16	5·4	4 24·7 ,,
21	10·4	8 40·2 ,,
26	15·4	*12 26·1 ,,
31	20·4	5 14·1 a.m.

* After midnight on the 25th.

The moon will be in conjunction with Venus at 9 a.m. on the 9th, with Mercury at 10 p.m. on the 10th, with Saturn at the same hour on the 16th, with Mars at 11 p.m. on the 21st, and with Jupiter at 7 a.m. on the 25th.

Mercury

Is a Morning Star at the beginning of May, but comes into superior conjunction with the Sun at midnight on the 10th, after which of course the planet travels to the East of him, and becomes an Evening Star. His angular diameter is 5″ up to nearly the middle of the month, when it increases to 5·2″, and so on to 6·4″ by the end of it. At this time Mercury is easily picked up with the naked eye after sunset over the N.W. by W. part of the horizon, and pretty close to it.

Day of Month.	Right Ascension.	Declination North.	Souths.
	h. m.	° ′	h. m.
1	1 56·4	10 22·6	11 17·2 a.m.
6	2 35·1	14 29·3	11 36·1 ,,
11	Behind	the Sun.	
16	4 1·6	21 43·7	0 23·1 p.m
21	4 46·1	24 5·4	0 47·7 ,,
26	5 28·0	25 21·2	1 9·8 ,,
31	6 5·4	25 36·9	1 27·5 ,,

The considerable arc thus described by Mercury begins on the northern portion of Cetus, extends right across Aries and Taurus, and terminates in Gemini to the N.W. of η in that constellation. He, however, approaches no conspicuous star in any part of it. He will be in conjunction with Neptune at 8 a.m. on the 15th.

Venus

Is a morning star throughout May, but is an insignificant object, becoming more and more gibbous, decreasing in diameter from 10·4″ to 9·8″, and being, in short, in a poor position altogether for the observer with the telescope. Nothing can be more striking than the difference between the insignificant aspect she now presents, and that size and brilliance of her disc which attracted such universal attention last November.

Day of Month.	Right Ascension.	Declination North.	Souths.
	h. m.	° ′	h. m.
1	1 24·9	7 17·5	10 45·8 a.m.
6	1 47·9	9 34·8	10 49·0 ,,
11	2 11·2	11 46·8	10 52·6 ,,
16	2 34·8	13 52·0	10 56·5 ,,
21	2 58·8	15 49·0	11 0·8 ,,
26	3 23·3	17 36·3	11 5·5 ,,
31	3 48·2	19 12·3	11 10·7 ,,

Hence it will be seen that, starting from a point in Pisces, Venus will travel through a small part of Cetus and through Aries, terminating her path in Taurus, some distance to the south of the Pleiades. She traverses a comparatively blank part of the Sky.

Mars

Is visible throughout the working hours of the night, but, of course, his present opposition is not one in which he is in the most favourable position for the observer. His angular diameter decreases from 17·7″ on the 1st to 14·7″ by the last day of the month, and he even begins to show faint traces of gibbosity.

Day of Month.	Right Ascension.	Declination South.	Souths.
	h. m.	° ′	h. m.
1	12 56·2	4 30·2	10 15·1 p.m.
6	12 51·5	4 15·4	9 50·8 ,,
11	12 48·0	4 7·5	9 27·7 ,,
16	12 45·7	4 7·0	9 5·7 ,,
21	12 44·7	4 13·8	8 45·1 ,,
26	12 44·9	4 27·5	8 25·7 ,,
31	12 46·3	4 47·7	8 7·3 ,,

The curiously-twisted path indicated by the

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* It may not be unnecessary to remind the reader in reference to this term—that with the pole lathe, of which the author is here speaking, the cut of the chisel is not continuous.—O. J. L.

Occultations of (and near approaches to) Fixed Stars by the Moon.

Name of Star.	Magnitude.	Disappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.	Reappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.
		h. m.		°	°	h. m.		°	°
50 Sagittarii	6	3 19 a.m.	Bright	12	359	3 33 a.m.	Dark	351	339
31 Capricorni	6½	2 50 „	Bright	143	112	3 43 „	Dark	238	214
61 Geminorum	6	†9 48 p.m.	N. by E.	171	212				
d^1 Cancri	6	11 5 „	Dark	35	74	11 45 p.m.	Bright	300	337
B.A.C. 3996	6	†7 0 „	N.N.E.	153	142				
b Virginis	6	12 57 „	Dark	101	139	1 44 a.m.	Bright	215	254
η Libræ	6	10 52 „	Dark	133	128	11 23 p.m.	Bright	184	184
ϑ Libræ	4½	3 45 a.m.	Dark	51	85	‡4 39 a.m.	Bright	285	322
B.A.C. 5700	6½	4 14 „	Bright	144	175	4 44 „	Dark	202	236
31 Sagittarii	6	‡10 17 p.m.	Bright	82	49	11 23 p.m.	Dark	266	240
20 Capricorni	6	2 45 a.m.	Bright	56	40	3 38 a.m.	Dark	330	322

Near approaches. ‡ Below the horizon. A description of the construction and use of the above table, illustrated by a diagram, will be found on p. 403 of Vol. XLVI.

Jupiter's Satellites.

Satellite.	Phenomenon.	H.	M.	S.	Day of Month.	Satellite.	Phenomenon.	H.	M.	S.	Day of Month.	Satellite.	Phenomenon.	H.	M.	S.
I	Ec D	2	36	59AM	13	II	Ec D	2	18	42AM	24	I	*Oc D*	2	42	A.M.
I	Sh I	11	43	P.M.	14	*III*	*Ec D*	3	23	49„	24	*III*	*Tr I*	8	56	P.M.
I	Tr I	12	12	„	14	*II*	*Sh I*	9	23	P.M.	24	III	Sh I	9	1	„
I	Sh E	1	55	A.M.	14	II	Tr I	9	46	„	24	III	Tr E	10	29	„
I	Tr E	2	23	„	14	II	Sh E	11	53	„	24	III	Sh E	10	56	„
I	Oc R	11	42	P.M.	14	II	Tr E	12	12	„	24	I	Tr I	11	50	„
II	Ec D	11	43	33„	16	*I*	*Sh I*	3	30	A.M.	24	I	Sh I	11	53	„
II	Oc R	2	55	A.M.	16	*I*	*Tr I*	3	40	„	25	I	Tr E	2	1	A.M.
III	Ec D	11	26	14PM	16	I	Ec D	12	53	8PM	25	I	Sh E	2	6	„
III	Oc R	2	27	A.M.	17	*I*	*Oc R*	3	10	A.M.	25	I	Oc D	9	8	P.M.
II	*Sh E*	9	18	P.M.	17	I	Sh I	9	59	P.M.	25	I	Ec R	11	23	37„
II	Tr E	9	58	„	17	I	Tr I	10	6	„	26	*I*	*Tr E*	8	27	„
I	Sh I	1	37	A.M.	17	I	Sh E	12	12	„	26	*I*	*Sh E*	8	34	„
I	Tr I	1	56	„	17	I	Tr E	12	17	„	29	II	Tr I	2	13	A.M.
I	*Sh E*	3	49	„	18	I	Oc R	9	36	„	29	II	Sh I	2	32	„
I	*Tr E*	4	7	„	21	II	Sh I	11	58	„	30	*II*	*Oc D*	8	21	P.M.
I	Ec D	10	59	13PM	21	II	Tr I	12	0	„	30	II	Ec R	11	12	11„
I	Oc R	1	27	A.M.	22	II	Tr E	2	26	A.M.	31	III	Tr I	12	12	„
I	Sh E	10	17	P.M.	22	II	Sh E	2	28	„	31	III	Sh I	12	59	„
I	Tr E	10	33	„	23	*II*	*Ec R*	8	36	16PM						

Eclipse ; Oc Occultation ; Tr Transit of Satellite ; Sh Transit of Shadow ; D Disappear- ; R Reappearance ; I Ingress ; E Egress. The printing of a phenomenon in *italics* ates that its visibility is rendered doubtful, either by the brightness of the twilight, or ıpiter's proximity to the horizon.

e ephemeris lies between θ and γ Virginis. h. p.m. on the 5th Mars will be in conjunc- with Uranus, 35′ north of that planet.

Jupiter

s into opposition to the sun at 5h. a.m. he 22nd, and although he will on this nt be as favourably placed for observation will be this year at all, this is saying little ; inasmuch as from his considerable Declination he is in a very poor position d for telescopic scrutiny. His equatorial eter increases from 41·6″ when the month , to 42·4″ by its close.

Right Ascension.	Declination. South.	Souths.
h. m.	° ′	h. m.
16 9·0	19 58·5	1 31·4 a.m.
16 6·7	19 52·4	1 9·4 „
16 3·7	19 44·5	12 42·8 p.m.
16 1·1	19 37·5	12 20·6 „
15 58·5	19 30·4	11 58·3 „
15 55·8	19 23·2	11 36·0 „
15 53·2	19 16·1	11 13·7 „

rting thus from a point to the east and e to the south of β^1 Scorpii, Jupiter travels ards towards that star, with which he is junction (only 2′ north of it) at 2h. a.m. e 21st.

Saturn

and Souths now in bright sunlight ; so seen at all must be caught in the west as soon as ever it is dark enough. His angular equatorial diameter diminishes from 16·2″ on May 1 to 15·4″ by the end of the month.

Day of Month.	Right Ascension.	Declination North.	Souths.
	h. m.	° ′	h. m.
1	8 11·3	20 38·3	5 31·0 p.m.
6	8 12·5	20 34·7	5 12·6 „
11	8 13·9	20 30·5	4 54·3 „
16	8 15·4	20 25·8	4 36·1 „
21	8 17·1	20 20·6	4 18·1 „
26	8 18·9	20 14·9	4 0·3 „
31	8 20·7	20 9·2	3 42·5 „

Whence it will be seen that Saturn is in that blank region of Cancer to the west of the Præsepe. He is travelling on the whole in the direction of δ Cancri.

So few of the greatest eastern elongations of Saturn's Five Inner Satellites will be visible at Greenwich that it would be useless to tabulate them. They are as follow. Tethys on the 2nd, at 10·1 p.m. ; Rhea on the 3rd, at 11·2 p.m. ; and Enceladus a little later, at 12·4 p.m. Dione early the next morning at 1·9 ; and, finally, Enceladus on the 10th, at 8·9 p.m.

Uranus

Is now visible during a good deal of the night ; but as he has South Declination, should be looked at as nearly as may be about the time of his Meridian passage. His angular equatorial diameter diminishes quite insensibly from 4″ on the 1st of the month to 3·8″ by the 31st.

Uranus.

Day of Month.	Right Ascension.	Declination South.	Souths.
	h. m.	° ′	h. m.
1	12 53·0	4 55·8	10 12·0 p.m.
6	12 52·3	4 51·9	9 51·7 „
11	12 51·7	4 48·2	9 31·3 „
16	12 51·2	4 45·0	9 11·2 „
21	12 50·7	4 42·1	8 51·1 „
26	12 50·3	4 39·7	8 31·0 „
31	12 49·9	4 37·7	8 11·0 „

This short retrograde arc indicated by the above ephemeris lies in that barren part of Virgo some 9½° North-West of Spica. His conjunction with Mars at 6 p.m. on the 5th has been referred to above, under the heading of that planet.

Neptune

Comes into conjunction with the Sun at 10 a.m. on the 20th, and is, of course, wholly invisible.

Shooting Stars

Are not very plentiful in May. The nights on which a watch for them will most probably be rewarded with success are the 1st and 2nd ; the 18th and the 30th.

Greenwich Mean Time of Southing of Ten of the Principal Fixed Stars on the Night of May 1st, 1888.

Star.	Souths.
	h. m. s.
α Ursæ Majoris	8 16 5·41 p.m.
δ Crateris	8 32 58·58 „
ε Corvi...	9 23 28·03 „
γ^1 Virginis	9 54 59·87 „
α Canum Venaticorum ...	10 9 45·79 „
Spica Virginis...	10 38 11·48 „
η Ursæ Majoris	11 1 57·93 „
Arcturus	11 29 18·65 „
α Libræ	12 3 21·10 „
α Coronæ Borealis	12 48 29·36 „

The method of finding the Greenwich Mean Time of Southing of either of the stars in the above list for any other night in May, as also that of determining the local instant of its Transit at any other station, will be found on p. 404 of Vol. XLVI.

IMPROVED DRY PLATES.

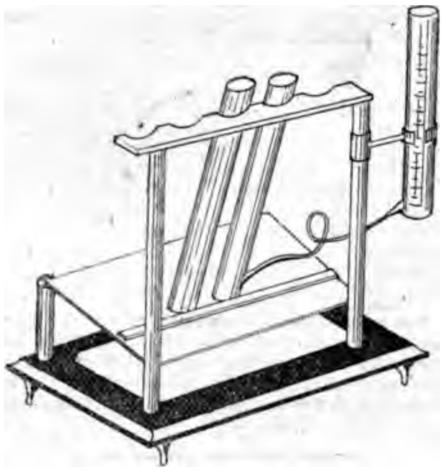
A RATHER novel improvement in dry plates to be developed by dipping in water alone has been patented by Mr. A. J. Boult, of 323, High Holborn. The plates, previously covered with emulsion and dried, are coated on the back with developing substance rendered adhesive, and preserved against oxidation by the following process :—The back of the plate is entirely covered with the following mixture : Pyrogallic acid or other suitable reducing substance, 10 grammes ; salicylic acid, 1 gramme ; gum-arabic, dextrine, gelatine, collodion, or other varnish-like substance, 10 grammes ; alcohol, 5 cubic centimètres ; water, 20 cubic centimètres.

The plates are dried at ordinary temperature, and the negative is developed by immersing the plate in water containing a small quantity of ammonia. The proportions of the mixture may vary according to the quality of the emulsion. The addition of ammonia may be rendered unnecessary by coating one half of the back of the plate with the above-described mixture, and the other half with a liquid obtained by digesting a solution of sugar of 25 per cent. with an excess of slaked lime by filtering, and then adding to 100 cubic centimètres of this liquid 15 grammes of sugar and 25 grammes of gum-arabic. The plates are dried at ordinary temperature, and the negative is developed by immersing the plate simply in water.

AN APPARATUS FOR COMPARISON OF COLOUR TINTS.

THERE lately appeared in the Abstract of the *Proceedings* of the Chemical Society an account of the above apparatus that was exhibited before the Society by Mr. A. W. Stokes, F.I.C. The apparatus was especially devised for Nesslerising in water analysis, but is of use in such operations as determination of lead in water, carbon in steel, colour of sugar, &c.

Whenever it is necessary to compare a number of depths of tint with one another, it is very inconvenient to have to make up a large series of standard tints. The apparatus devised by Mr. A. W. Stokes obviates this necessity. By reference to the annexed diagram it will be seen to consist of a base-board, on which lies a sheet of white opal glass. Placed obliquely a little way above this is a sheet of colourless glass, on which rest the Nessler-tubes containing the solutions whose tints are to be compared. The mouth ends of these tubes recline, towards the observer, in grooves hollowed in a horizontal bar. This bar is supported by two pillars, on one of which slides a ring clasping a calibrated glass tube; this tube has a side tubulure at the base, and is thus by means of a short india-rubber tube connected with a similar but uncalibrated tube resting on the glass plate. A known quantity of the standard colour being placed in that tube carried by the ring and diluted up to the top mark with water, if this tube be raised in its sliding collar its standard solution will flow into the tube resting on the glass plate. The movable tube is so calibrated as to show how much liquid is present in the tube connected with it. Hence, if a Nessler-tube containing liquid of an unknown depth of tint be placed beside the tube resting on the glass plate, and the tube in the sliding ring be raised or lowered till the tints agree in the two tubes that rest on the glass plate, a simple inspection of the level of the liquid left in the calibrated tube will give the quantity of standard colour the unknown solution is equal to. The distance apart of the grooves in the horizontal bar is the average width between the eyes, so that as the mouths of tubes lie inclined towards the observer, and the light is reflected up from the opal glass through the full length of the tubes, observations are easily made. As shown, the apparatus will take three tubes for comparison with the standard colour, but it may readily be made to take any number. By putting a similar pair of connected tubes on the other bar an unknown tint might be placed between *two* known depths of tint. A small slip of wood is fixed along the glass plate to keep the tubes in an inclined position. By placing blackened cards in front and behind the tubes light might be prevented from entering the tubes except from the bottom. The apparatus is simple and readily cleaned.



SOME EXPERIMENTS WITH AN ELECTRO-MAGNET.*

MANY very interesting and instructive experiments may be tried by means of an electro-magnet having a length of 5in. or 6in., and capable of sustaining a hundred pounds or so. The experimenter should make his own magnet. If he is the possessor of tools and a lathe, and understands working iron, let him bend his U-shaped bar, square off its ends, turn two wooden spools suited to the bar, fill them with wire, and proceed with his experiments. But if he is not quite so fortunate, it is possible the hints here given may be of some service. It often happens that a blacksmith is not available, or a bar of the right size is not at hand. To avoid difficulties of this kind, the core of the magnet is made of twenty thicknesses of ordinary 1in. hoop iron, about $\frac{1}{20}$in. thick, thus making a rectangular U-shaped core 1in. square. The parallel arms of the magnet may be 5in. long, and the distance between the arms 4in.

The pieces of hoop iron are readily bent and fitted one over the other in succesion, the inner one being fitted to and supported by a rectangular wooden block. When the core has reached the required thickness, the layers of which it is formed are fastened together by means of iron rivets passing through holes traversing the entire series of iron strips near the ends of the core. If it is inconvenient to secure the layers in this way, they may be wrapped from the extremities down to the angles with very strong carpet thread or shoe thread, and afterwards coated with shellac varnish, which holds on the thread and assists in cementing the whole together.

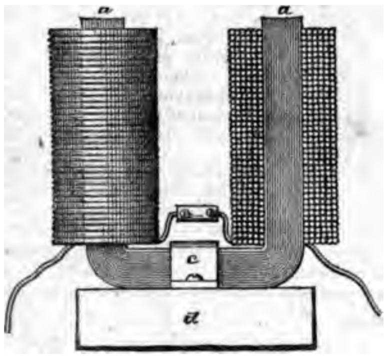


FIG. 1.—ELECTRO-MAGNET PARTLY IN SECTION.

The extremities, *a a*, of the core must be filed off squarely, and the yoke is to be clamped to the base *d* by the clip *c*, which may be made of hoop iron or of wood.

To the arms *a a* are fitted the coils *b b*, which are formed by the aid of the device shown in Fig. 2. This device consists of two wedge-shaped wooden bars, A B, which together form a bar a little larger than the core of the magnet, and two mortised heads, C D, fitted to the bar with a space of 4¾in. between them. The head D is provided with a screw for clamping the wedge bars A B, and with an aperture *a* for the inner end of the wire. The heads are lined with thick paper, and the bar between the heads is covered with a single thickness, E, of heavy paper.

The winding is begun by passing the end of the wire (No. 16 copper cotton-covered magnet wire) through the aperture *a*, allowing it to project about 3in., then winding the wire evenly over the bar from one end toward the other until the head C is reached. Before the second layer of wire is wound, the first one is brushed over with thin glue. The second layer is then wound, starting from the head C, and winding in the same direction toward the head D, and when the second layer is complete it is brushed over with the glue, after which the third layer is wound and glued, and so on, laying the wire on like thread on a spool until six or eight layers have been applied.

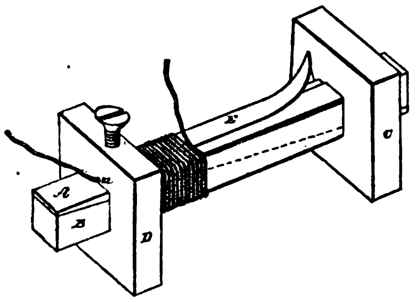


FIG. 2.—FORM FOR COILS.

To prevent the destruction of the coil by the loosening of the ends of the wire, a loop of tape should be placed on the beginning of the first convolution and laid over the first layer of wire, so that it may be clamped by the second layer, and in a similar manner some stout threads should be placed between the outer layer and the adjacent layer, so that they may be tied over the last convolution of the last layer. After the glue has become thoroughly dry and hard, the heads C D are removed from the bars A B, and the tapering bars are knocked out of the coil in opposit tions, their wedge shape facilitating this r Two coils precisely alike are required. Wh are placed on the core, the inner end of or connected with the outer end of the other, remaining ends are connected with a batte give the coils a finished appearance, they coated with shellac varnish, coloured wit ment of suitable colour, vermilion for exan

Probably the best battery for use in co with this magnet is one of the plunging bic form.

To the poles of the magnet should be fi short iron bars, having conical ends. Th will need no special fastening, as the attr the magnet will hold them in place.

It is perhaps hardly necessary to enter details of many experiments with this m they are described in the textbooks. A noticed, the reader is referred to electr physical works for others.

In Fig. 3 is shown a simple way of repr Foucault's experiment. A centrally - a copper disc, 6in. in diameter, is attached b of small nails to the end of a common spo the spool is mounted so as to turn on a s serted in a handle. The short iron b arranged on the poles of the magnet, as sh the engraving, with the conical ends ab apart. A strong current is sent throu magnet, and the copper disc is whirled ra quickly unwinding a string from the spo the manner of top-spinning. The edge of is then inserted between the conical pol but without touching them. The rotatio disc is almost instantly stopped. A sheet o moved back and forth between the pol offers a sensible resistance.

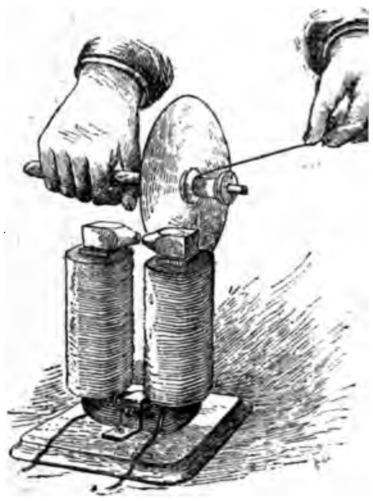
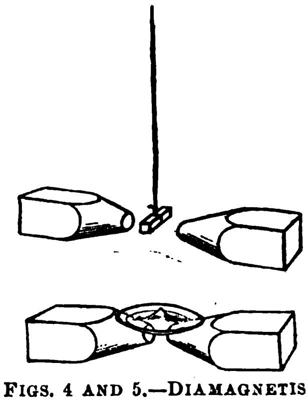


FIG. 3.—FOUCAULT'S EXPERIMEN



FIGS. 4 AND 5.—DIAMAGNETISM.

Most experiments in diamagnetism may formed with this magnet. Short bars of metals may be suspended, by means of a s between the poles. Iron, nickel, coba ganese, &c., will arrange themselves in l the poles, while bismuth, antimony, and other metals will arrange themselves ac line of the poles. The former are known magnetic bodies, the latter as dia Liquids placed in a watch-glass, as s Fig. 5, exhibit paramagnetic or diamagn perties; by piling up at the centre of the shown in the engraving, if paramagneti piling up on opposite sides of the centr

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* By Geo. M. Hopkins, in the Scientific American.

. The coils of this magnet, being re-
may be used in magnetising steel bars,
other purposes requiring the coils only.
about three pounds of wire in each coil
gnet.

CHARDSON ON IDEAL FOODS.*

e Memorial Hall, Farringdon-street, E.C.,
Friday evening, April 13, Dr. B. W.
on, F.R.S., resumed the above course of
the Right Hon. Sir James Hannen in the

for this, his fourth lecture, "The Selec-
Foods for Health and Long Life," Dr.
on said that, before proceeding thereto, he
iefly recapitulate a few of the points of
ecture, and add a few which could not
ntroduced through want of time. They
member that, dealing with foods for
and for work, he had described four great
classes of foods, and had illustrated them
ram showing a grain of wheat. They had
r water as a food, and he had explained
n why it should be considered one of the
portant of all foods. He had, further,
in what way water played different parts
dy—sometimes that of a carrier of various
s into and out of the body; making solu-
nstructing various parts, giving volume
ness of movement to the different struc-
ich were concerned in the acts of life.
o the second great class, called fuel foods,
seen that starch might be taken as the
ll, afterwards appearing in other forms—
example—either direct or through starch,
to fats and oils. Then they considered
series of foods, called structure-builders,
pair of the tissues—foods derived mainly,
dinary circumstances, from the animal
the present mode in which people lived,
untry at all events; but foods which came
from the vegetable kingdom. These, in
l world, were albumen or fibrine; in the
world, gluten and caseine. And, finally,
alt with the foods which went to support
r parts of the body, the skeleton—viz, the
mineral foods. He had placed several
ons of the different foods before them in
f tables, showing their values as supporters

hed now to dwell briefly on one or two
itted in his last lecture. He did not then
values of the ordinary garden vegetables or
nd every vegetarian should know some of
about these. Taking such vegetables as
nd vegetable-marrows, seakale, onions,
and such like, these would be found to
deficient in the elements of food. The
or example, contained 93 per cent. water,
y no fuel food, under 1 per cent. flesh-
and mineral matter scarcely deserving to
oned; vegetable-marrow, 95 per cent.
per cent. fuel food, flesh-formers one, and
y no mineral food; seakale, 93 per cent.
per cent. fuel, 2 per cent. flesh-formers,
il; cabbage, 89 per cent. water, 6 per
l, 1½ per cent. flesh-formers, 1 per cent.
tomatoes, 90 per cent. water, 6 per cent.
er cent. flesh-formers, mineral one; celery,
t. water, 3 per cent. fuel, 1 per cent. flesh-
1 per cent. mineral; lettuce, 96 per cent.
per cent. fuel, 1 per cent. flesh-formers,
ne; watercress, 93 per cent. water, 3 per
l, 2 per cent. flesh-formers, no mineral of
cucumber, 96 per cent. water, 2½ per
l, no flesh-formers, no mineral; mush-
per cent. water, 5 per cent. fuel, 5 per
h-formers, 0·5 per cent. mineral (this
mushrooms in their fresh state; when
newhat the other proportions rose, and
ns could be brought, by the reduction of
, almost to the value of milk as food, only
nferior in fuel food). There was one
l used on the Continent, popularly known
devil's snuff-box," belonging to the same
fungi, but never introduced into this
and yet it contained a considerable
f nutritive principle. This was a large
ngus, found in the fields in the spring-
the summer it ordinarily dried up and
ke a dusty ball, when it could be kicked
n parts of the Continent it was regularly
o the table and sliced with a sharp knife
e might slice veal. When cooked in a
e it was exceedingly good. This was an
getarians should look after. It resembled
od closely when cooked, and was very

g now to fruit, they would here find a very
d for the vegetarian to work upon. All
rmer vegetables he had spoken of, the
., were really only valuable for the water
ined and the taste they imparted to other
ey could not be regarded as of value in
g life. A great many mistakes had been made in the Vegetarian system by enthusiastic followers keeping too closely to these watery foods. In fact, it was well known that, during the year before last, he had under his care an earnest and enthusiastic vegetarian who actually died from starvation, in consequence of keeping too closely to this kind of food, refusing to take the proper class of vegetable food, and trying to subsist altogether on these green vegetable substances. When they came to fruits and nuts there were excellent results to be gained. In the common filbert they had a very grand food, and it admitted of being very largely used. In the fresh state, it contained 48 per cent. water, 40 per cent. fuel (28 per cent. of this being oil, the best of all fuel food), 8 per cent. flesh-formers, and 1½ per cent. mineral. Ground-nuts were also excellent food. They contained 8 per cent. water, 62 per cent. fuel (chiefly oil), 24 per cent. flesh-formers, and 2 per cent. mineral. Another remarkable fact in connection with the ground-nut was that its flesh-forming food consisted of caseine. They had already seen that caseine was present in the pulse in peas and beans, and that in China advantage was taken of this fact to make cheese out of pulse. The ground-nut, with its 2 per cent. of mineral matter, was an important item in the food supply, and would, he had no doubt, become a basic food by-and-by. In the apple they had 83 per cent. water, 7 per cent. fuel, 1 per cent. flesh-formers, 0·5 per cent. mineral; the pear, 84 per cent. water, 7 per cent. fuel, 1 per cent. flesh-formers, 0·3 per cent. mineral; grapes, 80 per cent. water, 13 per cent. fuel, 1 per cent. flesh-formers, 0·4 per cent. mineral; peach, water 85 per cent., fuel 2 per cent., flesh-formers 1 per cent., mineral 0·6 per cent.; orange, 86 per cent. water, 9 per cent. fuel, 1 per cent. flesh-formers, 0·4 per cent. mineral; rhubarb, which some people considered a food, contained 95 per cent. water, 2 per cent. fuel, 1 per cent. flesh-formers, 0·5 per cent. mineral; dates (dried, as usually obtained here) contained 21 per cent. water, 54 per cent. fuel, 7 per cent. flesh-formers, 1½ per cent. mineral, so that here they had a very excellent food indeed; dates should be employed very much more than they were by the vegetarian fraternity: figs contained water 17 per cent., 60 per cent. fuel food, 6 per cent. flesh-formers, 2 per cent. mineral, and therefore were an exceedingly rich food. There was another very excellent food now becoming common—viz., the banana. This, one of the best of foods, contained 74 per cent. water, 20 per cent. fuel, 5 per cent. flesh-formers, and 0·7 per cent. mineral. Comparing these figures with those furnished by milk—viz., 86 per cent. water, 9 per cent. fuel, 4 per cent. flesh-formers, 0·7 per cent. mineral, they might almost look upon the banana as condensed milk.

They had already seen that there were four great classes of food, and it would be well to bear in mind certain facts, all touching on this figure four, in regard to digestion—four sets of food, and four acts in the application of foods in the body First, the mixing of the food in the mouth, or the process of insalivation or mixing of the saliva through mastication; secondly, the stomachic digestion, or change in the food which took place in the stomach; thirdly, the further change which was called the intestinal digestion; and finally, the active absorbtion of food, or taking it up into the body. For this they had four digestive centres, the mouth for insalivation, the stomach for the first digestion, the duodenum for the next, and the small intestine for absorption. There were also four ferments, to act upon the food: Ptyalin, in the saliva; pepsin, in the secretion of the stomach; pancreatic ferment, in the small intestine; and lastly the bile, which was derived from the liver and laid up in the gall-bladder. There were, again, four modes of absorption of the food, four modes of distribution, and four modes of elimination.

The lecturer here exhibited several beautiful diagrams on the screen, first of the grain of wheat, and then of the intestinal canal, in explanation of the four kinds of food and the points in the digestive process where they were respectively treated by the four different ferments. To make this more clear, the results of three experiments were thrown on the screen, in which a small portion of the breast of a fowl, minced, was placed in a glass vessel with pepsin from the stomach of a pig, and then raised to the required temperature. The flesh in the three vessels, respectively was seen to be more or less digested or dissolved by the fluid, according to the length of time it had been subjected to the process.

With regard, then, to those foods, which gave the best work, which conveyed the most nourishment, were most agreeable to the taste, and less likely to produce disease? What foods from the vegetable and animal worlds were best fitted for work? He would put before them two diagrams, one of beef the other of oatmeal, in order to show, insofar as these foods were concerned, that vegetable products were better than animal. Prime beef contained 50 per cent. water, 30 per cent. fuel, 15 per cent. flesh-formers, 5 per cent. mineral. Compare that with oatmeal, which contained very little water (only 5 per cent.), fuel food 73 per cent., flesh-formers 20 per cent., mineral 2 per cent. The work derivable from 1lb. of beef was estimated at 177 foot-tons, whereas the oatmeal was estimated to produce 488 foot-tons. There could not be a shadow of a doubt that oatmeal stood admirably forward as compared with beef, which was considered the most nourishing of all animal foods. It was beyond dispute that, on this point the vegetarians were right; but then came this question in respect to health and these foods, Was it as healthy to take vegetable substances as animal? Vegetarians had not yet quite proved this point. There was something to be said on both sides. It must be admitted that, to a person habituated to taking animal food, that substance was more easily digested than vegetable food would be at first; and perhaps the habit in some persons might so change them that they could never take to a purely vegetable diet. The body, trained from its first days to take one particular kind of food, produced secretions for digesting that food, which continued so long as the food was used; but, take away that food and replace it by another, and then the power of digesting it did not exist. He would give them an illustration in regard to milk. During the time the child was young and at the breast, it produced, in addition to the ordinary secretion of the stomach belonging to it, a peculiar secretion for the digestion of the milk—a special digestion for the cheese therein contained. The child had a special secreting function for the digestion of milk, that lasted as long as it lived wholly on milk. But in the case of the child, or any mammalian animal, cease the supply of milk, and give it another food (animal food wholly), then that secretion after a time would cease, and the child or animal would not digest milk, and would be either thrown back again or great pain and disturbance would result. This accounted for the great number of people who, throughout their lives, could not take milk, the secretion of the milk ferment having ceased. So it may be that some persons could not, in perfect health, digest vegetable food, having lived long on animal food. But then, could people digest animal food with more facility than vegetable food, assuming the secretions to be natural? It would seem as if there was something to be said in favour of a meat diet. Animal food, derived originally no doubt from the vegetable world, but which had passed through an animal's body, one would think was more easily digested than food in its crude state. The digestion of the carnivorous animal was very rapid. The intestinal canal of the lion was but three times the length of his body, and of the sheep, 28 times its own length; hence in the latter there was far more digestive power going on. Vegetarians would have to look, in regard to man himself, at this question straight in the face. It must be conceded that there was some argument—and a good argument—produced by the animal feeders, that the digestion of flesh was more rapid than that of vegetables. But then, on the other side, something had to be said in regard to the injury which arose from flesh-eating. The flesh-eater almost invariably took more than was wanted, and thus great strain was thrown upon the body in consequence of that excess; and it must therefore be eliminated, got out of the body, or serious trouble would ensue. That elimination was done by a very elaborate chemical process, by which the animal substance was transformed into saline matter called urea, which was passed off by the kidneys, and this change must take place that life might properly go on. A great deal of disease was sustained by persons who ate animal food in excess through inability to get rid of its products. As to the relation of the taste and character of the food to the wants of the economy, here they might safely say that these wants were most naturally supplied, according to taste, by vegetable foods. Children took more readily and easily to vegetable foods and fruit than animal foods; their instinct seemed to be in favour of plant-eating, taking those substances which came direct from the vegetable world. Sugar, for instance, was much more enjoyed by most people than animal fat; both had the same function, but the first was most enjoyable. As regards fuel foods, vegetarians had it all on their side; there was no occasion to take animal fat at all, except in the extreme region of the North, near the North Pole, and where sufficient other foods could not be got; but all foods for producing animal heat were best obtained from the vegetable world.

Lastly, respecting disease, they had to consider, in the study of ideal foods, what were most likely, and what were least likely, to produce disease. Vegetarians here, again, laid claim to the foremost ground. They maintained that the vegetable world produced no disease, or need produce none; and he could not but think that vegetable supplies of food might be so arranged that they should not produce disease. But they did produce a certain measure of disease. Persons obliged to live on rye bread had suffered seriously through eating the spur of corn, and, according to some authorities, disease had been produced by a change taking

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* From the *Vegetarian*.

[illegible] the spot which had led to fatal conse[illegible], but it had sometimes happened. So, [illegible] mushrooms occasionally produced [illegible] but more commonly through unwholesome [illegible] being taken in mistake. Some fruits pro[illegible] disease, worms, in children. This [was] probably derived from the egg or germ, the [illegible] of the parasite, clinging to the surface of the [illegible]. They might say that that was an act of un[illegible]. Yes, it was, but it did occur. Then, [illegible], in summer time diarrhoea was common from [illegible] fruit; but whether this arose from the [fru]it itself, or something taken in with the fruit, [he] would not say. Turning to the animal feeder, [wh]at did they find there in regard to health and [dis]ease, what production of disease from animals? [H]ere he thought they might say the vegetarians [ha]d a very strong case. A great deal of disease [wa]s produced through the animal world, a great [de]al of disease to man from living upon animal [fle]sh. Some splendid evidence on this subject had [be]en obtained from the Jews. These people em[pl]oyed in this city, and all cities he believed, men [in] the slaughter houses who looked after the animal [foo]d, and saw that it was healthy and proper. [The]se surveyors of food marked with a particular [sig]n the carcases showing any blemish, and if they [fou]nd nothing wrong they marked the meat ac[cor]dingly; and in this way they rejected a great [de]al of food. He asked them once what became [of] the rejected meat, and they told him they sold [it.] The Christian consumed what the Jew re[jec]ted. As to amounts, very careful records had [be]en kept on these points by the Jewish authori[ti]es. In 1878, out of 22,308 oxen killed, 7,885 [(n]early one-third) were rejected as diseased. In [illegible] in the course of fifty weeks, 23,387 oxen were [ex]amined, and 9,531 were rejected. They had to [co]nsider whether these figures represented unwholesome food. Mistakes, of course, would sometimes occur; but in his experience the inspectors had always good cause for their rejections. Lastly, they had from meat disease produced by the introduction of parasites. This was a most important charge brought against animal food; and there could not be a doubt that the lower animal was responsible for the introduction of living parasitic worms into the body of man. The tapeworm was derived directly from the lower animal. Then there was another form of parasites, called the [hyd]atids or bladder-like worms. The pressure of these bladders on the brain of the sheep gave rise [to] the disease called the staggers. The trichina was also a parasite derived from flesh eating. This [illegible] was obtained chiefly from eating half-cooked [illegible], the heat of boiling water apparently destroying their vitality. As to this matter of disease of which he had spoken, through eating [animal] food, with cleanliness there need be no [more] danger, so far as he could see, from the transmission of disease through the animal kingdom than through the vegetable; so they must balance [illegible], and as they had the honour of being presided over that evening by a Judge, he hoped the chairman would be satisfied that he had endeavoured, in the fairest possible way, to "put the evidence before the jury."

IR W. R. GROVE ON ANTAGONISM.

THE discourse at the meeting of the Royal Institution on Friday last was delivered by the Right Hon. Sir W. R. Grove, M.A., F.R.S., under the title of "Antagonism," and was found to be supplementary to his momentous doctrine, first announced in 1842, when he was Professor of Experimental Philosophy at the London Institution, of the Mutual Convertibility of the Natural Forces, Heat, Electricity, &c. His lecture, delivered before a crowded and educated body of intensely interested listeners, consisted of a series of arguments and illustrations to show that "antagonism," a word generally used to signify something disagreeable, pervades all things, that it is not the baneful thing which many deem it, that it produces at least as much good as evil, but that whatever its doings, it is a necessity of existence, and of the organism of the universe, so far as we can comprehend it. The lecturer held that motion [illegible] without it, that it is not a [illegible] of nature, but that without it there [illegible] such a thing as nature conceivable by [illegible]. Further that it is inevitably associated with [illegible] matter, with organised matter, and [illegible]. Sir William proceeded to [illegible] that the universality of antagonism has not [illegible] the attention it deserves, considering the [illegible] of the element of force being [illegible] taken by us into account, and too little [illegible] upon the element of resistance. After [illegible] Heraclitus, who said "War is the father [illegible] of all things," and Hobbes, who said "[illegible] the natural state of man," and alluding to the Persian divinities Ormuzd and Ahriman, those [illegible] of good and evil respectively, who, however, [illegible] Sir William's own idea, according [illegible] antagonism is as indispensable to Ormuzd as to Ahriman, and after referring to Lamarck, Darwin, Huxley, and Spencer, Sir W. Grove went on to show the necessity of antagonism to maintain the existence of the solar system and the stellar universe, each sun or planet being kept in place and orbit by antagonistic forces exerted upon it by other bodies, and their several paths varied by the neighbourhood and pulling effect of these, so that if the stars on one side of our solar system were removed, our sun and its attendant planets would rush off in the opposite direction. Sir William then showed how light is affected by antagonism through the troubling of the so-called ether; he further pointed out its effect in the neutralisation of chemical affinity, as in photography, and, doubtless, in vegetation as well. He showed the result of an experiment of his own, by which two glass plates with paper letters between them were electrised for a few seconds, and then one of them (the paper letters having been removed) was covered with photographic collodion, and exposed to diffused light; the portion of the glass which had been covered by the paper letters became dark, while the residue remained unaffected, showing that on the unelectrised part the force of light conquered that of chemical affinity; whereas, on the electrised part chemical affinity conquered light, a result possibly occurring more or less through the action of the sun's light on growing vegetables and producing certain forms of blight. The lecturer then went on to speak of vegetable and animal life; blades of grass robbing each other of nutriment; animals preying on vegetables and on each other. As an instance of the beneficial effects of antagonism, he cited a result witnessed by himself in the instance of an estate in which he spent some of his time. The rabbits which lived on the hill-side and had to work for their food were all sleek and healthy, whereas in the valley, where the pasturage was luxuriant, they were all diseased. Sir William went on to speak further of the internal antagonism of organised beings; of the life and growth of vegetables; the internal struggles of the heart and arterial coatings in the case of animals; the fight for and against among the forces at work in breathing; again, the battles in the blood between the white corpuscles and the unwholesome bacteria, as brought to light by Prof. Metschnikoff. Sir William spoke next of communities and nations, showing, in addition to occasional and most formidable wars, the antagonisms of armed peace, of competition, of ordinary daily life, and even of amusements, nearly all of them combative; for instance, whist, billiards, cricket, football, and racing, even dancing being probably a relic of war. The game of patience seemed the only exception, which game, the lecturer added with a smile, he might assume his audience were at that moment playing, and suffering in consequence from internal antagonism. In the mechanism of the universe, the lecturer thought collisions play a more important part than is generally believed. When heat has dissipated itself by equalising temperature, it has been supposed that suns, planets, &c., would virtually die, but so long as gravitation is a property of matter there is always a means of regenerating heat and life by collisions—i.e., by antagonism reproducing nebulous matter with great heat, and this kept up by the contraction of the nebulæ into suns and so forth. The number of the smaller meteorites in space must be enormous, seeing that 400 millions of telescopic meteorites are computed to fall into the earth's atmosphere in every 24 hours. Sir William Grove said that though suns and planets might grow old and die others might be again formed and known, collisions at all events afforded some proof of the fact. He could not persuade himself to believe in a dead universe surrounded by a dark ocean of frozen ether.

Gelatine Plaster Casts.—A new basis for making casts of anatomical specimens is prepared as follows:—Take of "No. 1" gelatine, say 6oz., soak it till quite soft and swelled, afterwards dry it slowly until just pliable. As it has now the minimum of water necessary, melt it in a water-bath, and add 6oz. (measure) of clear glycerine. When the two are thoroughly mixed, the material is ready. To render it opaque, add while it is still hot, and therefore fluid, small quantities of a thick paint made by rubbing up oxide of zinc in glycerine. When a skin colour is wanted, a little vermilion is required to give a warm, life-like hue. Should other things be cast, the prevailing colour can be given with water-colour as required (tubes of moist water-colour, sold at 2d. each, will be found convenient). Several pounds of this mixture may be made at once, and portions used as required.

THE pneumatic dynamite gun which is being constructed by Lieutenant Zalinski for the Italian Government is 45ft. long and 15in. in diameter, and designed to throw 600lb. of explosive gelatine a distance of two miles. A similar gun is being constructed for the dynamite boat ordered by the United States Government, which, it is said, will be ready for launching in about a fortnight.

SCIENTIFIC SOCIETIES.

ROYAL METEOROLOGICAL SOCIETY.

THE usual monthly meeting of this society was held on Wednesday evening, the 18th inst., Dr. W. Marcet, F.R.S., president, in the chair.

Dr. T. E. Hale, B.A., V.C., Mr. R. Lawson, LL.D., F.S.S., and Mr. S. Walker were elected Fellows of the Society.

The following papers were read:

(1) "Jordan's New Pattern Photographic Sunshine Recorder," by Mr. J. B. Jordan. The improvement in this instrument over the previous pattern of sunshine recorder consists in using two semi-cylindrical or D-shaped boxes—one to contain the morning, and the other the afternoon, chart. An aperture for admitting the beam of sunlight is placed in the centre of the rectangular side of each box, so that the length of the beam within the chamber is the radius of the cylindrical surface on which it is projected; its path therefore follows a straight line on the chart at all seasons of the year. The semi-cylinders are placed with their faces at an angle of 60° to each other. They are fixed on a flat triangular plate, which is hinged to a suitable stand, having levelling screws attached, and fitted with a graduated arc as a means of readily adjusting and fixing the cylinders to the proper vertical angle agreeing with the latitude of the station where used.

(2) "On the Meteorology of South-Eastern China in 1886," by Dr. W. Doberck, F.R.Met.Soc. This paper gives the results of observations made at the custom-houses and lighthouses by officers of the Imperial Maritime Customs. In summer there is very little change of temperature with latitude. The temperature depends upon the distance from the nearest sea-coast, and is greatest at stations farthest inland. The highest mean temperature occurred in July, and the lowest in January. The north-east monsoon blows from September to June, and the south monsoon during July and August. The latter does not blow with half the force of the former. Rainfall is greatest in Northern Formosa, and least in Northern China. Along the east coasts of Formosa and Luzon the winter is the wet season, while in China July seems to be the wettest month of the year.

(3) "Lightning in Snowstorms," by Prof. A. S. Herschel, F.R.S.

(4) "Insolation," by Mr. Rupert T. Smith F.R.Met.Soc.

Aluminium.—The recent improvements in the manufacture of aluminium have reduced its price so considerably that a much larger field of usefulness is now open to it. The readiness with which it may be cast and chased, its colour and lightness, combined with its non-liability to tarnish, indicate a special application in jewellery and the manufacture of apparatus. In the market aluminium is to be obtained in the form of ingot, sheet, foil, and wire, and alloyed in certain definite proportions with copper. The commoner alloys are those in which the proportions of aluminium to copper are (1), 11 : 90—gold-yellow in colour: (2), 5 : 95—resembling 14 carat gold; and (3) 2·5 : 97·5—the copper in this case containing also silicon. All these bronzes are readily fusible, may be rolled with facility, take a high polish, and resist tarnishing; the No. 3 alloy would be a suitable substitute for telegraphic silicon bronze. It is possible that many have already experimented in applying aluminium to the arts, and have failed, partly from want of experience in manipulating a new material, partly from difficulties in casting; for if melted in a clay crucible, this metal reduces silicon from the substance of the pot, becoming itself grey and brittle in consequence. Lime crucibles, or clay pots either brasqued or lined with well-ignited cryolite alumina, must therefore be used for casting aluminium. In soldering the pure metal, the *Journal* of the Society of Chemical Industry says it is found that the clean surfaces rapidly become coated with an almost imperceptible film of oxide, which, although protecting them from further oxidation, is nevertheless sufficient to prevent their union in the usual way. The surfaces to be jointed must, therefore, be scraped or scratched perfectly bright and be covered with a film of paraffin, then a thin rolled piece of soldering alloy—Zn : Sn : Pb = 5 : 2 : 1—is placed on each, and each surface is heated separately. The paraffin first melts and protects the bright portions from oxidation, then the alloy fuses and unites with the aluminium. The overlaid aluminium surfaces may afterwards be soldered as usual.

CROOKES' "radiometer" is being used in France for timing the exposure of photographic plates, an equal number of revolutions of the vanes of this little instrument corresponding to the proper time of exposure, whatever the degree of brightness of the light.

SCIENTIFIC NEWS.

THE death is announced of Surgeon-Major F. S. B. Francois de Chaumont, M.D., F.R.S., the well-known professor of military hygiene at the Army Medical School, Netley. He was born in Edinburgh, in 1833, and entering the medical branch of the army, served in the Crimean war. He became assistant to Prof. Parkes in 1863, and on the death of that distinguished hygienist succeeded him in the professorship. Prof. de Chaumont edited Parkes's "Manual of Practical Hygiene."

Dr. Emil Bessels, who will be remembered as the scientific director of the voyage of the *Polaris*, is dead at the early age of forty. Born at Heidelberg, he studied medicine and natural history first at the University of Jena and finally at that of his native city. At the instance of Petermann, the geographer, he embarked on his first expedition to the North Pole on board the steamship *Albert* in 1869, the purpose of the voyage being to explore the eastern frozen sea between Spitzbergen and Nova Zembla, and to investigate Gillis-land. Only the first part of this project could be carried out, as the state of the ice made disembarkation on Gillis-land impossible; but the work effected was important. Hydrographic observations were made, and a complete series of deep-sea soundings taken, and for the first time the existence of the Gulf Stream east of Spitzbergen was demonstrated. In 1871 Dr. Bessels was summoned to the United States to undertake the scientific direction of the North Pole Expedition under Ch. Francis Hall. In pursuance of his researches he penetrated into the northern prolongation of Smith's Sound, and reached 82° 16′ of north latitude—a feat performed by no previous voyager. Unfortunately, the ship—the *Polaris*—foundered, carrying all his scientific treasure-trove to the bottom. From the direction of the wave current and from the pieces of walnut-wood borne upon it, he concluded that there was a northern connection of this arm of the sea with Behring's Straits. After passing a few years at Washington in connection with the Smithsonian Institution, a fire unfortunately occurred at his house, and in escaping Dr. Bessels caught a chill, from which he never recovered. He returned to Europe, and the last two years has been settled at Stuttgardt, pursuing his studies in connection with the Royal Natural History Museum.

Sawerthal's comet has now only about half its brightness at time of discovery, and is not well placed for observation; but its position for Greenwich midnight on April 30 is R.A. 23h. 22m. 55s., N. Dec. 26° 36·7′.

Minor planet 269, discovered by Dr. J. Palisa on Sept. 21 last, has been named Justitia.

M. C. Montigny has reprinted from the Bulletins of the l'Académie de Belgique his memoir entitled "Influence des Bourrasques sur la Scintillation des Etoiles (F. Hayes, rue de Louvain, 108, Bruxelles).

In commemoration of the bicentenary of the publication of Newton's "Principia," Dr. Glaisher, F.R.S., delivered an address in Trinity College Chapel, Cambridge. In the course of his remarks, Dr. Glaisher said, referring to Newton's 18 months' sustained effort: "The great event that stands out conspicuously in this memorable time is the determination of the attraction of spheres. This beautiful result was quite unexpected by Newton. The effect of this sudden transition from approximation to exactitude stimulated his mind to still greater efforts. It was now in his power to apply mathematical analysis with absolute precision to the actual problems of astronomy. We see the result in the third book of the 'Principia,' which will always remain a most astonishing record of what it is possible for human genius to effect. Thus was it granted to one man to be the first to form a conception of the true principle that governed the universe, to give precise meaning to his brilliant conception, and by the aid of a mathematical weapon which he himself had forged to wrest from his great principle its varied and subtile consequences, and even in the most difficult problem of all, the motion of the moon, to outstrip the observations of his time."

At a recent meeting of the Physical Society, Mr. C. V. Boys described and performed some experiments on soap-bubbles, and by their aid demonstrated in a remarkable manner the phenomena of surface tension, diffusion, and the magnetic properties of gases. By blowing one bubble inside another he showed that there is no electrical force inside a closed conductor. A peculiar property of soap-bubbles is their refusal to come into contact when knocked against each other; they may receive violent shocks and still remain separate. If, however, an electrical body be brought in the vicinity, they immediately coalesce. So sensitive are they to electrical attraction, that a potential difference due to one Léclanche cell between the two bubbles causes them to unite. They may thus serve as a very delicate electroscope.

A paper on Steam Boiler Explosions was read lately by Mr. J. J. Webster, M.I.C.E., before the Liverpool Engineering Society, in the course of which the author stated that the average number of steam-boiler explosions during the last twenty-five years was about fifty-six per annum, the average loss of life amounting to about seventy per annum, and although the number of explosions was very great, and the loss of life to be deplored, the actual percentage of explosions to boilers at work was very small, being at the rate of one explosion to every 2,500 boilers in use. Owing to the good work of the different boiler associations, and to the immense improvements in the design and construction of boilers, this percentage had now been reduced to less than one in 6,000.

The Steam-Engines and Boilers Bill has been refused a second reading by the House of Commons by 147 to 96.

At the council meeting of the Royal Geographical Society held on Monday, the Founders' medal was awarded to Clement R. Markham, C.B., F.R.S., on his retirement from the honorary secretaryship of the Society, after a service of a quarter of a century. The medal is also awarded in recognition of his numerous and important contributions to geographical literature during the past 35 years, and his labours as an explorer. The Royal Medal of the Society has been awarded to the German explorer, Lieut. Wissmann, in recognition of his great achievements as an explorer in Central Africa, which he has twice crossed from the Atlantic to the Indian Ocean, and especially for the arduous and adventurous journey in which he traced the course of the river Kassai, from its upper waters to its previously unknown confluence with the Congo. The Murchison grant has been awarded to Mr. James M'Carthy, Superintendent of Surveys in Siam, for his excellent map of Siam, and the great value of his survey work generally in that country. The Gill premium is awarded to Mr. Charles M. Doughty, for his great work on Arabia. The accumulated Cuthbert Peek grant is given to Major Festing for his services as cartographer on the Gambia river and the country in the neighbourhood of Sierre Leone. As honorary corresponding members, Dr. G. Radde, of Tiflis; Dr. H. Rink, of Copenhagen; and Dr. Rein, Professor of Geography at Bonn, have been selected.

The new Inventions and Designs Bill for India has been passed by the Supreme Legislative Council. The suggestion that the time given to foreign inventors in which to apply for patents should be three years, was negatived, and the limit of one year, originally fixed, was retained.

A Bill has been introduced to make the imperial standard yard of the United Kingdom the legal standard of length-measure for British India, the object being to facilitate future legislation on the lines of the British Merchandise Marks Act.

It is stated that Russia is likely to be a competitor in the cotton-producing market, as experiments made in the district of the Lower Don last year were successful.

Prof. Lubimoff employs a stain for tubercle bacilli called borofuchsin, consisting of fuchsin, half-part; boracic acid, half-part; absolute alcohol, 15 parts; and distilled water, 20 parts. This solution keeps well, and is always ready for use. The sputum is dried, and then stained by the aid of heat in contact with the borofuchsin for one or two minutes. The stain is washed out with dilute sulphuric acid, and alcohol applied, after which the specimen is immersed for half a minute in a saturated alcoholic solution of methylene blue, and is then washed with distilled water and dried. It is examined in oil of cedar or in Canada balsam. It is said that by this process the washing out with the sulphuric acid is almost instantaneous.

A Mr. G. Henrickson, of Rheola, writing to the Chief Secretary at Melbourne, refers to a remark of Liebig's that the gall of swine contains a peculiar organic acid, and suggests that this acid may be the antidote to snake poison. But it has been generally conceded the reason pigs are proof against snake-bite is that the poison rarely, if ever, reaches the circulatory system, owing to the fat carried by the pig.

Artificial sponge-rearing is being practised in Styria by Prof. O. Schmidt, of Gratz. From a report to the Board of Trade it appears that Prof. Schmidt, by taking small pieces of living sponge and "planting" them in favourable spots, has obtained large specimens in the course of three years. It is stated that 4,000 sponges cost no more for cultivation and interest on capital than 225 francs, and the Austro-Hungarian Government has authorised the protection of this new industry on the coast of Dalmatia.

USEFUL AND SCIENTIFIC NOTES.

Horseflesh or Beef.—The question whether beef or horseflesh is the more suitable diet for human consumption has long ago been settled in favour of the former by the common practice alike of civilised and savage races. An argument founded on theoretical grounds could hardly lead to any other conclusion. There can be no doubt that the flesh of the well-fed and easily circumstanced ox is far less likely to resist the work of digestion and assimilation than the stringy fibres of an animal whose life is a fairly constant round of muscular exertion, and in the majority of cases of overwork. Professor Gamgee has stated that bad effects are apt to follow the ingestion of the meat of overdriven animals, and if his observation be correct in the case of animals generally it cannot but apply to that of the horse. Apart, however, from any question of direct morbific influence, the quality of such meat must be, and is, inferior. Deficient in fat, it lacks what is probably the chief source of supply for the wear and tear of vital energy, while the proteids it contains are embodied in a dense tissue difficult of assimilation. However acceptable the flesh of the horse may be, therefore, when it alone is obtainable, it is certainly not to be compared as a food to ordinary butcher's meat, and to pass it off as beef (a practice by no means unknown) is a fraud not only disreputable, but distinctly, if not in a high degree, injurious. The summary conviction and punishment of a butcher in Manchester a few days ago for practising this kind of imposition may serve as a warning to others who may be disposed to follow his example. At the same time, it is evident that, however deterrent the penalty imposed, it will be difficult to eradicate this form of unfair dealing unless the poorer classes of customers are watchful to protect their own interests against unscrupulous salesmen.—*Lancet.*

Artificial Silk.—An artificial silk is prepared by De Chardonne by dissolving 3grms. nitro-cellulose in 100 to 150cc. of a mixture of equal parts of alcohol and ether; 2·5cc. of a filtered 10 per cent. solution ferrous chloride in alcohol, or of stannous chloride, and 1·5cc. of a solution of tannic acid in alcohol are then added. The filtered liquid is placed in a vertical reservoir, having at its bottom a blowpipe nozzle of glass or platinum. This pipe forms an acute cone with an orifice of from 0·10 to 0·20mm., the thickness of the margin not exceeding 0·1mm., and opening into a vessel of water acidulated with one-half per cent. of monohydrated nitric acid. The level in the reservoir being some centimètres higher than in the vessel of water, the outflow proceeds easily. The fluid hardens at once in the acidulated water, and may be drawn out by a uniform movement in the form of a thread, which must be dried rapidly by traversing a current of dry (not hot) air, and may be wound up as soon as dry. Soluble colouring matters may be introduced into the solution, so as to obtain threads of all colours.

A NEW departure has been made in the arrangement of the magazines of the Trafalgar, which are situated in a long passage between the two sets of engines, and are thus most effectually protected from the possibility of a stray shot reaching them. They are protected by practically 2ft. of solid iron and steel, with a cellular structure of steel on each side of them in addition to the double walls of the magazines themselves.

plication of continuous brakes; and it was, therefore, pleasing to me to find that the wonderful improvements in the Westinghouse brake have been obtained without the aid of electricity, and by mechanical skill in the employment of compressed air.

Numbers of express trains, composed of from 15 to 20 vehicles, are running upon railways in this country, and it is upon such trains that quick action is most necessary to public safety: two of the greatest disasters of modern times—namely, Penistone and Hexthorpe, would have been avoided or rendered harmless if the trains had been fitted with quickly acting continuous brakes. I trust some English railway company will fit a trial train with the new Westinghouse brake in order that its efficiency in actual traffic can be fully tested in this country.

Clement E. Stretton,
Engineer Associated Society of Enginemen.
Leicester, April 21.

THE SOUTHERN HEAVENS AND THE FLAT EARTH.

[28668.]—I WISH I could induce "Sigma" or some other honest opponent to discuss this question on my terms, instead of attempting to lead me into branches of physics which have no sort of connection with the real question at issue. It is most unfair to force anyone into a debate on subjects which he candidly admits he is perfectly ignorant of. I am too old a controversialist to enter upon such a one-sided discussion.

If I were to employ a surveyor to furnish me with the ups and downs or general configuration of a park of 500 acres, what should I say to him if he brought me a map of the southern skies, or, without going so far, of the Isle of Wight? But it would be just as reasonable as what "Sigma" proposes. He complains that "our maps do not comply with the same laws" as the globe theorists have laid down. This is certainly a curious objection. This style of reasoning is utterly subversive of all intelligent discussion. We do not make our maps to order; we plan them according to *facts*, not theory. On a circular plane, such as the earth is, the lines of longitude must diverge from the central north to the southern circumference. We disown all theories, we ignore all "laws." I am sure "Sigma" will not venture to assert that any practical measurements of the meridians of longitude south of the Equator have ever been made. Why does he, then, attempt to impose upon me the fanciful conjectures of Pagan astrologers? His assertion that north and south correspond is unworthy of an honest disputant. He must know that I am not obliged to take his mere word that such a preposterous agreement can possibly exist. If he would only endeavour to disabuse his mind of "laws" and popular conjectures, and the stereotyped formulas of star-gazing astronomers, and have the manliness to face the elementary conditions of his vaunted system, he would be much startled at the discovery that our facts and his theories have no shadow of agreement. Let him convince me, or any half-dozen intelligent men, that the line of railway, say, from Cambridge to Carlisle, or that any 15 or 50 miles of water is curved like a rainbow, or has any greater approach to a curve than the slate bed of a billiard-table; I will then listen to his description of the stars in the southern skies, but not before. This is the very first step, and I will allow no opponent to evade or avoid it as long as I have any voice in the matter. The prescribed curvature *must* begin somewhere! If "Sigma" cannot show it on any part of the earth or ocean, he may be quite sure I shall not pretend to see it in the skies above our heads. I say, once for all, my opponents must submit to my terms, and strictly confine themselves to the question at issue, and to one thing at a time.

John Hampden.

[Hopeless, as usual. The above is hardly worth space, except as another proof of the inability of Mr. Hampden to respond to a direct challenge.—ED.]

THE GLACIAL PERIOD.

[28669.]—IN the ENGLISH MECHANIC of the 13th inst. appeared a letter (28612) from Dr. F. E. Cane, in which he said, amongst other things—"That the Glacial epoch was due to an immense addition of water to our atmosphere from somewhere outside of our planet, and that it fell north and south of the Tropics as snow." If such were the case, whence did this water come, and where has it gone now? It cannot by any means have left this globe; for we know that when anything on our earth will be sufficiently attracted so as to leave it, that attraction will be greater than the earth's attraction, and therefore would also draw the earth in the same direction, so as to come into collision with it; but such has not yet happened, neither are there glaciers in Great Britain now. Then the Glacial epoch was not due to an immense addition of water. There are a great many theories put forth to give a reason for the existence of glaciers, icebergs, &c., in Britain during the Pleistocene period. The most general are the following three:—1. That it was brought about by a change in the geography of the earth. 2. A change in the form of the earth's orbit. 3. A change in the position of the earth's axis.

With regard to another part of his letter, he says that the theory of the continual see-saw land and sea changing is not true, and that the *Challenger* Expedition has proved the bottom of the ocean to be of great age; it is of great age in comparison to the time since man made his first appearance; but, geologically speaking, many parts of the ocean's bottom are of very recent age. Not so very long ago, yet before the existence of man, Europe was joined to North America. Dr. Cane, being familiar with charts, can follow the boundary of this North Atlantic Continent, named by geologists Archaia, by joining the 1,000 fathom line across the Atlantic. Iceland will be included in it, as it is a part of the old continent still remaining. The theory is no longer a theory with regard to many coast lines which are changing, but a fact depending on accurate measurements.

Oliver Drayton.

GOLD: ITS OCCURRENCE AND EXTRACTION.

[28670.]—YOUR correspondent "V. I. A.," writing from Pilgrim's Rest, South Africa, says: "There are thousands of tons of stuff so fine that it feels to the touch like flour, from which the gold cannot be got in any payable way."

I saw similar masses when I was a gold-miner in Australia from 1852 to 1858, at Ballarat, Bendigo, Forest Creek, the Sofula, and Turon Diggings. On my return home I made a study of the matter. After many years of failure I found a way to extract every atom of the gold from its matrix when silicious, the refuse silica being of commercial value. I do not think the residuum cherts, manganese, &c., would have any marketable value, but the silica and gold would be separated from them. The plant for my process would cost about £1,000 on the spot. The chemicals used are cheap everywhere.

Sam. C. Dean.
39, Bramber-road, Fulham, S.W.

THE ROYAL VICTORIA HALL.

[28671.]—MAY I ask a little of your valuable space to call attention to a proposed memorial to one whose death was a national loss—the late Mr. Samuel Morley? So deeply was he impressed with the dangers arising from the extremes of wealth and poverty, and the dreary lives led by the very poor, that he used often to speak of society as existing on a volcano, and spared neither labour nor money to lessen the evils he deplored. Among his many good works, none was dearer to his heart than the Royal Victoria Hall, which has for its object to brighten the lives of the poor by providing healthy recreation (apart from temptations to drink) and opportunities of instruction for those who desire them. It has been carried on under many difficulties for more than seven years; once a gift of £1,000 from Mr. Morley (towards buying the remainder of the lease) saved it in a crisis, and from that time he regularly took the chair at the committee meetings. It has occurred to those who worked with him there that there could be no more fitting memorial of his unselfish life, none more in accordance with his wishes, than to establish this work on a permanent basis. During his lifetime he caused inquiries to be made as to the possibility of buying the freehold; but the then owner refused to sell, and there appeared to be no prospect for the future but that the hall should relapse at the end of the ten years which the lease had still to run into the state from which the present trustees rescued it. What that state was we may learn from the pages of "Alton Locke," or from the reports of any of the police, who used frequently to take 30 or 40 from the old theatre to the lock-up on public holidays. But an opportunity offers now of making a return to the old horrors impossible. The ground landlord is willing to sell the freehold, and the trustees' committee propose to raise a memorial fund to buy it. If they succeed, the Charity Commissioners will take over the hall, as part of the scheme for people's palaces in South London. In that case there would be no more appeals to the public for the Royal Victoria Hall; its future would be provided for, and Mr. Morley's name associated for ever with the work which he did not live to finish. But the proposal is, for the Commissioners to meet the public with an endowment after the freehold has been bought, and for this £17,000 must be raised, and unless this is done by September, a deposit of £500 (already paid) will be forfeited. The value of the freehold we are told is much more than this. The landlord has abated several thousands in consideration of the public utility of the object, and £4,000 is allowed for the present value of the lease, which is freely given by the trustees and committee. The £1 covers the remainder of the price, law exp &c. Towards this individuals on the comn have promised £3,500.

I will not trespass on your space with det the entertainments, concerts, lectures, tech and other classes, working men's club, &c flourishing at the hall. Let those who wi know, come and see. The popularity of the is shown by the fact that £1,825 was taken in months for admission at the doors, chiefly in of one penny to three-pence.

I will only add that this work is like Mr. ley's generous sympathy in taking no accou differences of creed or party, and that all who to help in perpetuating the name of a good m the way he would have chosen, are invited to municate with Miss Emma Cons, hon. sec., a hall, Waterloo Bridge-road, S.E. She will gl send tickets for the meeting which is to be he Grosvenor House at 3 p.m. on the 25th inst. at which the Duke of Westminster, Canon Ba Cardinal Manning, Mr. Arnold Morley, and o have promised to speak.

Lucy C. F. Cavendi
4, Upper Brook-street, April 21.

MICROSCOPICAL.

[28672.]—IN reply to "A Constant Reade is quite impossible to compare lenses, micro or otherwise, which are known by numbers, le or other fanciful terms. If you buy at va times a certain maker's X, Y, Z lens, you will the power vary considerably. There is only scientific way of designating a lens, and that its equivalent focus. Now, every combinati microscopic, photographic, telescopic, achrom apochromatic eyepiece, objective, or conden is equivalent in its magnifying or diminis power to some simple lens of a certain focus. combination should be designated by the length of the simple lens to which it is equiva This equivalent simple lens is, of course, an one, as it is supposed to be infinitely thin. inch microscope objective means, therefore, a sy of lenses which magnifies or diminishes an obje much as a simple ideal lens of 1in. focus. I these estimations, as far as the micros is concerned, the screen on which the ima received is supposed to be placed 10in. from lens [more correctly from the posterior prin focus]—*i.e.*, the assumed distance of distinct vi In a straight line take three points, o, l, i, that $o l$ = 1in. and $l i$ = 10in. Then in the mi scope o would represent the object, l the lens, i the image on the screen. Suppose l to be an convex of crown of 1·5 ref. index, then the only one definite curvature which will focus an image of o placed 1in. from it. If o wer object and i a sensitive plate, then it would re sent the taking of a photomicrograph: o and i interchangeable; thus if you place the object and the sensitive plate at o, you will take, ins of a photomicrograph, a microphotograph. amount of diminution will equal the amoun magnification. The magnification or diminut it matters not what you call it for they are id cally similar, is always proportional to the dista $o l$ and $l i$. In the case above, $l i$ is 10 times gre than $o l$: the image or object at i will be 10 ti greater or smaller than the object or image at o

Let us see what would happen if we mad 100in. instead of 10in. Before we could make image o come on the screen i, we should hav do either one of two things—viz., focus the nearer o, or keep the lens where it is, 1in. fro and alter the curves, making them shallower the image came on i, the screen. We must do latter in order to keep the lens an inch (thi theory), in practice, however, the distance wl l must be moved would be so small (·01in.) th might be neglected. The magnification or dim tion now will be 100.

If the lens l was a ¼in., the magnificatio diminution at 100in. would be 400, because 10 are 400 times greater than ¼in.

One would think that all this elementary ma was uncalled-for; but some time ago I notic correspondent required five equations (!) to de mine the diminishing power of a $\frac{1}{16}$th obje at 100in.; 100in. are 1,600 times greater than $\frac{1}{1}$ therefore that is just the magnifying or dimin ing power of that lens. As we said above, the sa distance for all microscope objectives is fixed at 1 It is fixed also at that distance for all eyepieces they microscopic, telescopic, spectroscopic, otherwise.

All eyepieces ought always to be designate the focus of the simple ideal lens to which t are equivalent in power. Thus, an A eyep should be called a 2in., because it is equivalen a simple 2in. lens in power. A 2in. lens ma fies five times, because 10in. are five times gre than 2in. Now let us see the mistakes that contained in the catalogues. Here are some tracts out of the first one to hand: 1in. with eyepiece = 50 diam. From this we learn that A eyepiece is a 2in., the 1in. magnifying ten ti the A or 2in. eyepiece five times—5 × 10 = 50. Next comes the $\frac{2}{3}$rds, which gives, with the same eyepiece, 75 diam.

This confirms the view we have taken of the A eyepiece, for as 10in. are 15 times greater than $\frac{2}{3}$in., the power of a $\frac{2}{3}$ is therefore 15, which multiplied by 5 for the eyepiece = 75.

Now, the next is the $\frac{1}{2}$, which with the same eyepiece gives 110, which is sheer nonsense. For as 10in. are 20 times greater than a $\frac{1}{2}$, the power of the $\frac{1}{2}$ is 20, which multiplied by 5 gives 100, and not 110. In like manner the $\frac{4}{10}$ ought to be 125 instead of 145, and the

$\frac{1}{4}$	200	instead of	250
$\frac{1}{5}$	250	„	265
$\frac{1}{8}$	400	„	425
$\frac{1}{10}$	500	„	550
$\frac{1}{15}$	750	„	900

Another catalogue states that a $\frac{4}{10}$ of 65° with a No. 1 eyepiece magnifies 125 diams., and a $\frac{4}{10}$ of 95° with the same eyepiece 150°! Just as if the increase of 30° in the angle of the lens made an increase of 20 per cent. in its power.

The reason I go into this matter at length is to expose frauds which are frequently committed on the inexperienced—I allude to the advertisements of $\frac{4}{10}$ths and other low-power objectives of abnormally high angles.

It is very much easier to put great aperture to a high-power lens than a low one. Thus it is not a difficult thing to make a lens having an initial power of 40 of 100° angle, but it is a difficult thing to put that angle in a lens having an initial power of 25.

Likewise it is not difficult to put 80° in a lens of 25 initial power, but it is difficult to do the same in a lens of only 5 less initial power. I have a Tolles $\frac{1}{4}$ of 140° which was considered a wonder in its day, and so it would have been if it had been a $\frac{1}{4}$, but it is really a $\frac{1}{6}$, and so the illusion is dispelled.

That Spencer $\frac{1}{4}$ of N.A. 1·3, about which so much was written, had nothing $\frac{1}{4}$ about it except the engraving on the box: it was a $\frac{1}{6}$th.

Everyone should be very cautious in buying a high-angled low-power glass, otherwise they are sure to be taken in. It is manifestly absurd to give £6 for a $\frac{1}{2}$ of 80° when in reality it is a $\frac{1}{4}$, which could be bought for £1. It is much more difficult to make a wide-angled low-power lens, and for that reason Zeiss very justly charges £2 more for his apochromatic 1in. than for his $\frac{2}{3}$ of the same aperture. The magnifying power of his lenses are fairly true to their focal lengths—e.g., the initial power of his 24mm.; one I measured gave 11·8, another 11·1. It would be an excellent plan if the initial power of every lens measured at 10in. as well as the N.A. and equivalent focus, were engraved on the box, thus, $\frac{1}{4}$ N.A. 0·85 × 41. The sign of multiplication (×) would stand for "initial power."

Eyepieces should have their power marked on them as well as their equivalent foci. Zeiss does this, but his figures are too inaccurate to be relied on. In conclusion, I would like to point out that telescope object-glasses and ordinary photographic camera-lenses are similar to microscope objectives in these respects, the difference being that the screen distance is not fixed. They are really diminishing lenses; the object is placed at *i*, a diminished image of it is made at *o*, as in the case of the micro-photograph.

Example:—A telescope of 10ft. focus is pointed at a house three miles off, having a window in it 10ft. square. To what size will the image be diminished at the focus *o*? Ans.:—The number of feet in three miles is 15,840, which is 1,584 times longer than the focus of the glass; therefore, the window will be diminished 1,584 times, or to $\frac{7}{100}$in. (nearly). If this image is examined by a 1in. eyepiece, the size of the window will appear $\frac{7}{10}$in.

Another example:—A cliff 100ft. high is 300yds. distant from a camera having a rectilinear lens of 12in. equivalent focus. What will be the size of the image on the plate? The distance of the cliff is 900 times the focus of the lens; therefore, the image will be diminished 900 times, or will equal 1$\frac{1}{3}$in. The arguments throughout this paper, though not strictly accurate, are practically so. My object in writing it was to assist practical workers, and not to bore them with theoretical optics. In this last example, for instance, the exact diminution will be 899 times, which will make a difference of about ·001 in the size of the image of the cliff.

This difference is caused by my measuring the 10in. from the lens to the screen, whereas it ought to be measured from the posterior principal focus of the lens to the screen. This makes a greater percentage of error with the lower powers. Thus, the real power of a 1in., measuring the 10in. from the posterior principal focus, is 10. In practice, the English tube is an 8in. tube with low powers, while it is a 10in. with the medium and high. Aperture:—Fras D'Agen's method is quite correct, and exhibits much ingenuity. I fear his dark ground would not be worth very much with his condenser of N.A. 1·2, as he would have only ·02 of available aperture in the condenser for the light to pass. Dark ground with high-angled lenses, those even dry ones, is always unsatisfactory.

The fact that Fras D'Agen gets a dark ground with a condenser of 1·2 N.A. does not in any way prove that his lens is up to 1·0 N.A.; it merely proves that it is less than 1·2 N.A. I think I know what he meant to say: it was that it took such very extreme marginal illumination of his 1·2 condenser before the ground got dark that he considered his aperture was fully 1·0 N.A.; otherwise it would have been easier for him to obtain it. I regret to have been so long in answering the questions.

Since writing the above I have read "A. S. L.'s" letter. There is a much better relation of aperture to power in the microscope than the 100 per inch business in the telescope, which, by the way, is all nonsense.

No quarter ever made will stand a power of 1,350. No microscope lens ought to be pressed more than ten times its initial power. The rest of the business is easy, for, given the separating power of the unaided eye at 10in. in lines per inch, then multiply this number by ten times the initial power of the lens; then calculate the aperture the lens must receive to resolve that number of lines, and you have it. I can separate 250 lines per inch at 10in. by my unaided eye. In order, therefore, that a microscope may resolve all I am capable of seeing it must have ·26 N.A. of aperture in its objective for each 100 diam. of combined magnification. In the ENGLISH MECHANIC in 1883 I published a table of apertures constructed on the plan of ·26 N.A. for each 100 diam., and stated that "if ideal perfection is to be reached, the values given in the above table must be aimed at." This met with opposition, and Prof. Abbé was quoted as not approving of such high angles. Let us now compare the angles of his apochromatics with my list:—

My List, 1883.	Apochromatics, 1886.
1in. .... 0·26 N.A.	24mm. .... 0·30 N.A.
$\frac{1}{2}$in. .... 0·52 N.A.	12mm. .... 0·60 N.A.
$\frac{1}{4}$in. .... 1·04 N.A.	6mm. .... 0·95 N.A.
$\frac{1}{8}$in. .... 1·66 N.A.	3mm. .... 1·40 N.A.

In the first two my ideal apertures are exceeded. With regard to the 6mm. it is, of course, quite politic to keep it a dry lens, and 0·95 N.A. is the maximum for a dry lens.

The 3mm. ought to have an aperture of 2·08; but it has been very wisely kept to 1·4, because it is not at present technically possible to exceed that without introducing errors. In other words, if more aperture could have been usefully given to the 3mm. objective it would have had it.

0·26 N.A. per 100 is a golden rule for microscopists. I do not despair of living to see those old dicta of "Low-angled glasses for penetration," "Good enough for histological purposes," "Jackson limb for steadiness," and "Thin stage for oblique illumination," "fall like Lucifer—never to rise again."

Edward M. Nelson.

London, April, 1888.

AN ELECTRO-MOTOR SUITABLE FOR DRIVING TRAMCARS.

[28673.]—"C. E.'s" proposition (April 13) of having a separate truck to contain the cells is certainly advantageous in that the tram itself is not required to be standing idle while cells are charging. But it would be found cumbersome among heavy traffic, is unsightly in appearance, and holds out very obvious temptations to the street arab.

I should suggest that the space above the cells be utilised for the use of passengers, thus overcoming the two latter objections.

But why not use cells of sufficient capacity to carry a whole day's work? Then they can be placed beneath the seats or body of the tram (the usual method), rendering the whole affair compact, a great consideration in crowded cities. When the day's work is done, and the trams are housed, the charging can be effected.

W. Perren-Maycock.

GRAVITY LECLANCHE.

[28674.]—"ASSOC.INST.ELECT.ENGS.," letter 28626, page 148, asks for information respecting this form of cell. I can tell him that it will work fairly well for a week or two, and then he will find that it polarises quickly and takes longer to depolarise than it ought to, for the simple reason that the air, which is a considerable factor in the economy of the Leclanché, is entirely excluded in the arrangement he alludes to.

With our Editor's permission, I will now describe an arrangement of a gravity cell that I made and had in use for months, intermittently lighting 5c.p. lamps, which I found to answer for this purpose better than any other arrangement, in consequence of the low internal resistance and high E.M.F., which remains the same as when porous cells are used, which is not the case with agglomerate blocks.

The outer jar is brown stoneware, 3in. deep, 6$\frac{1}{4}$in. internal diameter at top, narrowing to 4in. at bottom, paraffined for 1in. down. Zinc is the usual rod, but 3ft. long, which I made very warm and bent into a flat spiral, leaving about $\frac{1}{8}$in. between each convolution. To one end of rod solder a copper wire (18 B.W.G.). Over this wire, soldered joint, and about $\frac{1}{2}$in. of zinc rod, draw a 4in. length of I.R. tube, which effectually insulates and protects them from the sal. am. solution. The zinc still being warm (or else must be warmed), is then dipped into melted paraffin wax which will adhere in a thin but perfect coat. When the wax is quite set and hard, it must be scraped off that part of the zinc which will be the underside as it lies flat in jar. This precaution is absolutely necessary, because however well the carbon lumps are washed, there will still be a slight sediment of carbon and manganese dust, which, if it fell on the zinc, would be the cause of a very energetic local action. The zincs must be placed level in jar, but are best raised about $\frac{1}{8}$in. from bottom on triangular pieces of wax, or with a little care, they can be made of such a size as to rest on the sloping sides of jar, which will do as well for the purpose of keeping the unprotected side of zinc above any possible sediment. Immediately above the zinc comes the support for the carbons, which consists of a ring of split cane large enough to rest on the sloping sides of jar just clear of zinc. Across this ring is stretched a single thickness of coarse wrapping of canvas, firmly sewn all round to the ring. Place this in jar quite level, and fix in place by means of small lumps of pitch and a hot iron. This is necessary, as otherwise it is liable to become displaced when packing in the carbon lumps. I may here mention that, even if the canvas does touch the zinc, it does not matter, as the latter is protected by its coat of wax. The negative pole consists of eight or ten pieces of arc-light carbon about 4in. long, well soaked in paraffin wax and lead capped. To paraffin the carbons properly is the most difficult, and yet most necessary, operation—most necessary because, if not done, connection will be quickly destroyed, and most difficult because, if not properly and carefully done, it will considerably increase the resistance of cell. I have found that the best, besides being the most expeditious way is to bundle a number of lengths together, and place the ends which are to have the lead cap about half an inch deep in melted wax, put in a moderately-warm oven, and leave for about one hour; they will then be thoroughly soaked without there being the unnecessary coat of wax on the outside, which is usually the result when they are soaked bodily in the wax; it is this outside coat which increases the internal resistance by decreasing the effective surface of carbon. Each carbon should then be separated, and placed with the same end down to get cold; they are then ready for lead caps. It is not necessary to drive the wax back with a hot iron—as I have repeatedly seen it advised in "Ours"—because the hot lead will do that more effectually, and leave the superfluous wax just where it is most wanted. The carbons being paraffined and capped, they must be placed upright in the cell, resting on canvas support, and equally distributed over the whole surface, then packed tightly round with a mixture of equal parts by weight of carbon and oxide of manganese, each in small lumps. Before doing so, however, both carbon and manganese must be thoroughly washed as free as possible from dust, then fill the jars nearly to top. I prefer leaving the carbon exposed to the air, but it has the disadvantage of constantly requiring the addition of a little water, as the evaporation is considerable on account of the extensive surface. Of course, it might be covered in with melted pitch and air-holes left, but that restricts the free circulation of air, which is a very much greater disadvantage than the trouble of replacing the water. Each of the lead caps must be soldered to a length of 18 B.W.G. copper wire, passing from one to the other, and the end brought to the side opposite to the wire which connects to the zincs.

Do not pour in more sal-am. solution than will fill the jar higher than a quarter the height of carbon mixture.

Matlock Bath. **James J. Ryder.**

DIRECT TRANSFORMERS OR INDUCTION COILS.

[28675.]—I HAVE looked up "Engineer's" prior letter on this subject, of the existence of which I was, of course, unaware.

The cores of transformers should be twice as thick as they were shown in sketch last week. Their possible heating, to which "Engineer" draws attention, would be better overcome by having them of extra thickness than by working transformer under its full power, which would mean decrease in efficiency. In special cases, where the transformer is likely to be put to prolonged use, the cores can be hollowed. It might be suggested to build them of wire, but any advantage that might ensue would be neutralised by increased structural expense.

W. Perren-Maycock.

LETTERS TO THE EDITOR.

◆◆◆

[We do not hold ourselves responsible for the opinions of our correspondents. The editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

⁂ *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

◆◆◆

MR. ESPIN'S NEW VARIABLE STAR.

[28657.]—THE place of D.M. + 40° 2694 should be xiiih. 42m. 43 8s. + 40° 15·9′ (1855), and not as printed in Wolsingham Observatory *Circular* No. 19. The star is not in Lalande or Weisse's Bessel, and I have failed to find it in any modern catalogue. The place in D.M. is taken from B.B. vi., where it occurs as a 9·2 magnitude star; the place for 1855·0 being xiiih. 42m. 43·82s. + 40° 15′ 55 9″, from a single observation with the Bonn circle on April 23rd, 1858.

The star D.M. + 40° 2701, which was referred to by Mr. Espin as being possibly variable (letter 28637, page 168) is Ll. 25549, 25550, W². B. XIIIh. 988. It is 7½ and 8 magnitude in Ll., 8 magnitude in Weisse's Bessel. It is in the second Armagh Catalogue, but the magnitude is there assumed from D.M. Dunér finds a spectrum of type iii a ! and calls it 6·0mag. in April, 1879, and May, 1880. The observation in D.M. is a single one.

H. Sadler.

32, Manor-street, Clapham, London, S.W.

THE STARS IN THE TRAPEZIUM OF ORION.

[28658.]—WITH reference to the supposed discovery of a new star in the Trapezium of Orion with the great Lick telescope, I desire to say that I have just received a copy of the first volume of the *Publications* of the Lick Observatory, by which I find that the fifth and sixth stars in the Trapezium were seen, and even some of the positions and distances measured, by Mr. Burnham with one of the smaller telescopes in use at the Observatory. This being so, I think we may assume that the observers would not have announced as a new star one of those already observed and measured at their own observatory, and that the star recently discovered is not one of the six.

Dublin, April 21. **W. H. S. Monck.**

SATURN.

[28659.]—I AM encouraged by Dr. Terby's letter (28635) to say that I have noted on the following dates re-entering curves of general outline, and of size and position similar to those depicted by him upon ring C: Feb. 25, March 1, March 12, and March 14.

On March 21 the ring thinned out, where it passes behind the ball; but I saw no other irregularity. During February, March, and April ring C has always appeared to me plainer on the *f.* side, while the reverse has been the case with the markings of ring B. I have used a With 8½in. mirror, powers 276 to 406.

P. H. Kempthorne.

Wellington College, April 21.

ILLUMINATION OF THE ECLIPSED MOON.

[28660.]—KINDLY allow me space to correct two mistakes which obscure the meaning in my letter (page 169):—

In law 3 "curved" should be "central"; in law 4 "end" should be "centre."

April 23. **George F. Burder, M.D.**

SUN'S RAYS.

[28661.] — BOTH correspondents who have attempted to explain this subject in Thursday's issue must be in error. From the June solstice to the frigid zone is not more than 3,000 or 4,000 miles. The sun's altitude is said to be from 92 to 93 million miles. Let anyone construct a triangle according to this scale. He will see the absurdity of referring to any "obliquity of the sun's rays." But there *is* an obliquity of the solar rays; therefore the prescribed elevation is a myth.

John Hampden.

FIG. 1.

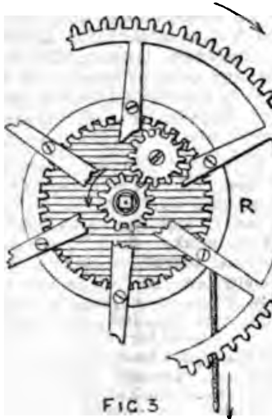


FIG. 2.

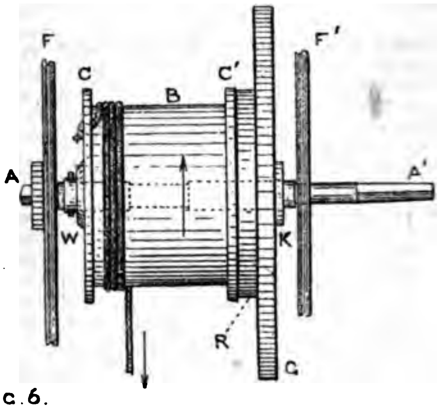


FIG. 3.

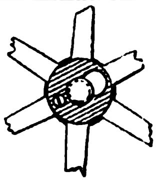


FIG. 6.

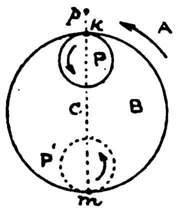


FIG. 4.

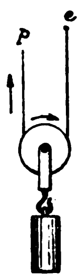


FIG. 5.

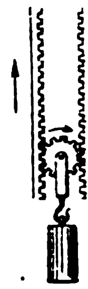


FIG. 7.

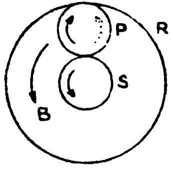
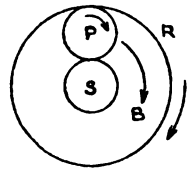


FIG. 8.



COILS WITH HORSESHOE CORES.

[28662.]—THE idea of constructing coils with these cores (see letter 28649, p. 170), is some years old. In Vol. XXXVIII., p. 325, is a letter of mine suggesting such an experiment being tried as possibly giving a larger spark. Our friend "Sigma" was then writing some papers on Magnetism, and in a paper subsequent to my letter he stated that though horseshoe magnets have greater attractive power at the poles, they have not such an extended inductive influence as bar magnets. This remark, from such a well-known authority, appeared to me to settle the question, and after another letter on the subject (at p. 473) I dropped the matter. The number containing the first letter is dated Dec. 14, 1883. **B. Harcourt.**

MAINTAINING SPRING FOR SMALL TURRET CLOCK.

[28663.] — ONE of the most elegant contrivances for a maintaining power, in which neither auxiliary spring nor weight is required, is that described, but not illustrated, in "Reid's Treatise on Clock and Watch-Making," published in 1826. He describes it as "a very ancient way of going while winding, which was long applied to the fusees of clocks and watches," and for particulars refers to Thiout's "Traité de l'Horlogerie," published at Paris in 1741. This arrangement was applied to the barrels of the machines used for Alexander Bain's Chemical Marking Telegraph about 1851, when this system was used by the Electric Telegraph Company. This arrangement superseded the "going ratchet" previously used, which latter, although adapted for slow-motion machines, was not sufficiently prolonged in its action for the comparatively fast-running trains of telegraphic apparatus. As this pretty contrivance is useful for other purposes besides clockwork, and finding that it is by no means generally known, it occurs to me that an illustration showing its construction may be both useful and interesting to many of the readers of the ENGLISH MECHANIC. The telegraph machines alluded to have long since become extinct, as far as I am aware, not a single specimen having been preserved, and not having seen one for the last 26 years, the construction is necessarily reproduced entirely from memory. The barrel B, Figs. 1 and 2, is of boxwood, and unprovided with grooves; the brass caps C C′ are secured by wood screws in the usual way. The winding arbor A A′ passes through both great wheel and barrel without being attached to either. It is provided with a ratchet at A, the click being fixed to the back frame-plate F. There is a brass tube in the inside of the barrel forming part of one of the caps, which acts as a socket to receive the arbor, and within which the latter may turn. To the crosses of the great wheel G a ring R is secured by six screws; this ring is toothed on its inside, forming a wheel with internal teeth
side this ring, between the great wheel an
barrel-cap C′, are two toothed wheels of equ
and the same number of teeth, though this eq
is not necessary. The centre wheel is fa
permanently to the arbor (soldered, I th
was), while the other, which gears between
R, is pivoted to the barrel cap by a d
shouldered countersunk screw. This gearing
the only connection between the arbor, barr
great wheel. The two latter are kept in p
on the arbor at the back by a washer and
and in front by the fusee key K, of which
view is shown in Fig. 3. For facilitating ref
we will call the wheel which is fixed on the
the sun-wheel, the other which is pivoted
barrel the planet wheel. When the windi
applied to the square A′ is turned, and th
wheel revolves in the direction of its arrow,
cause the planet-wheel to roll round the inte
the ring R and wind the cord on the barre
out interfering in any way with the action
weight on the great wheel G, which will co
to be urged in the direction of the arrow a
the arbor is at rest. This action is precisely
to that of raising a weight by a movable
one end of the cord being fixed. In Fig. 4
end *e* of the cord be attached to a fixed point
a force is applied to the end *p* to raise the
Although the sheave is turning and the we
rising, the pull on the point *e* will rema
same whether the weight be rising or falli
the end *e* be attached to or form part of the co
barrel, the case will remain the same. Th
principle of the construction of the "endless
the celebrated Netherlands philosopher, Hu
who applied it to his clock, and is the fir
taining power of which we have any recor
it will in no way affect the case if a tooth
be substituted for the sheave, and two ra
the place of the cord (Fig. 5). If, now, w
conceive the racks to become circular
toothed wheels, concentric with each othe
toothed wheel between them pivoted to
volving round the same centre as them
shall arrive at precisely the same arrang
that of Fig. 1. Here the wheel R rep
right-hand rack in Fig. 5; the sun-
left-hand rack, and the planet-wheel t
wheel between them. It will thus be
the arrangement shown in Figs. 1 and
so different in appearance, is virtual
more than the principle of the "endle
Huyghens applied to wheel-work. It is
well to give this illustration, having fo
many experience a difficulty in clearly rea
action, and certainly at first sight it appe
terious to see the cord winding on the bar
the latter retrograding without producin
interference in the speed of the machine. Fo
benefit of those who may not be familiar

I understand from "Byford's" statement in letter 28618 that the backs and breasts of the violins which he tested gave sounds 3½ semitones apart; but he says he is not sure whether the *f* holes were cut or not. I should be inclined to think they were not, for a difference of 3½ semitones between the plates, I think, would be too great, and that a violin so constructed would have only an indifferent tone. The cutting of them would lower the sound of the breast about a tone, reducing the difference to rather less than a tone.

M. Savart, the eminent scientist and authority on violin matters, in speaking of the experiments which he made with the violins of Stradivarius, states that he almost invariably found the back and breast to give sounds a tone apart.

Mr. Davidson also states, in his little work on the violin, that a violin deteriorates in proportion as this is departed from. Again, the sound-bar perfectly compensates for the cutting of the *f*-holes, the plate giving the same tone when finished as it gave before the cutting of them, or the fixing of the bar, assuming, of course, that the latter be of the proper dimensions. **F. Watson.**

CURIOUS ALLOYS.

[28684.]—I HAVE read with great interest the series of short communications by our respected correspondent, "Eos." From practical experience, I have but little faith in the antimonial copper alloy which he describes in No. 28478; but, apart from its fine colour, it may possess some estimable qualities as applied in some of the various arts.

Can "Eos" give any information as to the preparation of "Handaru," an apparently alloyed metallic cement used by the Japanese in the erection of some of their gigantic bronze statues?

H. B. F.

SAFETY BICYCLES.

[28685.]—THE cycling season having now begun, it would, I am sure, be of interest to many readers if some notes on new pattern machines were given by those having experience. Personally, I should be glad to know if those rear-driving safeties provided with the quadrilateral or parallelogram frame possess any advantage over the ordinary build? The former seem to me to be stronger, and probably would steer better, but I have no experience of either. As a would-be rider, I should be glad of advice on the subject. **R. W. F.**

SURVIVAL OF THE FITTEST AND ASIAN MYSTERY.

[28686.]—I SHOULD like to know what "E. L. G." (28641, p. 169) means by "the obvious non-survival of the fittest on any land disconnected from Asia?" I know a land so disconnected, the whole of the animals of which have survived from very ancient times, certainly long antecedent to the supposed Flood or the Glacial epoch. That land is Australia, which presents a problem absolutely inconsistent with a total destruction of the earth's inhabitants, and a repeopling from any central point in Asia or elsewhere.

We have to deal there with a large continent, every native quadruped in which belongs to the marsupial order—an order of animals which, while once spread over the earth, has disappeared wholly from all the rest of the world, with the single exception of the opossum of North America. (There are some in New Guinea, which may be regarded as part of Australia.) Now, whether the disappearance of the marsupials all over the world is to be attributed to a general destruction, or to their gradual displacement by creatures better suited to gradually altered conditions, it is evident that nothing has occurred in Australia to destroy them there. But the striking fact is that there are no others—from the largest kangaroo down to mice-like creatures, all belong to this early type. The only exception is the wild dog, which is pretty surely a late arrival, accompanying man.

Let us also admit that it is an argument against evolution in that, through all the ages which must have passed since the early marsupial creation or development, no higher or modified type has come into existence. On the other hand, the climate and nature of Australia are such that probably the marsupials were best adapted to them — until man's advent (civilised man that is) altered the conditions of existence.

The problem becomes clearer when we consider, not merely the existing state of the world, but the probable periodical changes it undergoes. At present the bulk of the land surface is in the northern hemisphere, while not only water prevails in the south, but the southern ice cap is much the more pronounced. But geology, while it cannot tell us whether the southern land surface ever predominated, does tell us that not once, but often, the northern lands have been under water, and the northern ice cap came far down south.

There are good astronomical explanations of the causes of these recurring glacial epochs in one hemisphere, accompanied by hot conditions in the other, such as we know have existed in high northern latitudes, and there are good reasons for the belief that astronomical causes may draw an excess of water alternately north and south. If this is the case, and the conditions such that, when the southern land last descended into the water, the marsupial animals were generally diffused, and retreated as the water rose, we have an easy explanation of the facts as they exist. Australia is the remnant of the old southern continents: its animals, the preserved and isolated remainder of their inhabitants, preserved from being superseded by higher types by their isolation from the rest of the earth's land surface.

Anyhow, one thing is certain: no cosmical torrents of water, hot or cold, ever destroyed the early animals of Australia, nor did an inrush from Mr. Hampden's encircling ocean from beyond the ice barrier. All teachers of a universal deluge have this nut to crack. **Sigma.**

TIGERS AND TELEOLOGY.

[28687.]—I WAS pleased to see the sensible letter (28616) of your esteemed correspondent, "W. G. P.," on this dark subject. While it is no doubt true that each species acts for its own benefit, we must not forget the inter-dependence that exists in nature. The whole animal kingdom is, of course, directly or indirectly dependent upon the vegetable kingdom. Much of the so-called waste in nature of seeds, fruits, ova, &c., affords the means of subsistence to a variety of creatures. All this involves no suffering, but the existence of so many species, "red in tooth and claw," is a perplexing mystery. Vicarious suffering runs, indeed, largely through nature. We all suffer at times from the misdeeds or misfortunes even of those who are no relations of ours, while we have our full share of physical evil as well. If suffering were confined to the human race, the difficulty would not be so great; but moral considerations do not apply to animal suffering. The principle of degeneration, however, has a bearing on it. It seems that food and safety, when very easily attained, results, as a rule, in degeneration. When a creature turns aside from the path intended for it, it sinks in the scale of existence; so that it would appear as if some degree of struggle and difficulty were necessary not only to effect progress, but to prevent retrogression. In any case, it is possible to make too much of this feature of nature. Even when animals die by violence, they probably suffer infinitely less than many a human being who dies from a lingering, painful disease, while they are spared the mental trials which are often worse than the bodily pains. That man's heavy hand lies upon them is certainly not the least of animal afflictions. **J. A.**

USEFUL AND SCIENTIFIC NOTES.

A NEW dry or semi-dry pile has recently been invented by M. Messerole, which is made with common soap dissolved in boiling water, to which has been added a small quantity of caustic soda or caustic potash. This mixture is poured while hot in a cell, in which has previously been placed a large carbon rod and a plate of amalgamated zinc. On cooling, the mixture forms a paste which does not easily evaporate.

COLONEL IRVINE, who lives just on the outskirts of Richmond, Kentucky, had three barrels of Anderson county whisky 14 years old in his cellar, says a Lexington paper. He left the bungholes open to age it faster and make it mellow. Judge of his surprise when he went to show it to some visiting friends one morning to find that it was nearly all gone, and in one of the barrels only about two gallons were left. In this barrel over 40 large black snakes were discovered, all in a state of intoxication, while in the dark corners of the cellars groups of rattlesnakes were coiled, some sobering up, while others were in various stages of intoxication.

MISS CORNELIA SORABJI, who recently graduated as Bachelor of Arts at the Bombay University with marked distinction, has been appointed a Fellow of the Ahmedabad Arts College, and has entered upon her duties as a college tutor. The Bombay newspapers notice as remarkable the fact that, at a time when municipal school committees will not intrust the education of even little girls to women, a young lady is thus set to teach young men.

IN a report on the trade of Baltimore for 1887, it is mentioned that the immigration to Baltimore is curious in the distribution of nationalities. The total number of immigrants in 1887 was 40,273, of which 25,600 were Germans, 3,080 Russians, 2,550 Bohemians, 1,778 Austrians, 1,109 Hungarians, 1,662 Swedes, 1,056 English, 300 Irish, 22 Scotch. The sexes were tolerably evenly divided, for of the whole 40,273, 21,255 were males, and 19,048 females.

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[64390.]—**Backwork for Eyepieces.** — In No. 860, Vol. XXXIV., will be found an illustrated description how to do this work by Mr. Lancaster, and querist should buy No. 857, Vol. XXXIII., as well, treating of the construction of the telescope, by the same writer.—J. C. LINSCOTT.

[64478.]—**Church Bells (U.Q.)**—Bell-metal is composed of copper 78 parts, and tin 22. It is sometimes stated that the old bells contained silver, but I believe that authorities do not regard this as correct. Perhaps if you read "Lomax's Bells and Bellringers" you would find it interesting, and might gather some information from it.—PRINCIPIA.

[64547.]—**Problem.**—If "E. L. G." will re-read the question (p. 589), he will see that he has again slightly misunderstood it. It is this: "In how many ways can 12 men be *re-arranged* . . . . &c.?" "Re-arrangements" cannot include the *original* arrangement; therefore, "Reymond's" figures (page 150) are perfectly right; and "E. L. G.'s" are, in each case, too great by 1. Now, with regard to the circular re-arrangements: a b (a) can have no re-arrangement; a b c (a) can have just three—namely,

a c b (a)
b a c (b)
c b a (c)

And a b c d (a) can have exactly four re-arrangements (under the conditions laid down)—namely,

a d c b (a)
b a d c (b)
c b a d (c)
d c b a (d)

I have made trials with five and with six, but have not been able to discover any law by which circular re-arrangements of higher numbers can be calculated. The result so far, by experiment, is as follows:—

No. of objects.	No. of re-arrangements according to the condition, p. 589.	
	In line.	In circle.
2	1	0
3	3	3
4	11	4
5	53	40
6	309	216

The number of possible re-arrangements of 12 objects is, by calculation, as "Reymond" has it (p. 150). "J. C." evidently made a slight slip in working it out. I should like to say, whilst writing on this subject, that my figures for circular combinations (p. 107) are unreliable. A glance at the combinations of a b c d e f (a) will show that more than two would have to be struck out from the six arrangements given.—F. S. S.

[64602.]—**Evolution.**—I agree with "Dens" in his reply to this query, and would recommend anyone interested in the subject to examine microscopically sections of human hair, taken from all sundry parts of the body, and compare them with similar sections taken from like parts of any anthropomorphous ape. Our esteemed correspondent, "F.R.A.S.," on page 31, avows himself an "Evolutionist." He has taken his seat on one of the horns of the dilemma. Some two or three years ago (I have not here back numbers for reference), in a protracted correspondence in your columns, he objected to my use of the word "creation" as involving the idea of *a* "*Creator*"; but what, I would ask, is his position as an evolutionist? Does he repudiate the idea of *an* "*Evolutioner*"? Does he believe in self evolution? If not, I can join hands with him.—H. B. F.

[64619.]—**Chemical Balance.**—For exact and, at the same time, rapid work, the querist will find a short beam balance, such as Bunge's, greatly superior to the longer beamed balances hitherto generally in use.—H. B. F.

[64633.]—**Scotch Putty.**—For patching up joints in a cooking stove here, I have found the following recipe thoroughly satisfactory, and it may suit the querist. Take 8 parts sifted clay, mix thoroughly with 4 parts iron filings, 2 parts black oxide of manganese, 1 part salt and 1 part borax. A quantity of this may be made and kept dry, and only so much as is immediately required made into a putty with water.—H. B. F.

[64640.]—**Test for Gold.**—The reply which "Principia" gives to this query requires an addendum. The solution in aqua regia must not be repeatedly evaporated to dryness with additions each time of HCl to expel all nitric acid. I have frequently known experimenters pronounce the presence of gold under this test, from the oxidation of ferrous salt in a solution imperfectly freed of nitric acid.—H. B. F.

[64656.]—**Joints in Slate Cistern.**—A putty of red and white lead is quite effective, provided only the slate is quite dry before its application, and due time be allowed for its hardening.—H. B. F.

[64678.]—**Blast Furnaces.**—I append a useful diagram showing the most fusible silicates of alumina, lime, and magnesia, and by which one is enabled to calculate readily the amount of base or silica to add to a furnace charge so as to produce such fusible slag (see diagram). The ordinate represents silica, the abscissa bases:
The line—

A B = $18\,SiO_2 + 21\,Al_2O_3$ = silicate of alumina
C D = $12\,SiO_2 + 22\,CaO$ = silicate of lime
C E = $12\,SiO_2 + 16\,MgO$ = silicate of magnesia

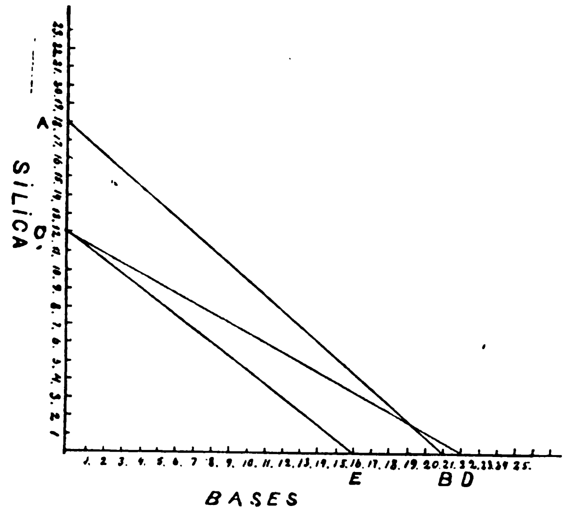
Example.—Suppose the slag-forming materials of the charge have been found to be:

CaO = 2 per cent.

The quantity of base required to take up this excess of silica is found as follows:

MgO = 1 per cent.
Al_2O_3 = 6 per cent.
Silica = 18 per cent.

For 2 per cent. CaO draw a line from 2 on the abscissa parallel to C D, and it will show 1·09 per cent. of silica as requisite. Similarly for MgO and Al_2O_3 draw lines from 1 and from 6 on the abscissa respectively, parallel to C E and to A B. These will give 75 per cent. and 5·14 per cent. as the amount of silica required. That is, 1·09 + 0·75 + 5·14 per cent. = say 7 per cent. of silica is sufficient to combine most fusibly with the bases present. To take up the 11 per cent. of silica in excess, draw another line from 11 per cent. on the ordinate parallel to C D, and this will show that 20·17 per cent. CaO requires to be added to the charge to produce the best flowing slag—H. B. F.

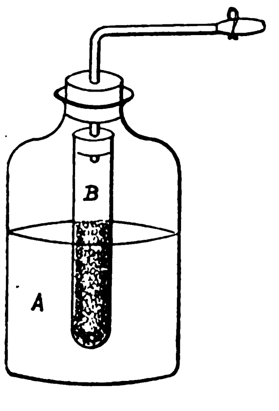


[64697.]—**Raising Air to High Temperatures (U.Q.)**—The hot blast iron furnace is fed with air at about the melting point of lead, by forcing air through a series of pipes which are maintained at a high temperature, either by means of a separate furnace, or by a portion of the waste heat of the furnace itself. A Mr. E. Cowper has improved upon this plan by burning the gases which escape from the furnace in a chamber of brickwork filled with firebricks, so arranged as to allow the heated gases to circulate freely around them. Two such chambers are prepared; as soon as the bricks in one of these chambers are red hot, the current of gas from the furnace is cut off, and directed into the other chamber in order to heat it. In the mean time a current of cold air is forced through the heated chamber, and a hot blast of from 1,200° to 1,300° is thus obtained. Each chamber is worked alternately, the one becoming heated whilst the other is employed in heating the blast. Could you not contrive some arrangement of this kind to suit your purpose? Say, an earthenware pipe fixed across a furnace and packed with scraps of firebrick.—PRINCIPIA.

[64718.]—**Gas-Engine.** — Bore a small hole through slide and cylinder end so that the igniting tube is in connection with the cylinder when the piston is drawing in the charge of gas and air, that the tube may empty itself of the compressed charge before the next time of igniting.—CAASI.

[64722.] — **Iron Casting.** — "Constant Subscriber" will find it easiest to cast rings for mortar mills open sand; but without a crane it will be very awkward, or some other appliance the size they are. It will require 8cwt. to cast one. You should have a small crane ladle, and cast one at once. Make them as near cupola as possible for hot iron; it makes best tops. Have a piece of flat iron, turned at the end, to rake any dirt that rises off top; but if you use 1 riddleful of strong sand to 2 of black, and no coal-dust in, to face with, you will be able to get good castings; but you must be careful and not ram too hard. It only requires to be hard half-way up, and then ease a little all the way; after that a stramp is almost sufficient. By making them open sand, you will be able to make four in one day where you would just get two by covering. You have the extra hard ramming and top box; but if you can cast them without a crane, how are you going to take them out of sand? You will have to fix blocks up from roof, or use other methods.—CONSTANT READER.

[64704.]—**Sulphuretted Hydrogen.**— Kipp's apparatus is the best you can employ, if for work at home; but in out-of-the-way places I have found the following arrangement, based on the same principle, quite effective: A, a wide-mouthed bottle or pickle-jar half-filled with dilute sulphuric or hydrochloric acid; B, a test-tube perforated beneath by two or three tiny holes, and fitted with a cork and bent tube, which latter passes through the cork of the jar, and is closed by a short piece of indiarubber tube held by a pinch clamp. The mode of operating is self-evident; but the gas should be washed before applying it.—H. B. F.



[64745.]—**Separation of Tin.**—I have to thank "Metallurgist" for his information; but I would prefer a cheaper process, so as to work on a large scale. If he or any reader cannot give me one, I should like to know the amount of nitric acid (coml.) required for 1lb. of alloy, the composition being—

Tin and antimony	82
Lead	14
Copper	4
	100

—T. J. N.

[64752.]—**Storage Tanks for Coal-Tar.**—The best tanks would be made of iron, I think; but something must depend on the foundations which the querist has to put in. The shape is immaterial.
so long as the tanks hold the tar, and it ca
readily got out when wanted. There is no pu
cation on the manufacture of roofing felt, for
simple reason that the sale would be so small
it would not pay expenses. Mr. Smith should
a definite query, and he would doubtless get
answer.—E. G.

[64755.] — **Expansion on Freezing.**—W
expands to become ice; bismuth expands whe
changes from the fluid to the solid state. I
contracts on cooling, though it expands at
moment of solidification. The properties of m
rials of the kind are given in the textbooks.—S

[64756.]—**Cold Air.**—"W." can obtain
information he requires by looking up b
volumes; but he must remember that the prod
tion of compressed air in any quantity on boa
fishing vessel means the fitting up of rather m
machinery than there is room for in the general
of fishing vessels. Any of the engineering firms
make air-compressing machinery would give
estimate.—J. T.

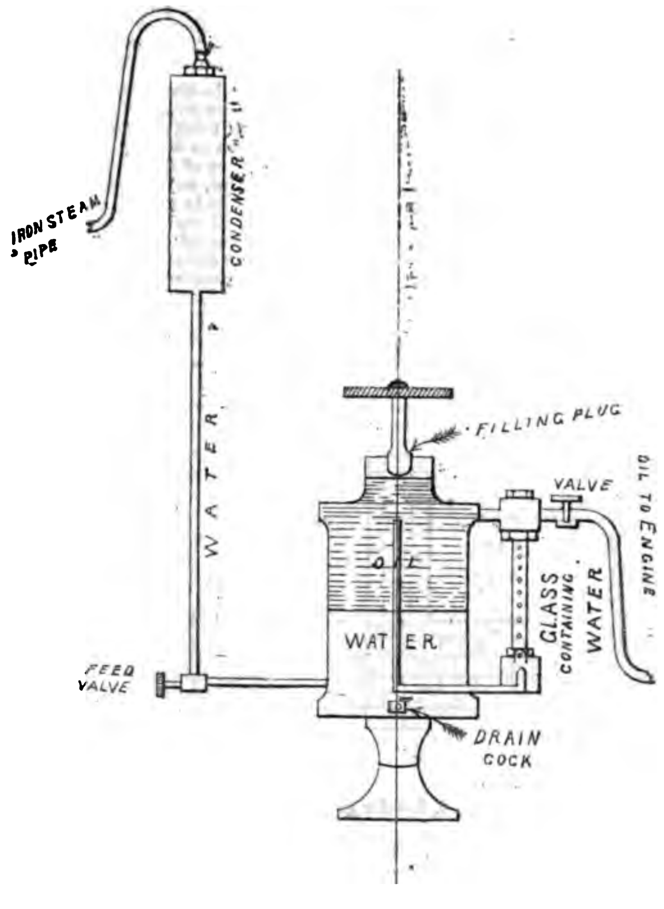
[64821.]—**Measuring Buildings.**—I took
figures 50, 40, 70 from the solution on page
instead of 60, 40, 70, as in the question. I co
not make the figures given satisfy the equat
given. I am sorry that my mistake has seemed
justify part of Captain Battersby's letter last we
but the mistake was not in calculation. The wr
figures, even with the graphical method, wo
have given a wrong result.—J. GEO. RICHAR
B.A., B.SC.

[64840.]—**Science and Art Exam.**—The
lowing is a good test for morphia in the prese
of salicylic acid:—Gently warm the salt with co
H_2SO_4 free from HNO_3—a mixture of salic
acid and morphia forms a clear liquid—then ad
single drop of conc. HNO_3; if morphia is pres
the liquid turns a deep red colour, which appe
almost black when much morphia is present;
the red colour can be seen on diluting the liquid
M. ISADER, Lewes.

[64897.]—**Indicator Diagram.**—A. J. D
does not give the speed of his engine, though th
seems to be little doubt that it is high enough
make the Richards indicator unsuitable. The
dulations in the diagram, which, I presume, c
stitute to him its peculiarity, result from the ine
of the indicator, and he should try some ot
make specially adapted to high-speed work. Le
of course, can have no effect on the undulation
the card, though it might be beneficial in anot
respect.—ALBERT SPIES, Jersey City, N.J., U.S

[64972.]—**Ventilating Church.**—"M."
speaks of height of ceiling, but does not tell us
thing needful to know in order to estimate veloc
of efflux and influx—viz., the height from lo
end of inlet tubes where they meet the outer ai
the upper end of the outlet shaft, where it pa
through roof and meets the outer air. Call
height = *h*ft., then "M." can calculate the th
retical veloc. himself as follows:—Let *n* =
number of degrees difference between internal
external temperature; then, $\frac{\sqrt{n\ 002h}}{4}\,16 =$ ve
feet per sec. If there were no friction the e
vents need be of no larger area than inlet ve
But there is friction, and the exit vents should
be less, generally speaking, than 33 per cent. m
area than inlet vents. "M." must not fall into
error of supposing that by increasing his areas
can increase the veloc. due to *h*. That is
possible; but, of course, by a slow current a
large areas the same volume of fresh air can be
as by a quick current and small areas. The su
ject of ventilation is a tremendous one, and m
imperfectly understood by even the wisest. T
correspondent who advised "M." to "provi
plenty of inlets and leave the air to get out as b
it could," must have been ignorant of the sim
fact that you cannot get fresh air in unless y
make a free and ample escape for the foul a
You might as well try to force fresh water do
the spout of a kettle already full of water a
with lid screwed down. There is no cowl inven
can give so high a velocity of current as that d
to a pipe quite open and unobstructed at the t
This was proved at Kew a few years ago, when t
plain open pipe was tried against all the ventilat
in the market, and beat every one of them. "M
may not be aware of the penetrativeness of air.
is stated upon very high authority that 4c.ft.
air pass per hour through 1 square yard of bri
exterior wall of a house. It seems hard to belie
but it is approximately true, no doubt.—FRA
CAWS, Sunderland.

[64929.]—**Sight-Feed Lubricator.**—I inclo
sketch of the commonest lubricator. It is identical
on the same principle as the old-fashioned imp
meator. Steam is led into a small condens
which fills the pipe leading into the lubricat
(which has previously been filled with oil). Th
water, with the pressure behind it, overflows th
oil down an internal pipe and up through a gla
thence to the engine. The oil is forced into th



t against its own pressure. The con- t be placed above the lubricator, as it is of that column of water that forces the e pipe against the pressuro. Use special .—J. G. DUTTON.

— **Chemical.** — May I point out to that "Sm" is right when he says that hlorate may be fused? If the heat is egulated, the chlorate may be fused actically undergoing any alteration. I t fused for five minutes (by the clock), end of this time, when dissolved in es only a faint cloud with a solution of te, thus showing *almost* entire absence Supposing the salt to be fused in a ssel, or with organic matter (dust, chips ooke, &c.), this would account for it ere is no need whatever that "Sm" Roscoe's primer.—PRINCIPIA.

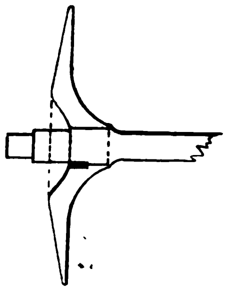
–**Soldering Joints in No. 11 Gal- Wire.**—Procure a piece of 1in. iron gas or 8in. long, with one end stopped up; methylated spirit, and push a piece of the open end. With this soldering strip of solder, a small vessel of zinc piece of glass rod or stick, and a little u will be able to solder perfectly. Wash after soldering with a wet rag.— .

–**Rust in Kitchen Boiler.**—"Rosi- ys "softening the water in many cases the evil." This is quite correct if ith lime or lime water. There are other hich are used for softening water, but recipitate iron, while lime will; but requires daily attention and a small trouble, while filtration goes on with- tention, except, say, to clean the filter ar. A properly-constructed filter will , and retain it as brown ferric hydrate r.—CHAS. E. GITTINS.

–**Hydraulic Leather.**—"Proprietor" e hydraulic ram leathers ready made to tinual pressure of 50cwt. to the square Thomas Smith, 20, Cowsill-street, C.-on- ester.—NO SIG.

–**Grinding Gauge-Cocks.**—Grind in ry way with emery and oil. When efully clean the emery off, then oil and r.—J. M. WELLWOOD.

–**Bicycle-making.**—1. The ordinary, ly the best, way to fit flanges to spindles ving turned down spindle to size re- a shoulder for flange to drive against, ut flanges to fit tight on spindle; then ndle and flange, and while hot drive on h should have end of hole next shoulder on spindle slightly bevelled, or countersunk. When cold, drill a hole about $\frac{3}{16}$ between flange and spindle, into which drive a piece of steel wire. The best place to drill is from the crank end of spindle, as sketch. Add a little more solder. 2. The handles should be bored out to the taper of the handle-bar; but should not go quite up to proper place. Warm the handle-bar and drive on your handles; if you like, put a little tire-cement on first—countersink end of handle-bar and rivet over; finish off neatly.—A. M. M. A.

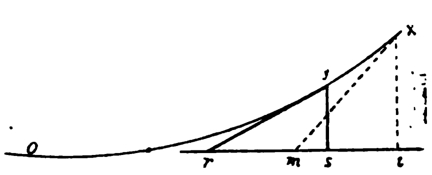


[65011.]—**Lathe Fitting.**—Fit the bridge in same as for screws, and if you do not wish to use the latter, why, bore holes for bolts, counter-sinking them to let the heads lie level with the top of shears, the bolts to tighten with nuts under the shears. Yes; you had better put in steady pins; the bridge can then be put into its place more easily, and they will prevent it from shifting if not properly tightened up by the bolts. To count the threads, lay the rule on the screw and count the number of threads within the inch. Do not count any cut. Certainly, in $1\frac{1}{8}$in. there will be three threads.—J. M. WELLWOOD.

[65013.] — **Marine Boiler.**—I should advise "Salt Water" to fit a blast to his funnel and use his condenser. If he is not a practical man, he must be careful or he may burn his boiler, as he evaporates all the pure water up the funnel, leaving the impurities in the boiler in the form of magnesia and lime, which can only be removed by chisels or chipping hammers.—J. G. DUTTON.

[65013.]—**Marine Boiler.**—Stop using the sea-water until you have first opened the boiler, to see how much scale is deposited; if it is thicker than an eighth, it must be removed. Then get the boiler fitted with a scum-pipe and cock; purchase a salinometer, and use both, to prevent over-incrustation.—W. M. J., Dublin.

[65014.]—**Wire Ropeways.**—Drop a vertical line *y s* from that point of supporting rope at which the travelling load is hanging at any moment. Draw horizontal line *r s* level with vertex *o*. From *y* draw the line *y r* tangential to rope; then *y s* is the measure of actual weight of rope between point *y* and vertex *o*, plus weight of travelling load—that is to say, *y s* is the measure of total load at *y*, and *s r* is the measure of stress on rope at *o*, and *y r* is measure of stress on rope at *y*—i.e., at the particular moment when travelling load is passing over the point *y*; but the greatest stress on rope, at that same moment, occurs at highest point of support *x*. Now instead of *y s*, let dotted line *x t* be the measure of travelling load plus weight of rope from *x* to *o*; then the tangential line *x m* is the measure of stress at *x*, while the horizontal line *m t* is the measure of stress on rope at *o*. But perhaps I have not caught what "A. J. S." means by the term "angularly suspended."—FRANK CAWS, Sunderland.



[65015.]—**Concrete Floors.**—The "domed" centring can be easily formed by ordinary but very narrow floor boarding, without any tapering. The cost is only slightly in excess of flat centring. The object of "doming" is to reduce the leverage of the floor's weight. The same mass of concrete in a floor of uniform thickness would not be so strong, though very strong slabs quite flat underneath are made, but only to comparatively moderate sizes. —FRANK CAWS, Sunderland.

[65016.]—**Gramme Dynamo.** — Allowing for friction, a 1H.P. will be ample for 120c.p. If you use a steam-engine, have a vertical boiler, 4ft. 6in. high, 1ft. 8in. diam.; firebox, 3ft. high, 1ft. $4\frac{3}{4}$in. diam., with two cross tubes, 5in. diam., uptake, 6in.; shell, $\frac{1}{4}$-plate, firebox, tubes, and uptake $\frac{5}{16}$ Low-moor.—ALBAN.

[65018.] — **Calcium and Ammonium.** — *Estimation of Calcium.*—Heat the solution to the boiling point, and gradually add ammonium oxalate in moderate excess; keep the solution boiling for about five minutes, and let the precipitate settle, which will take about a quarter of an hour; pour the clear liquid on to a filter without disturbing the precipitate, wash the precipitate several times by decantation with hot water, and finally bring the precipitate on the filter by rinsing with hot water, but do not add a fresh portion of liquid until former portion has completely passed through the filter, or some of the precipitate will be washed through. Wash the precipitate on the filter thoroughly, and dry it on the filter in the funnel. When dry transfer the precipitate to a platinum crucible, leaving as little as possible on the filter; burn the filter in the usual way, and let the ash drop into the lid; place the lid inverted on the top of the crucible, and gently heat the crucible, taking care that the bottom never gets above a dull red heat. A good plan is to turn down the burner until the flame is about 1in. high, then place under crucible, and surround the flame by a little cone to protect it from draughts. Keep the crucible at this temperature for about 15 minutes; put into desiccator and weigh as carbonate. The contents of the crucible should be perfectly white, or with a slight tinge of grey at the edges. If you wish to control the result you may heat the crucible to white heat, when the carbonate will be converted into oxide. The crucible is let cool in desiccator and weighed; then again ignited and weighed. The two weights ought to agree: if they do not, you must continue the ignition until the weight is constant. *Estimation of Ammonium.*—This is estimated in exactly the same way as potassium is, by the double chloride of ammonium and platinum. You can control your results by igniting the precipitate and calculating the ammonia from the weight of the residuary platinum. I presume from your question that you know how to estimate potassium; if you do not know the method of estimating potassium by precipitation with platinic chloride, I shall be glad to tell you.—M. ISADER, Lewes.

[65018.]—**Calcium and Ammonium.**—If the querist wishes to estimate the calcium in simple salts, proceed thus:—To the solution in water add a little ammonic chloride and a slight excess of ammonia—the solution must remain clear; now add a slight excess of oxalate of ammonia, heat to about 70° C., allow to stand a few hours and filter, taking care to transfer as little as possible of the precipitate to the filter. Wash the precipitate in the beaker with ammonia water about three times and then transfer the precipitate to the filter finally washing on the filter till the excess oxalate and chloride of ammonia, &c., are removed; all these several washings to be done with ammonia water. We have now the whole of the calcium as oxalate. We may either dry it, incinerate it, and ignite it till constant, and weigh as lime (CaO); or treat it volumetrically. For this purpose make a small hole in the apex of the filter, and wash the precipitate through into a flask, and finally treat the filter with small quantities of dilute HCl, allowing these washings to enter the flask, being careful that no traces of the filter find their way into the flask. Add more HCl, and heat till the precipitate is dissolved; add a little H_2SO_4, and heat to 70° C. Titrate with decinormal potassic permangate till the faint pink tinge no longer disappears. Each cc. of standard solution equals ·0028 CaO ·0050 $CaCO_3$. I have used this method in scores of analyses of all kinds, and never found reason to suspect its accuracy. Of course, the permanganate must be correct, and this is kept so in a laboratory where analyses are always going on. To estimate ammonium place about 1grm. of the substance in an 8oz. flask, add excess of caustic magnesia, soda, or potash, and distil with excess of normal sulphuric acid, and find the excess of acid after distillation by means of normal caustic soda. Each cc. of normal H_2SO_4 equals 0·017grm. NH_3. You have no gases to test for, nothing but bases and acids. There are, speaking generally, about three metals, sometimes four, with a corresponding number of acids, or perhaps less; but in cases where metals such as Ni and Co are present only two. If querist will forward me his card I will send him any further information he may require. —J. A. WILSON, Crossfields, Tottington, Lancashire.

[65019.]—**Gas-Engine.**—If "W. O. S." will describe the arrangement of his engine, I could give him the information he seeks. If you get the correct proportions of gas and air into your cylinder, and ignite it, the engine will work; but therein lies the difficulty. You do not give any details. Will it be a compression or non-compression engine? You might increase the length of stroke with advantage, especially if you intend to make it on the non-compression principle. Is the larger engine you propose similar in arrangement? If you will give a description, I might be able to help you with a governor.—ENGINEER, St. Mary Church, Torquay.

[65027.]—**Perspective.**—Only "E. H." rightly answers this querist, who confounded two very different things, painting perspectively on a plane or on a spherical surface. The latter, which would be called a panorama, renders all straight lines by portions of great circles of the same sphere, and is like the picture formed in our eye, on the spherical retina. But painting on a plane must render, as "E. H." says, every straight line by a straight line. There is no compromise in this, nor —however large the picture, whether including twice, or thrice, or four times what the eye can view without turning—is there need for anything not rigorously and geometrically true. Moreover, pictures containing architecture or any straight line are nearly always assumed to be on a vertical plane, in which case all vertical lines have to be parallel. If a camera be directed to a building, with its plate vertical, all the upright lines will be upright on the plate. If they converge upwards on the plate, it has been tilted back; and if they converge downwards, it has been tilted forwards. There is a very remarkable stereoscope slide of Salisbury spire, taken with a tilted camera. Viewed without stereoscope it is quite unintelligible; but standing with your back to a window, and directing the instrument up towards the ceiling, you have the building overhanging you in faultless perspective.—E. L. G.

[65029.]—**Brightening Brass, &c.**—Clean the brasswork with a solution of oxalic acid and Bathbrick. Afterwards varnish over with brass lacquer. —T. CLARKE.

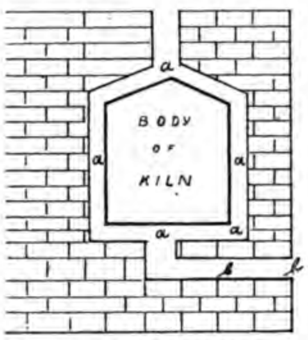
[65029.]—**Brightening Brass.**—Dissolve oxalic acid in water (saturated solution), apply this to the dirty brass or copper with a small piece of waste, and then rub with a dry cloth, and you will have a brilliant polish immediately. For your purpose, there is nothing better; but it will tarnish again in a few days. I have used it largely for out of doors unlacquered brasswork. —ALBAN.

[65032.]—**Tandem or Sociable Tricycle.**—If "Intending Cyclist" can see any of the tandems of the Centaur Cycle Co., I should advise him to get one, or, if he prefers a sociable, let him obtain one of the same makers. The tandems are very compactly built, moderate in price, their weight is none too heavy to be safe, and what is almost as good, have plenty of room between the riders, so will carry a large amount of luggage, or even a child. The driving wheels should be of a good height, not less than 44in. As regards gearing, the machine never ought to be geared higher than 53in. at the utmost for people who want to ride easily and at an ordinary rate of speed.—S S.

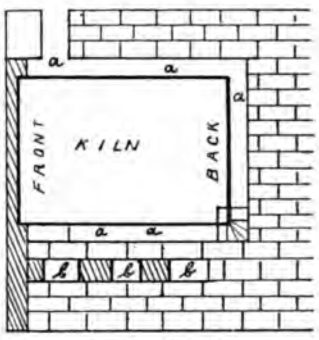
[65038.]—**Varnish for Motors and Dynamos.** —The best varnish for this purpose is Beckett's prepared varnish paint. If you will advertise address, I will send you a sample.—T. CLARKE.

[65043.]—**Enamelling.**—The most easily-fused enamel is made as follows:—In a crucible, or even an iron ladle, melt some borax (do not put too much in at a time, or it will boil over); when melted to glass, pour it into a basin containing water. To 5lb., or parts, of this glass add one part of oxide of tin, and grind to powder; for yellow, to six parts enamel add one part crude antimony or oxide of silver; for grey, add one chromate of iron, one black oxide of manganese, to from twenty-five or thirty enamel. You can vary the colours to suit your own taste in tint.—POTTER.

[65044.]—**Muffle Furnace.**—Below is a rough sketch of a small kiln or muffle, to be made of fireclay, about 1in. thick, and burned as ordinary fireclay goods. *a*, flue to chimney; *b*, flue for gas-pipes.—POTTER.



FRONT-VIEW



SIDE VIEW

[65048.]—**Jensen's Electric Bell.**—There is no special winding for these bells. Your wire is too large; it should be 30 double silk covered, and wound on magnet till it is ⅞ diameter. I should have made core ½in. longer. Of course, you have the armature in actual magnetic contact with the core.—ALBAN.

[65051.]—**Varnish.**—I have found the following very successful:—Add to the oil varnish rosewood stain, that is soluble only in spirit, in proportion about 1½oz. to the gallon; then add a few drops of methylated spirit, sufficient only to dissolve the stain; stir up well, and let it stand until next day.—T. CLARKE.

[65052.]—**Electric Bell.**—Below is a sketch of some of the different parts of the bell in detail, and trust they will furnish "J. D." with the information he requires. Fig. 1 is a plan of the iron frame F, and Fig. 2 is an elevation of the same from the armature end. Fig. 3 is a section of the baseboard (made of teak), with the iron frame F in its place. The contact screw-post is shown fixed in its position, and likewise the supporting arm (N). Fig. 4 is a side view of the armature A, with spring S attached, while Fig. 5 shows the rod R and hammer H. The end of the rod R passes through the hole in the armature, and is loosely pivoted by the screw T. Fig. 7 shows two views of the support X. Fig. 6 is a section of the gong, showing method of fixing it to the frame. The screw Y passes through the gong and tube W, and screws into the arm of the iron frame F. The lettering is the same as in the previous sketches, and the drawings are (with the exception of Fig. 6) half size for a 3in. bell.—F. C. ALLSOP.

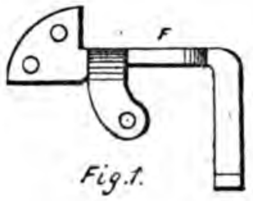


Fig. 1.

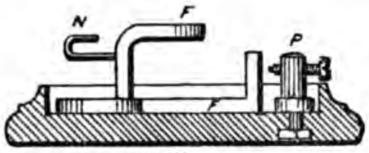


Fig. 3.

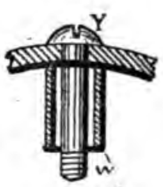


Fig. 6.

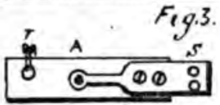


Fig. 4.

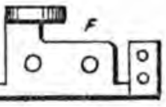


Fig. 2.

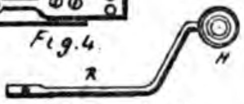


Fig. 5.

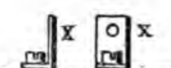


Fig. 7.

[65054.]—**Shafting.**—I believe the best application is a good coat of tallow and white-lead.— J. M. WELLWOOD.

[65054.]—**Shafting.**—Perhaps the following will suit your purpose:—Mix equal quantities of rosin and tallow or wheel grease; apply the mixture hot. This may be cleaned off at any time with turpentine.—T. CLARKE.

[65054.]—**Shafting.**—Get a piece of soft wood —willow or poplar—about 18in. long, 4in. broad, and 2in. thick; hollow out a space about the middle, an inch deep, corresponding with the circumference of shaft; lay a piece of emery cloth in this hollow, well saturated with oil; press on the shaft while in motion, going over the whole length to clean off rust and dirt; dry with clean waste. Get a piece of sheet zinc, bend it in the hollow, and fix at sides with card tacks; go over the shaft while in motion, pressing hard, as if trying to burnish. In this way the shaft takes on a slight coating of zinc, and will keep clean for months in any atmosphere.—EARCAM.

[65058.]—**Blowpipe Solder.**—Tin, 2 parts; lead, one part. Run it in small strips, say, ¼in., $\frac{1}{16}$in. thick, any length. You will then find it work easily.—ALBAN.

[65057]—**Chatterton Compound.**—Stockholm tar, 1 part; rosin, 1 part; guttapercha, 3 parts. Melted and well mixed together; but should not be permitted to really boil, and should be melted in a double pan, like a glue-pot.— ALBAN.

[65060.]—**Pewterer's Repairs.**—Try solder of bismuth, 8 parts; lead, 3 parts; tin, 5 parts. Or you might make a better job by burning in a piece of pewter (100 parts tin, 17 parts antimony), it would then be all one colour when done, and if neatly cleaned off with a file, the place would be perfectly invisible. You can burn it either with a large soldering iron nearly red-hot, or a blowpipe.— ALBAN.

[65071.]—**Bichromate Cell.**—If you take the nut carbon out you will get a better result. It makes the cell have a very large internal resistance.—S. N. C.

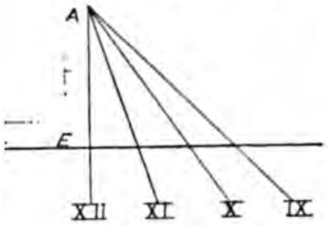
[65063.]—**Vertical Sundials.**—(1) The only difference in the construction of a horizontal and a vertical south-dial, is that in the latter the angle B A R (Fig. 3, p. 27, "E.M.," March 9) is made equal to the complement of the latitude, instead of the latitude; and the angle subtended by the style must also be equal to the complement of the latitude. (2) As to making a dial facing "nearly South," that is a very difficult matter, as the declination of the dial, either east or west, must first be accurately found, and the hour angles can only be calculated by the use of logarithms, there being no really practical method of determining these geometrically. I have seen some, certainly, but could never work them out. Perhaps our friend "F.R.A.S." can help us. The querist does not say whether it is a south, or an east or west vertical dial he wishes to construct. I presume, however, the first.—ILIAD.

—**Vertical Sundials.**—For horizonta^l

$E \times \text{sine lat.} \times \text{tang. } 15^\circ = E_1.$
$\times\ ,,\ 30^\circ = E_2.$
$\times\ ,,\ 45^\circ = E_3.$

n for each hour up to E_6 or VI. For
als, facing south:

$E \times \text{cos. lat.} \times \text{tang. } 15^\circ = E_1.$
$\times\ ,,\ 30^\circ = E_2.$
$\times\ ,,\ 45^\circ = E_3.$



this dial the sun passes behind the plane
l before VI., it is not necessary to go
[. hours on each side of noon.—W. S.

—**Vertical Sundials.**—In reply to
aves, a vertical sundial exactly facing
may be constructed in the same way as a
dial, the co-latitude being used, how-
ad of the latitude. A graphical method
on page 133, Vol. XLV., which will
well for a direct south dial. But if the
rate method of calculation be preferred,
la for the dial hour angles is as follows:
he co-latitude, A the equinoctial hour
' = 1 hour), *a* the corresponding hour
he face of the dial; then, tan. a = sin. γ
, or cot. a = cosec. γ × cot. A. The
the dial need not be taken out in degrees,
ogarithmic tangents may be converted
al numbers, and the distances laid off on
wn on the dial at right angles with the
distance of such line from the point
style intersects the face of the dial being,
equal to the unit of the scale. The first
formulæ should be used for angles up to
and the second for the remaining angles,
ig of lines of unwieldy length being thus
Of course, the cotangents must be plotted
parallel with the style. In the case of a
l only one side need be calculated, the
being simply a reverse. Also, as the
t shine on a vertical dial for more than
urs, the lines need not be carried beyond
morning or evening. But direct vertical
seldom seen except on church towers,
cause most buildings are placed with
to a road rather than "square with
ss." It is highly probable, therefore,
ne desiring to place a vertical dial
l that the wall was not built with
precision of the Great Pyramid, and that
therefore, have to provide a declining
is termed. This is rather more difficult,
ps an example of a dial actually con-
ill be the best way of explaining the
We will suppose, then, that we have the
of a house which looks nearly south, but
does not do so exactly. The first thing
tain the amount of this deviation. There
l methods available for this; but the
is the best, and has the advantage of
ing any instrumental means. We con-
wall itself a kind of transit instrument,
the sun as it emerges from or disappears
in the morning or evening, noting care-
time. In the example, the preceding
e sun was sighted at 8h. 3m. 35s. G.M.T.,
following limb at 8h. 6m. 25s. The
refore, passed at 8h. 5m. 0s. a.m., and
the longitude of the place in time,
quation of time for the date (Aug. 3)
the local apparent time of transit
2s., which, deducted from 12 hours,
hour angle of 3h. 58m. 58s., or in arc
'. Knowing this and the declination of
the moment, together with the latitude
, we find by the usual process (see p. 229,
I.) that the azimuth of the sun was
ry nearly, at the moment when the centre
wall. It is clear, therefore, that our
sted towards the west by 13° 4', and this
rtained, we may proceed by considering
e position of a plane what it may, there
me spot on the earth's surface where a
llel to it would be horizontal. If we
latitude and longitude of that place,
ruct a horizontal dial for it, we
e the vertical dial we want, if
the nomenclature of the hours
our own longitude. We can ob-
latitude of the place in question
s. lat. × cos. dec. of wall = sin. of lati-
ired. Putting in the values in our
e get 37° 4' 50". This is the height of the style of our dial, which can be made without any further calculation. Also, we can say sin. lat. × cot. dec. of wall = cot. of difference of longitude. This comes out 16° 28', or 1h. 5m. 52s. in time. We can now get the position of the style by remembering that the line showing noon must be a vertical line (the intersection of the plane of the meridian with any other vertical plane giving of necessity a vertical line). We can, therefore, mark this on the centre of the dial to begin with, and set out the others afterwards. The dial looking westerly, the style will fall among the afternoon hours, or precisely at 1h. 5m. 52s. C.M. A few of the hours are here given in a tabular form, showing how the work can be conveniently arranged.

Hours.	Equinoctial Hour Angles in Arc.	Logarithms.	Natural Tangents of Dial Hour Angles to Radius1000.
11.45	20.13	·78028 ·56615 ·34643	222
12.0	16.28	·78028 ·47067 ·25095	178·2
12.15	12.43	·78028 ·35346 ·13374	136·0
12.30	8.58	·78028 ·19807 ·97835	95·1
12·45	5.13	·78028 ·96047 ·74075	55·0
1.0	1.28	·78028 ·40830 ·18858	15·4
1·15	2.17	·78028 ·60067 ·38095	24·0

In the first column are the hours and quarters, in the second the angles corresponding. These are easily obtained when one is known by adding or subtracting 3° 45' for each quarter of an hour. In the third column are the logarithms, the constant log. being the sine of the style's altitude; the next is the tan. of the angle in the second column; the last (the sum of the other two) gives the tan. of the dial hour angle. In the fourth column are the natural tangents to radius 1,000, which can be laid off on the dial. The constant log. need not be repeated, as it can be written on a separate piece of paper and moved down; it is not necessary to trouble about seconds in the angles, and five-figure logarithms are quite accurate enough. The task, therefore, is not quite so operose as it looks; in fact, it takes longer to describe than to do. One troublesome peculiarity of this dial cannot be got over, however—that is, one side will not reverse for the other, and we must thus calculate all round for the twelve hours. An enthusiastic dialist, however, will, of course, not mind this in the least; in fact, will revel in his forty-eight little computations.—W. J. R.

[65066.]—**Une Idee.**—Permettez moi de corriger un erreur qui s'est introduit dans ma lettre de la semaine passée. J'avais ecrit "Sous l'action d'une etincelle," et l'imprimeur m'a fait dire, "Sans l'action."—S. BOTTONE.

[65066.]—**Une Idee.**—This is totally impracticable. The weight of batteries necessary to evolve a requisite quantity of gas in a reasonable time would be enormous; while the explosion would tend more to lift the canoe vertically rather than to propel it. Supposing these difficulties overcome, progress would necessarily be by fits and starts—very undesirable. — W. PERREN-MAYCOCK.

[65073.] — **Microscopical.**—On page 104 of "Davies' Manual" (edited by Matthews), will be found directions for mounting both infusoria and entomostraca. It is true that there is not much said there about the former.—YOUNG ANALYST.

[65073.]—**Microscopical.**—Entomostraca, such as Daphnia and Cyclops, I mount by dehydration in alcohol, clearing by prolonged soaking in turpentine or oil of cloves, and transfer in the ordinary way to Canada balsam. I put generally three or four on a slide, and then they support the cover glass evenly without necessitating pressure. I generally stain them before dehydration with logwood or carmine. Astracoda are usually mounted dry in a cell, as the carapace is the distinguishing feature. I have never tried the other infusoria.—DOCTOR MED.

[65074.]—**Induction Coil.**— You have ample battery power. The reasons for which you are unable to get a spark are probably among the following:—(1) The secondary wire is not continuous, but broken at some point. Test this, by connecting up one end of secondary with a galvanometer, and then trying to send a current through the other end of secondary and free end of galvanometer from a battery. (2) The secondary-wire insulation is bad. (3) The primary wire is wrongly connected. (4) There is no condenser. — S. BOTTONE.

[65074.]—**Direct Transformer.**—A coil constructed as shown in "Letters" column last week would give excellent results with minimum battery power. I should use finer than No. 26 wire for secondary—say, 36—and 14 wire for primary. Fill both bobbins equally to make the transformer symmetrical.—W. PERREN-MAYCOCK.

[65075.]—**Flywheel of Lathe.**—By all means have a grooved wheel for this or any size foot lathe; but have belt for power. I have had both gut and strap for foot lathes, and greatly prefer the gut.—T. C., Bristol.

[65075.]—**Flywheel of Lathe**—A plain 1in. band or strap for lathe-driving presents decided advantages over the gut cord. 1. It grips better, consequently it gives more power, while its tension upon wheel and pulley is easily regulated. 2. It can be made longer than necessary, so that if the head-stock at any time requires wedging up temporarily, in order to admit of a greater diameter being turned with the face-plate, it merely requires to be unlaced for two or three holes. This cannot be done with the cord. Note.—For laces nothing is better than dried eel-skins soaked in olive oil. 3. Less trouble in working. Should the lace break, nothing is more simple than to substitute a fresh one; whereas the hooks and eyes of the cord are difficult to attach securely, are constantly liable to come off, and when they do so are very apt to be lost. Indeed, an engineer here was showing me in his workshop lately a large six-speed grooved flywheel which he said that he had removed from one of his lathes for this latter reason alone.—G.

[65077.]—**Bunsen Burner for Oil-Gas.**—Reduce the jet hole from which the gas issues to about one-half the diameter required for ordinary coal-gas.—THOS. FLETCHER.

[65078.]—**Compressing Air.**—The cylindrical egg-ended vessel of a quart capacity may be made of 3in. diameter and 11in. long over all. And to have a factor of safety of 6, should be made of $\frac{1}{15}$th thickness. If the brazing of the last seam can be satistactorily done, $\frac{1}{16}$th might do. Would one of the air-gun pumps not suit?—W. M. J., Dublin.

[65078.]—**Air-Vessel.**—As the actual proportion is not given, we may take the maximum diameter as 5in., in which case it would require to be $\frac{1}{8}$in. thick, and joints well brazed. You will require a well-made force-pump, such, for example, as that used for charging air-guns.—T. C., Bristol.

[65079.]—**Preparing Skeletons.**—The best method of whitening bones is to bleach them in the open air. In the Vienna Anatomical Institute they are put out on the roofs, turned occasionally, and left until they are ready for mounting. Of course, all the flesh, &c., is carefully dissected off previously with the scalpel, and boil only for a few hours. Do not bury your skulls, that is a most ridiculous and lazy way of stripping the flesh.—B.Sc., Plymouth.

[65080.]—**Shed Roof.**—Such a roof is not suited for a detached wall unless much thicker than stated. You could in such a case reckon only on the weight in the piers; the remainder of the wall would have enough to contend with in a breeze. The weight on each bay, at $\frac{1}{2}$cwt. ft. super., would be $9 \times 6 \times \frac{1}{2} = 27$cwt., with a leverage of $3 \div \frac{3}{4} = 4$, so that weight of brickwork required simply to balance it would be $27 \times 4 = 108$cwt., which would require to be three times as much for safety. Brickwork, say, 1cwt. foot cube. If the brackets were brought down and foot extended to 3ft., the middle portion would act as a beam, and obey the laws of such.—T. C., Bristol.

[65080.]—**Shed Roof.**—If "J. R. G." would build a corbel stone right through the wall in Portland cement to support the foot of the bracket, I think he will not require to put any more on the wall, for taking 3ft., the half of the brackets overhang, by half its weight, would give the one side. To meet this, take the pier as weighing 15cwt., or from the bottom of the bracket to the top of the wall, 5ft. 6in. by 1ft. 6in. by 1ft. 6in. by $1\frac{1}{4}$ equal 15cwt., nearly. Taking half of this weight, acting through a leverage of 9in., half of the pier's thickness, gives a difference in favour of the wall of one and a half times. I should, however, recommend a back washer or "wall plate," the full length of the bracket, and to take both the upper and lower bolts.—W. M. J., Dublin.

[65082.]—**Angleberried Horses.**—Try acetic acid (glacial) applied freely every day.—Doctor Med.

[65083.]—**Injector.**—If the nozzles are fixed you had better let the makers fix suitable ones to work within the range of pressure you require. They require to be closer for a lower pressure.—T. C., Bristol.

[65084.]—**Spark Coil (Quasi).**—I beg to direct "E. A. B.'s" attention to last week's "Letters" column. He would get very good results from a transformer constructed on that principle; No. 14 wire for primary, 38 or 40 for secondary.—W. Perren-Maycock.

[65085.]—**Dynamo.**—To Mr. Bottone.—The amounts of wire are not so well adapted to a generator; besides, the machine has such a small armature that you would hardly get two or three 5-candle power lamps lighted with it even at best. A wire armature without cogs is about the worst form you can adopt for a small dynamo. See my books, "The Dynamo" and "Electrical Instruments," for further information on these points.—S. Bottone.

[65086.]—**Barlow Lens.**—The lens is utterly useless for the purpose. He might try a plano-concave or bi-concave lens of 6in. to 8in. virtual focus in the position he states; but he will undoubtedly disturb the chromatic correction of the object-glass, and I fear he will not be charmed with the resulting images of bright objects.—J. C. Linscott.

[65088.]—**Coffee-Maker.**—Put the coffee between the two strainers; pour on a breakfast-cup of boiling water; put on lid and screw down tight. Then pour some methylated spirit into the saucer at bottom of cylinder, light it, and set the spout over the breakfast-cup. In a few minutes the coffee will come pouring out boiling hot, and free from grounds.—Doctor Med.

[65088.]—**Coffee-Maker.**—Put in the first strainer, then the requisite amount of coffee; upon this place the second strainer, then fill with water, and screw on the lid. Stand the whole in a little metal saucer, with a small quantity of methylated spirit, and light. The pressure of steam obtained will drive the boiling water through the coffee and out at the pipe, into a cup placed in readiness.—Coffee.

[65088.]—**Coffee-Maker.**—"Shunt's" coffee maker seems like one I had many years ago, of French make. The ground coffee is placed between the two strainers, it is filled up with either hot or cold water, the top clamped on; it is then placed in a metal saucer, containing about a tablespoonful of spirits of wine; a light is applied to the spirit, and when the water boils, it is forced through the coffee up the tube into a cup placed to receive it and the coffee is made. Be careful to see the tube is clear before using, or an accident may occur.—H. Holloway.

[65088.]—**Coffee-Maker.**—I conclude this is the old siphon coffee-pot—my favourite pattern over 40 years ago in my Indian wanderings. After placing the charge of coffee over the fine strainer, pour hot water into the cylinder till nearly full; screw down the lid, and set the vessel in the metal saucer, two-thirds filled with methylated spirit, apply a match, the coffee will soon boil with a hissing noise, and rush out of the siphon mouth into any cup, or other open vessel, placed ready to receive it. I do not think any modern appliance can produce an equally fine preparation of the berry, provided you roast your own, and use enough of the powder in proportion to the water, as I always did.—Eos.

[65088.]—**Coffee-Maker.**—This is one of Lebrun's coffee machines, and a very excellent one it is. Put the strainer with the wire to it in the machine. Cover it with about two teaspoonfuls of good coffee. Place over the coffee the strainer with the tube-handle over the coffee. Fill the machine to the brim with cold water. Put on the cover, and screw it down very tightly by means of the clamp. Now place the machine in its metal tray, and put about two tablespoonfuls of methylated spirits in the tray. Set fire to the spirits, and place a cup under the spout of the bent tube. In about two minutes the water will boil, and the steam generated will force the water through the coffee up the pipe into the cup, and the result will be an excellent cup of coffee. See that your pipe is clear before you start work, or the machine will burst.—S. Bottone.

[65089.]—**Brake.**—To work this problem I require to know how much of the circumference is embraced by the strap and diameter of brake wheel. Also, does the wheel tend to lift the lever or to pull the fixed stud?—T. C., Bristol.

[65089.]—**Brake.**—Friction is quite irrespective of surface. The co-efficient for metals on wood is given in "Rankine" as ·25 to ·2.—W. M. J., Dublin.

[65090.]—**Launch Engine.**—You would probably not gain in power by adding an air-pump to your non-condensing engine, as in such small sizes the friction of the air-pump generally absorbs the benefit of the vacuum. The chief advantage you would gain would be the economy of coal; and, supposing you use the boat in salt water, doing away with trouble from salt. Unless, however, your boiler is full large for your present engine, you will probably have a difficulty in keeping steam without the blast. The second part of your question is hardly put in a form easy to answer. It would, I think, be sufficiently close for your purpose if you take it that with equal pressures of steam, a compound (condensing) engine will give you about the same power as a simple non-condensing double engine with cylinders the size of the high-pressure cylinder of the compound.—Banker.

[65093.]—**Engine.**—I suppose the grates of boiler are about 6ft. long. If so, the grate area $= 6 \times 2 \times 2{\cdot}75 = 33$sq.ft., and if we allow ½sq.ft. per area I.H.P., this will be, say, 66I.H.P. I do not understand your formula; but an old rule for nominal power is diameter × length ÷ 6 $= \frac{30 \times 8}{6} = 40$, which, with a good engine and good draught, may be doubled. You do not describe valves and cut-off of engine, so one cannot judge if it is economical. If you mean average pressure is 50lb. square inch, the power of engine

$$= \frac{150 \times 50 \times 9 \times 2 \times 16}{33{,}000} = 66\text{I.H.P. nearly, so}$$

that one boiler could do it with a good engine; but I presume two would be required for this engine, as the speed is low and cut-off (if any) probably late. Either formula would be accepted by examiners. As 1lb. of coal will evaporate, say, 9lb. of water from 212°, it would require $\frac{200}{9}$ = say 22lb. to keep the 200 boiling, as when it boils it evaporates. But as it requires 6⅔ times as much to evaporate as it does to raise it from 60° to 212°, it will require only 22 ÷ 6⅔ = say 3½lb. of coal to raise from 60° to 212°. Put the fire under the vessel containing the flesh.—T. C., Bristol.

[65094.]—**Electric Lighting.**—You would find the 20c.p. lamps, of about 48 ohms cold resistance, the more serviceable of the two. Each lamp will take about 1 ampère of current. Lamps can be worked with 0·6 of an ampère; but it is false economy. Every maker of lamps will tell you his own are best. "Chaqun à son gout." An engine of about 1½H.P. will do the work easily. Roughly, a 20c.p. lamp gives the same light as a paraffin burner, with 1in. of flat wick.—S. Bottone.

[65094.]—**Electric Lighting.**—You will find that 20c.p. incandescent lamps will be more suitable for domestic lighting, and we should recommend the Edison-Swan 55 volt type. Power required to run 20 such lamps, allowing only 80 per cent. efficiency for the dynamo (very low), will be 4·7H.P. You had better preserve your gas-fittings intact and ready for use in case of accident; but you may attach the incandescence lamp-holders to the branches of the gasaliers by means of small metal clips, providing shades, &c., in the usual way, but so arranged that the electric light need not interfere with the gas, and vice-versâ. You may neatly run the wires down outside the gasaliers, choosing well insulated flexible leads of the pattern and colour to match the gas-fittings, attaching the leads to the same by means of fine brass or bronze wire, using a strip of asbestos paper between said binding and wires to prevent damage to the insulation. A shaded incandescence lamp of 20c.p. will, if hung 8ft. from the floor, fairly illuminate an area inclosed by a circle 8ft. in diameter. If you attach any lamps to wall brackets, place a good reflector behind them, or much illuminating power will be lost.—Fredk. Walker and Hyde.

[65096.]—**Launch Engine.**—Applying an air pump and condenser would increase the efficiency 10 per cent. The pump should be nearly as large as one of the cylinders, and double-acting. A still further gain of power would be got by compounds at the higher pressure; but what about the weight? It probably would put down the boat. If surface condensing were admissible, a smaller air-pump would do.—W. M. J., Dublin.

[65097.]—**Coppering Carbons.**—I have coppered about 30 carbons, and had no difficulty. Two quart Daniells in series are quite enough; but I would recommend "Sigma's" directions to be followed as to paraffining the carbons first for an inch, commencing at 1in. down. If any gets on the top inch, burn it off with a blowpipe and dip quickly into water.—R. Gill.

[65097.]—**Coppering Carbons.**—What I meant in the passage quoted is that the density of current should be, at the first start, rather greater than that which gives the best quality of deposited copper; the closeness and toughness are not of so much consequence in the first thin films as the quickly filling up of the pores of the carbon surface; therefore a larger current is admissible, but it does not require high E.M.F. for the purpose, because the mass of carbon gives good circuit to all parts of the surface to be coated. It wants a large anode brought near, and then removed farther off, or made smaller, as soon as the coating is seen to be thoroughly formed. The case is different in the other quotation referring to the deposit on a blackleaded surface; here high E.M.F. and small current are the conditions required. The film is a high resistance, and requires to have the current forced to its most distant parts to obtain an even deposit all over, and avoid the formation of local deposits all around the wire, or some spots where the conduction happens to be greatest.—Sigma.

[65100.]—**Medical Coil.**—If you refer to my article in the "E.M.," Vol. XLIV. page 52, you will find a full description of the kind of coil you require, with every information as to construction. Should you be unable to refer, you will find the same in my book "Electromotors for Amateurs."—S. Bottone.

[65101.]—**Engine and Boiler.**—Make the boiler about 3ft. high and 2ft. or a little less in diameter, and refer to back numbers for further particulars. These questions as to boilers for this size engine, or very close, have been answered *ad nauseam*.—T. C., Bristol.

[65102.]—**Noises in the Head and Ears.**—Our friend is suffering from Tinnitus aurium. He has evidently had a bad cold in the head some long time ago, and this, being neglected, has turned to chronic catarrh. Of course, without seeing him, I could not say what part of the ear was at fault; but from his description I should imagine that the Eustachian tube has become blocked with mucus, which has been thrown off in much greater quantities than usual, on account of the above-mentioned cold. I should advise him to go and see Dr. Field, 34, Wimpole-street, Cavendish-square, London, W., who is a specialist in matters connected with the ear.—S. S.

[65102.]—**Noises in the Head and Ears.**—The causes are various, and it would be very dangerous for you to accept advice unless from a specialist who has examined you carefully. Go to the Royal Ear Hospital, Frith-street, Soho, or to any of the Great London hospitals, such as Guy's, London or University College (the latter takes up ear cases at 9 on Saturdays) and get examined. If you do not reside near London go to the nearest specialist if he is known not to be a quack, or to the nearest public hospital, where, in all probability one of the surgeons has made the subject a special study. You will only waste time by going to a "country practitioner.—B.Sc., Plymouth.

[65102.]—**Noises in the Head and Ears.**—To attempt to cure "Shon-y-Gof," one should first know from what form of disease he suffers, which no human being could tell from his description. It may be some consolation to him to know that what he describes are symptoms of tumour, abscess, or softening of the brain; disease of the bones of the skull; three or four diseases of the auditory nerves; as many affections of the tube leading from the ear to the nose; disease of the bones of the ear; irregularities of blood supply in the veins of the skull; disease of the external ear; and, finally, and very often, wax. All these cause variously-described noises to be heard, and as "Shon-y-Goff" has only told us he hears these noises, how can anyone prescribe for him?—Doctor Med.

[65103.]—**Forced Draught.**—Use a 40in. Lloyd's or a smaller "Capel" fan, and a 5-horse engine should be sufficient, say, 8in. cylinder. Pressure in bellows not above 2 or 3oz. per square inch.—T. C., Bristol.

[65104.]—**Manchester Dynamo.**—To Mr. Bottone.—F.M. cores 10in. long, oval in section, 3in. by 5in., wound with 90lb. No. 16, connected in series; armature 8in. diameter, 6in. deep, wound with 9lb. No. 12; the above for a shunt wound machine. If specially for arc lighting, the F.-magnets should be wound with 36lb. No. 12, but should be connected in parallel. In either case a laminated armature, preferably of the Pacinotti type should be used; speed about 1,300 to 1,500. Wrought iron is useful in F.M. cores, and also in the armature, if punchings are not used. Size of commutator 3in. diameter, 3in. long. Brushes held in a box by thumb-screw, pressed against commutator by a coiled spring on a swivel, which pass through lugs in the box. I prefer thin laminæ of copper for the brushes. Many give the preference to bundles of copper wire.—S. Bottone.

[65105.]—**Pressure.**—As you have 450lb. out of 1,100, you require 650lb. per square inch more. The pressure in boiler being 50lb., you would require an area of 650 ÷ 50 = 13sq.in. for each inch area but, to allow for friction of packing, &c., ırea of 16in., or a drain of 4½in. You do e quantity of water required.—T. C.,

.]—**Motor.**—To MR. BOTTONE OR .—The motor is too small to drive such a Γhe ring described is a Gramme ring. you mean a Pacinotti; this latter would :. No. 19 B.W.G. is the nearest to No. 18 and No. 18 B.W.G. is close to No. 16 —S. BOTTONE.

'.]—**American Motor.**—Yes, it can be a dynamo if driven against the brushes. 'e about 12c.p., and absorb ¼H.P. The › would be better if cast with cogs; the gnets best as directed. No. 18 A.W.G. › B.W.G.; No. 16 A.W.G. = No. 18 B.W.G., ·S. BOTTONE.

ı.]—**Tram Engine.**—Refer to last number tting engine valves, and then give more ırs if you want to know actual amount of ı it a model?—T. C., Bristol.

.]—**Mouthpieces.**—Vulcanite, horn, and nay be polished with rottenstone and oil › a paste and used with a soft rag. They shaped with a file, and rubbed smooth with ›er. Tools required would include files of :orms, blowpipe, hammers, and stakes for —W. H. H.

.]—**Razor Setting.**—A long chapter on ject (too long for insertion in "E. M.") ı find in Holtzapffel, pages 1146 to 1156, .—EOS.

:.]—**Watch Repairs.**—The roller must ved from the staff, and the pin cemented with shellac carefully applied. Be careful verheat it.—W. H. H.

ı.]—**Rollers of Wringing-Machines.**— have a yoke at one end with hole in centre t to slip through, and a hole at each end for o pass to a little beyond shaft at further ave a plate with a hole at each end for pass through, and let plate rest on shaft. ılts through, and strain them up, and give plate with the maul occasionally to start t, then screw away again.—T. C., Bristol.

l.]—**Screw-Cutting.**—The usual plan is, ading screw has two threads, the wheel on has 20 teeth. Then, if you require to cut ds, you put 100 on the lead of screw, and with a pair of equal wheels. As you must ud and have 30 on the mandrel, all you do is to use a 30 and 20 on stud, or any ıeel whose teeth are half as many more in as in the other. In other words, make the › a mandrel with a 20-wheel on it.—T. C.,

ı.]—**Voltmeter.**—What is an "ordinary ›r"? A Carden voltmeter or Siemens lynamometer may be used for measuring › currents.—W. PERREN-MAYCOCK.

ı.]—**Voltmeter.**—No, an ordinary volt- ill not do this. You must have a special ›r for alternating currents. But volts do › the lamps; ampères do.—S. BOTTONE.

ı.]—**Indiarubber Solution.**—Bisulphide n is the best solvent. By increasing the · of the bisulphide, the solution can be fluid as querist desires.—DR. MED.

ı.]—**Indiarubber Solution for Water- g.**—I buy a bottle of Benzine Collas and to it a little pure rubber. Note.—Vulcan- ber is of no use.—B.SC., Plymouth.

ı.]—**Indiarubber Solution.**—For patch- mending all waterproof goods, indiarubber at a shilling a tin is better and cheaper ı can make. However, here are two good No. 1 Cement.—Guttapercha cut fine, 3 ıaoutchouc, ditto, 1 part. Dissolve slowly ;h bisulphide of carbon to a thick, glutin- l state, on a water bath, using it warm, ping the wide-mouthed bottle tightly stop- ıs this cement rapidly hardens. No. 2.— › pure rubber, cut into small shreds, in coal or benzine, free from oil; a lump of rub- · of walnut, is enough for a pint of cement. ›pered bottle should be constantly shaken ıs any undissolved portion remains; if too l watery, add more rubber; a good solution ›e the consistence of honey. These are the pidly drying of the various caoutchouc ıions.—EOS.

ı.]—**Flower-Pots.**—The simplest and y to clean flower-pots is to steep them two in a tub of water; a scrubbing-brush n in a very short time make them quite d like new ones. I cannot answer remain- ›ur question, as I only use pots made here. GRIMSHAW.

.]—**Flower-Pots.**—The quality of all ery is very variable. I think that from is the best. It cannot be too sonorous when struck with a cane. On breakage, the pieces should be very hard and ruddy in hue. Soak foul pots in a tub of soft water—hot, if possible—adding thereto 2 or 3oz. of the coarse carbolic acid used for drains; scrub with a hard brush next day, and rinse.—EOS.

[65120.]—**Metal Disc.**—For the general solution suppose thickness at centre $= a$, thickness at edge $= b$, radius $= r$. Then plate can be divided into three parts; the middle one a flat disc of thickness b, and the others right circular cones, height of each being $\frac{a-b}{2}$. Hence whole volume $= b\pi r^2 + 2\frac{(a-b)}{6}\pi r^2$. Suppose mean thickness $= x$, then volume $= \pi r^2 x$. Equate the two expressions, and we get $x = b + \frac{a-b}{3} = \frac{a+2b}{3}$.

In given question, mean thickness $= \frac{\frac{3}{4}+\frac{3}{4}}{3} = \frac{1}{2}$in.—J. GEO. RICHARDS, B.A., B.SC.

[65122.]—**Sheep Dip.**—I could give "J. M." a score of recipes for making sheep dips; but let him take my advice, and not dabble in such things, for they are dangerous. I know men who have found it out to their cost. Take a good reliable article like Cooper's sheep dip; it is cheaper than making a dip yourself. All things considered, it is the best I know of, and I know a good many.—A SHEEP BREEDER.

[65123.]—**Accumulator.**—To S. BOTTONE.—Procure four sheets of lead, 6in. by 4in. Punch all over their surfaces with ⅛in. holes. Make a paste of oil of vitriol and red lead; rub it all over the plates, and fill in the holes with this paste, using a lead or pewter spoon to do it with. Allow the paste to set on the plates. Procure two glass or earthen cells, 6in. by 4½in. by 1in. internal measure. Now get a square strip of mahogany, 13in. by ¼in. by ¼in., cut it into two equal lengths, and soak it in melted paraffin; when permeated, allow it to cool. To each strip fasten, by short screws (taking care they do not go through to touch the other plate), a pair of plates by their top edges. Each plate should have a leaden lug, 2in. long and 1in. wide; screw to it for connection. Place one pair of plates in each cell; fill each cell nearly to the top with dilute sulphuric acid. Connect the two inner plates of lead together by their lugs. Pass current from three or four bichromate cells, and discharge, until the accumulators are "formed." See also my book on "Electrical Instruments."—S. BOTTONE.

[65124.]—**Farrant's Solution.**—The following extract is taken from "Purser's Histology":—"Many of the advantages of glycerine mounting without its disadvantages may be had by using Farrant's solution. This consists of equal parts of glycerine and a saturated solution of arsenious acid, in which as much gum as possible is dissolved. The solution must be filtered, and is very troublesome to prepare. It is applied in the same way as glycerine, but the gum hardens at the edge of the cover-glass, so that the cement can be applied after a few days without risk, and there is no danger of leakage." I do not quite understand what "Garcon" means by "circles"—possibly he may mean circular cover-glasses.—PLAYFAIR.

[65126.]—**Harmony.**—The major triads contain major thirds and perfect fifths; the minor triads, minor thirds and perfect fifths. B D F contains a minor third and a diminished fifth. A major third is two whole tones—a minor third a tone and a half. They are the third notes in the major and minor diatonic scales respectively. The fifth is the same in both scales; but the interval B—F (which does not occur in either diatonic scale of B), being nearly a true fifth, is called an "imperfect fifth."—BANKER.

[65126.]—**Harmony.**—It is not easy to see from this question what is the precise nature of the difficulty the querist has encountered in reading the excellent articles on harmony by Mr. Evans; but perhaps the following explanation will be of service: There are three kinds of triads, 1st, major triads, consisting of a note, its major third and perfect fifth; 2nd, minor triads, consisting of a note, its minor third, and perfect fifth; 3rd, diminished triads, consisting of a note, its minor, third, and diminished fifth. In all major keys the tonic, dominant, and sub-dominant notes bear major triads. In the key of C, for example, the interval (C, E) is a major third, having the ratio 4 : 5, and the interval (C, G) is a perfect fifth, embracing seven semitones, and having the ratio 2 : 3; thus the three notes are to each other as 4 : 5 : 6. Similarly the intervals (F, A) and (G, B) are major thirds, while (F, C) (G, D) are perfect fifths. The notes D, E, A (in the same key) bear minor triads, for the intervals (D, F), (E, G) (A, C) are all minor thirds; at least, approximately, for the interval (D, F) is 27 : 32 instead of 10 : 12, which is the true ratio for a minor third. The intervals (D, A) (E, B) (A, E) are perfect fifths, subject to the remark that the interval (D, A) is 27 : 40 instead of 2 : 3. The ratios for a minor triad are 10 : 12 : 15. The triad borne by the leading note B, is diminished, for the interval (B, D) is a minor third, and the interval (B, F) is a diminished fifth, containing only six semitones instead of seven. Similarly it may be shown that in the key of C minor the triads borne by E G A are major, by C and F minor, and by D and B diminished. A fourth kind of triad consisting of a note, its major third and diminished fifth, such as C, E, G flat is possible, but it does not occur naturally in either scale.—WM. JOHN GREY, F.C.S., Analytical Chemist, Newcastle-on-Tyne.

[65126.]—**Harmony.**—Seeing a reference to the articles on "Harmony" in Vol. XIII., and a query thereon by "Major" this week (see No. 65126), I, having derived great benefit from them myself, will try to explain his little difficulty. He must, in the first place, learn all the intervals perfectly, so as to be able to recognise them at once, and say whether a 3rd or 6th, &c., is major, minor, diminished or augmented. Having got so far, it is easy sailing. A major triad is so-called because the interval between its first and second notes is a major 3rd; the minor triad ditto. A major triad consists of a given note, its major 3rd, and perfect 5th, as C, E, G; D, F sharp, A; or E flat, G, B flat. A minor triad consists of a given note, its minor 3rd and perfect 5th, as G, B flat, D, B, D, F sharp, or D, F, A. An imperfect triad consists of a given note, its minor 3rd and imperfect 5th (whence its name) to distinguish it from the minor triad, as major B, D, F, minor G sharp, B, D. In the major mode it (the imperfect triad) occurs only on the leading note, or 7th degree of the scale. In the minor mode it occurs on the supertonic as well as the leading note (accidentally sharpened as in ascending, of course).—HUGH HARDING.

[65129.]—**Condenser for Steam Launch.**—A good type of exhaust ejector or ejector-condenser would suit you; but it is not at all suitable for feeding the boiler. There are special ejector condensers made for steam launches to suit the peculiar conditions of water-level, &c., and a vacuum of 26in. may be easily maintained. These require no delivery valve.—FREDK. WALKER AND HYDE.

[65129.]—**Condenser for Steam Launch.**—You can have an exhaust condenser of any size, and it would be about the only suitable thing for you. Write Morton and Co., Liverpool (I think that is the firm). An exhaust injector will feed the boiler. The condenser will create a vacuum. I have delivery a little above water-line.—T. C., Bristol.

[65129.]—**Condenser for Steam Launch.**—In reply to the above inquiry, an exhaust injector having a 2in. inlet steam branch and 1in. delivery and water supply pipes, will use most of the exhaust steam from the engines spoken of if they do not run at an extraordinary speed. We usually couple the exhaust injector to the side of exhaust pipe, leaving the other end open to the atmosphere, so it takes just what is necessary for its work. Our experience shows that the back pressure is reduced by their use at least 2½lb., sometimes more. Water is supplied to the boiler by them (if 40° outside) at about 180°—190°, so the saving of coal over pumping cold is very great. We are busy now with a modification of the exhaust injector for the purpose of producing a larger vacuum, and not forcing against a high pressure. At present it is impossible to do both. We can feed against 100lb. with reduction of back press. 2½lb., but not the converse.—E. H. BIRLEY AND CO.

[65131.]—**Regulator.**—To MR. BOTTONE.—I have not seen anything exactly like your regulator. Medland has patented a regulator consisting of a rod of carbon with a sliding ring running along its surface, which includes more or less of the carbon rod in circuit. But your idea is a very neat means of taking advantage of the increased conductivity of carbon under pressure.—S. BOTTONE.

[65132.]—**Cooling Water.**—For such a size engine, and the space at your disposal, cooling is out of the question. You can compound without condensing.—T. C., Bristol.

[65132.]—**Cooling Water for Engine.**—A similar case I remember to have been met by an ingenious arrangement of cross-stacked timber. This timber was in round rods about 3in. diameter. I believe the rods were turned in the lathe. This stack was some 30ft. high. The water was delivered across the top, and falling in broken sheets was cooled down to nearly the temperature of the atmosphere.—W. M. J., Dublin.

[65132.]—**Cooling Water for Engine.**—We presume that when you thought of compounding your engine you did not think that any advantage could be gained by compounding without using a condenser. You have so little space at your disposal that any system of cooling your condensing water by means of surface area cannot be considered. We were consulted once respecting a matter of this kind, where there was a limited supply of water that was raised from a well by a pump, and the overflow from the condenser ran into a series of 8 ditches, 200ft. x 6ft., and finally returned into the well. The engine indicated 28·5H.P., and towards the end of the week during summer the temperature of the condensing water averaged 160° Fahr., and the utility of the condenser was *nil*. At such times the exhaust was conducted to the chimney-stack until the water had cooled, which took two to three days. In this case there was several acres of space available for surface-cooling, had such been practicable; but in your case you have not even this doubtful advantage. Still, something might be devised in your case if you will state the cost of water in your locality and the quantity of fuel consumed per week. For proper condensation the water required is from fifteen to twenty times the quantity of the feed-water.—FREDK. WALKER AND HYDE, 4, Little Moorfields, E.C.

[65134.]—**Cracking Noise in Telephones.**—These are instruments having permanent magnets, and are not intended for use in conjunction with cells.—W. PERREN-MAYCOCK.

[65138.]—**Plating Dynamo.**—Use a laminated armature 8in. diameter—not 8½in.; wind it with about 6lb. No. 12 in two parallel layers, or No. 10 in one length, whichever you can manage to wind best. Do not rewind the magnets, but connect them up in parallel, so as to reduce the resistance to one-quarter its present value. If the resistance of your plating vat is very low, you may require a little external resistance to bring the dynamo up to the working point.—S. BOTTONE.

UNANSWERED QUERIES.

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The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

Since our last, "Principia" has replied to 61478, 61697.

64503. Thermopile. To S. Bottone, p. 588.
64507. Hooter, 588.
64509. Waterproof, 588.
64513. Coppering Rifle Projectiles, 588.
64519. Coach Painting, 588.
64524. Hemp Scutching, 588.
64529. Rust in Water Pipes, 588.
64530. To Mr. Wimshurst, 588.
64542. C. and C. Battery, 589.

64773. Mineral Waters, p. 69.
64776. Mechanical Organ, 69.
64786. Double Star near Eta Orionis, 69.
64804. Encke's Comet and Faye's Comet, 69.
64811. Kites, 69.
64816. Time Keeper, 70.
64819. Skates, 70.

QUERIES.

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[65139.]—**To Mr. Wimshurst.**—I have started to make one of your beautiful machines with 17in. plates, have varnished them, fixed the sectors on (tinfoil) 14 in number, 3in. long, 1in. wide at top and ⅝in. at bottom, and have mounted them on stand per usual way. Now, what surprises me is that on rotating the plates I get no sign of electricity whatever. I have held an excited ebonite rod close, but with no effect. Will you kindly tell me if I am to expect any sign of electricity before fixing up the terminals, collecting combs, neutralisers, &c.? It seems to me that there should be. Also please say if sectors are right. The plates are ⅜in. apart—is that right? The varnish is on rather uneven, and fairly thick, also the plates do not run quite true. Would this account for the failure?—G. H. D.

[65140.]—**Stirring Gear.**—In the process of dyeing small lengths of sewing cotton I stirred them round and round in an ample pot. They came out twisted and curled in a lump. My stirrer was of glass with a knob at the end. Can this effect be obtained by treating, say, one or more hundredweights at a time in a relatively larger vessel, and what shape or combination of shapes ought the stirring apparatus to be?—TOWN.

[65141.]—**Watch Springs.**—I have noticed that hair springs are sold in different coloured papers, which are also numbered. Will any reader kindly inform me if the colour has anything to do with the quality, and if the numbers run according to their strength?—W. S.

[65142.]—**L.B. and S.C.R. Locomotive.**—Can anyone give me a sketch and dimensions of the locos. on this line known as "Stroudley's Improved," built 1872 and 1875? They are numbers 201-207.—C. F. C. M.

[65143.]—**Storage Cells.**—Will any reader kindly inform me how to make storage cells—that is, how to make the red lead adhere to the plates, and how they are first charged?—A LATE BEGINNER.

[65144.]—**Engine Query.**—Will "T. C., Bristol," or any other kind friend give me the h.p. of horizontal engine, stroke 12in., piston 8in. diam., pressure 30lb., cut-off just over the half-stroke, 140 revs. per min., fly-wheel 4ft. diam., 8in. on face? Also give simple rule for finding the above.—ONE IN A FIX.

[65145.]—**Automatic Tank Filler.**—I want an *automatic arrangement* by which a 50gal. water tank when nearly empty shall open the supply tap, and then when the tank has filled itself it shall cut off supply till it again becomes nearly empty. A sketch would oblige.—YARTY.

[65146.]—**Siemens Armature Winding.**—Some short time ago "Xero" gave practical instructions how to make and wind a Gramme armature. I should feel greatly obliged if the same gentleman would give a practical idea how to make, wind, and connect up a Siemens drum armature? I have seen it illustrated, but no practical instructions.—PRACTICUS.

[65147.]—**Galvanic Machine.**—I am desirous of constructing a large galvanic machine of the following dimensions and would like a few particulars as to wire and sizes and proper connections with six powers, and what battery power. Length between coil ends 12in., diam. 5in. How can I connect up for powers with contact breaker on base-board and switch?—AN AMATUER CONSTRUCTOR.

[65148.]—**Soda.**—What is the reason of the contamination caused by hypo in any photo. process by vessels used for it or stained fingers, &c.? In one formula common washing soda is given as one of the ingredients. Has this any similar deleterious qualities, or may it be used without fear of consequences in ordinary developing dishes and glasses, &c.?—H.

[65149.]—**Link Belting.**—Will some one kindly say how the links for these belts are cut? I have a lot of scrap leather that for years we have put in the fire. I now see my way to turn them to a better account if I can get them cut cheaply into pieces 1in. long by ⅝in. wide, and one small punched hole in the centre.—LINK.

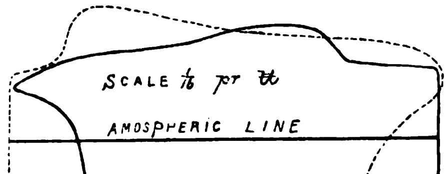
[65150.]—**Telescope.**—Having read instructions to make a telescope, having o.g. 3ft. focus and e.p. 1in., I am desirous of making one on larger scale on the same principle. What focal length and diameter should the lenses have for a 6ft. and 10ft. telescope respectively, and what would be approximate cost? The tube in the above is of paper. Would this answer, as I only require it for amusement?—W. H. L. E.

[65151.]—**Boot-cleaning Machine.**—I am instructed to get made and send abroad for use in an hotel a machine for cleaning and polishing boots and shoes. I feel rather at a loss how to proceed, not having seen a machine of this kind. Possibly one of your valued correspondents could assist me. Would two round brushes fixed on each end of a spindle and driven like a foot lathe answer the purpose?—THOS. BAINBRIDGE.

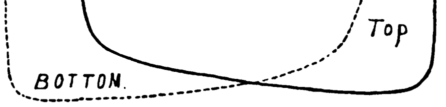
[65152.]—**Boiler.**—Would some kind reader give size and thickness of plates, of a cylindrical marine boiler for compound engine, 2 by 2, and l.p. 3½ by 2? Also number and size of tubes. Working pressure to be 60lb.—ONE IN A FIX.

[65153.]—**Straps.**—1. How can I calculate the weight held by a brake strap? I mean a formula to find size of brake strap to hold a given weight. 2. How to find width of eccentric strap, supposing I have a slide valve, 22in. by 30in., with 80lb. pressure on the back. What is the width—i.e. sectional area—of strap?—APPRENTICE.

[65154.]—**Beam-Blowing Engine.**—Would "T. C., Bristol," or others kindly say what could be done to improve beam condensing blowing engine giving the inclosed diagrams? Steam per gauge 22lb.; cylinder 108in. long, 42in. diam., stroke 90in., revs. per minute 13, valves 8in. diam. Working gear has handles actuated by clacks on air-pump rod. Air pump 28in. diam., head and foot valves indiarubber, butterfly valves in bucket, vacuum per gauge 12½lb., temperature at inlet 55° and at outlet 95°. Blowing cylinder 84in. diam., pressure per gauge 4lb.—YOUNG MECHANIC.



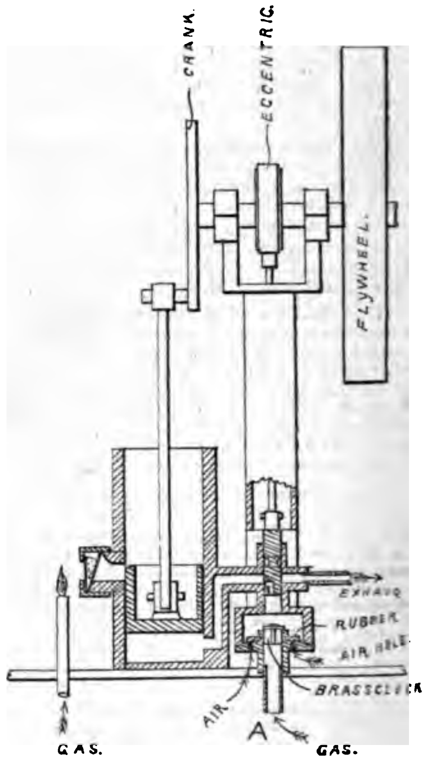
[65155.]—**Electric Bells.**—Will Mr. F. C. Allsop or other kind electrical friends assist me in the following? I have three chattering bells, two fitted in house and one in workshop at back of house. Now, push P is at front door; bell A inside front door, bell B in workshop, and bell C in kitchen; push O is at kitchen door. I can get push P to ring A and B, but want push O to ring C and B on the same two wires leading to B, but not to ring A when O is pressed. A switch S cutting out B, so that push P will ring A independent, and push O ring C independent. All bells to work from same battery. A sketch will oblige.—ONE IN A FOG.



[65156.]—**Gravity Leclanche.**—On p. 148, No. 1203, "Assoc.Inst.Elec.Engs." gives a sketch of a so-called gravity Leclanché cell. It seems to be only a tray form of the battery. I always understood the term gravity battery to be applied to those batteries in which the difference in the specific gravity of two liquids is utilised in keeping them apart instead of using a porous pot. Now in the ordinary Leclanché the porous pot is used merely to keep the broken carbon and manganese in contact with the carbon rod of the cell, and, as a matter of fact, the cell is improved by making a few holes through the porous pot and thus lessening the resistance. The agglomerate form was invented to do away with the porous pot altogether. Now in the so-called gravity cell above mentioned I see nothing to justify the name. But perhaps "Assoc.Inst.Elec.Engs." can explain.—ELAG.

[65157.]—**Induction Coil.**—I am about to make an induction coil; but am not quite clear on one or two points. I want it 5in. long between the flanges. Will some one kindly say what quantity of wire should be used for primary and secondary and what diam. of flanges would be required? What is the advantage of having a condenser? I propose having a contact breaker on the end of coils. Also to have a regulator, either a brass tube to fit over core or a water regulator. If a water regulator is best, will some one explain how I am to make it? STEAM.

[65158.]—**Gas Engine.**—I have a small gas-engine with 1½in. by 4in. cylinder, and I cannot get it to work. I have never seen one of this design before, but I see no reason why it should not go. The gas enters through the pipe A, lifting the small brass clack, around the seating of which is a groove and into which is stretched a thin rubber ring, broad enough to cover the holes through which the air enters. The gas and air supply and the exhaust are regulated by the small piston valve worked by the eccentric. The igniting apparatus consists of a cap, with a hole in the centre, screwing on to a brass boss out slant-wise. The valve is a circular piece of sheet brass flattened on one side, and is shut when vertical and open when resting against the boss, as there is then a way for the flame to enter, being drawn in through the centre hole of the cap, up over the flattened side of the flap, and into the cylinder. The rest may be seen by the figure. I got the gas to ignite once or twice, but no more. Could some one tell me from the general description I have given whether it could be got to work without making any very great alteration?—GAS.



[65159.]—**Compounds on Great Western.**—Are there any compound locomotives working on the G.W.Ry.? If so, of what type?—W. E. B.

[65160.]—**Closed Circuit Bell Ringing.**—To MR. PERREN MAYCOCK.—Will you please say how long the gravity Daniell cells, described by you in the number for March 16, will remain in constant action (day and night) without recharging?—I should require them for closed circuit alarm purposes—and about how many cells should be sufficient for a mile circuit, using a good 5in. bell?—WIRE.

[65161.]—**Elasticity.**—A piece of indiarubber elastic is 3ft. long, and of such a strength that 1lb. will stretch it 2in., and therefore 2lb. will stretch it 4in., and so on. It is fixed at each end in a horizontal position to two supports and a weight of 2lb. is suspended at the middle of the elastic. Required the depth below the horizontal line to which the middle point will sink.—S. A. S.

[65162.]—**Noise in a Tunnel.**—Can any reader kindly explain the cause of the excessive noise which all passengers by the Midland Railway to London must notice upon the up journey through the new Belsize tunnel, Haverstock Hill? Is it caused by steel sleepers?—A PASSENGER.

[65163.]—**Electric Motor.**—To S. BOTTONE.—Could you give sketch of electric motor whose armature would revolve in either direction—one that will not be infringing any patent?—STOKE.

[65164.]—**Hot Brazing.**—I should feel thankful for full instructions on the above. I have been trying it and I have failed. Do I want to get the article red hot before putting the borax and spelter? Will brass turning dust do for spelter?—YOUNG BLACKSMITH.

5.]—**Violin Repolishing.**—I have scraped a nd want to re-coat. Will someone give the process iiring a rich amber brown, and the best varnish to BRUNO.

]—**Piano.**—A note in a cottage piano slaps action). I have put a new leather hinge and re- ammer head. What else can I do to cure it?— .

.]—**Oil for Belts.**—In a little book giving hints ise of belts issued by a Yorkshire leather firm it is Never use castor oil—it rots the leather." May I ais is in accord with the experience of practical I always understood castor oil was a very good o preserve belts, and I am using it now in those iy charge? May this instruction be explained by t that the firm named manufacture a "belting tion" which they recommend?—TRUTH.

.]—**Photo - Micrography.** — I should be if anyone who has used special eyepieces for uld say if there are any advantages attending e. Projection eyepieces of the new German glass ie market; but English opticians are advertising orm, adapted both for ordinary use and photo- These appear from the catalogues to contain an ial lens, a double concave at the eye end. Whilst subject I beg to suggest that micro. negatives be some standard size—say ¼ plate—so that micro- could exchange their negatives after they have paper prints or lantern plates they require for ves. This would be carrying out the present l of 3 to 1 slips and Society thread for objectives. LL.

.]—**Lever.**—Will one of your readers kindly n as to the following? I have a lever 2ft. long ; on a pivoted bearing exactly in the centre, and r is properly balanced. Supposing I have two 1oz. suspended at equal distances on each side of the I should, of course, still keep my lever in balance; move one of my weights ⅛in. further from the in what proportion shall I have to decrease the of it so as to still retain my lever in balance for rt of an inch that I move it from the centre—the ie still remaining as at first—viz. 1in. from centre? natter clearly explained in any book that I could and, if so, what is the name of it?—SAMSON.

.]—**Photographic Studio.** — Can any of inform me how to construct the above? I am inched up in a small premises—picture a coach- id stables inclosed by a forecourt, 40ft. running west by 18ft. running north and south. The house ie south. There is no back whatever. Now I mething portable that could be erected in about te, and taken down in half that time, made of ht materials which would afford sufficient light to , but with arrangements to keep down the glare in. The walls of the inclosure are about 12ft. each side, and the front wall and gate are 9ft., the bout 30ft. high. I am dreadfully put to when get a portrait. Can any ingenious—and there y among "ours" who can lay claim to the title— it and mature a plan whereby others as well as an carry on the beloved and fascinating art of aphy in defiance of our surroundings and scanty —HYPO.

.]—**Evaporation.**—I evaporate large quantities l by means of a pan fitted with a steam jacket and l desire to know the quantity of steam used for a iantity of liquid evaporated. It seems to me the y is to measure the condensed water as it issues pan; but there is this difficulty—a large amount steam passes as well. Does not this free steam evaporate, although it may not be cooled down to it of condensation? I could, of course, put in a ap, but do not want to. Will your able corre- t "T. C., Bristol" kindly give me the benefit of ce?—W. HARDCASTLE.

.]—**Ritchie's Revolving Magnet**—In all criptions of this original electro-motor it is stated pper wire should be used on the rotating bar I think a correspondent in the "E. M." a few o said it was necessary to have this short thick the reversal of the current took place so rapidly hinner wire it would not work so well. Can any- me this reference, or mention a book where a remark is made? The opinions of our practical ndents as to the truth of the statement will much -M. S. A.

]—**Boiler.**—Will "T. C., Bristol," or some other der tell me what pressure it would be safe to vertical boiler at, the dimensions of which are as —2ft. high, 1ft. diam. (outside shell). Inside is a ich surrounds the fire) 1ft. diam. at bottom, and to 4in. diam. where it comes through top of out- l and connects with chimney. It is made of 16 on and riveted with ¼ rivets. I have had 35lb. it; but do not know if it is safe to work at or iat. The engine is half-horse horizontal. How uld this boiler last if used a few hours a week A. W. C.

]—**Gas-Lighters.**—Are all the forms of gas- used by means of a spark, or is there any form hts the gas by a current rendering a piece of a wire white hot? If both forms are used, which reliable? If Mr. Bottone or some other of our ans would describe the most reliable forms that sed with Leclanché cells, I think the information e valued by others besides myself. I have looked the indices of the last three vols. and can find . A number where such information was given print. I think it was 991. I should prefer a which red-hot platinum wire was used.—W. H. H.

.]—**Oil Painting.**—I have an oil painting n. by 10in., a piece of lake scenery—"Ulswater" he name A. Hunt on it and the date (which is not iust), 1844. Can anyone give me any information painter?—W. H. H.

]—**Clockwork Recording Cylinder.**—I make a cheap recording cylinder to carry a paper all register, during my absence, on what day and hour of the day or night a pencil, actuated by ty, is pressed against the paper. I can do the l part. Will some obliging horologica. fellow-reader show in detail how I can make some cheap common clock actuate such an apparatus, so as to turn the cylinder once round in (a) 24 hours, or (b) 48 hours, or (c) 8 days?—IL PENSEROSO.

[65177.] — **Methyl-Orange Indicator.** — Would some kindly disposed chemical reader furnish me with particulars of the formula, mode of preparation, &c., of the above, and also of the reasons for the change in colour on adding an acid? Is phenolphthalein regarded as a better indicator? Is it not sometimes difficult to obtain the pink colour of the methyl indicator with $H_2C_2O_4$ and Na_2CO_3?—YOUNG ANALYST.

[65178.] - **Hydrostatics—Centre of Pressure.**—Will any reader please indicate method of obtaining formula for C. of P. as given in "E. M."? I refer to rectangular plates immersed with plane vertical and with upper edge below surface of liquid. I can obtain C. P. when one edge in surface of liquid, but not when lowered. —HUDOR.

[65179.] - **Retorts.**—Will any reader kindly inform me how best to heat earthenware retorts and stills? I want to use gas, if possible, but believe they will not stand the flame. I should also like to know the best luting for fixing the arm to headpiece and worm that will stand strong chemical action, and any other information, such as ascertaining depth of liquor after working some time, &c.—NO SIG.

[65180.]—**Organ Details.**—Will Mr. Robinson oblige by giving me the width and depth of grooves and lengths of pallets for bourdon, scale 5in. by 3¾in., 30 notes, and the width he would advise me to put the back-falls? They run for the swell 17in. to 22in. long. As I am so far advanced I should like to finish.—OPEN DIAPASON.

[65181.]—**Indian Jugglers.**—May I ask "Eos," whose letters I read with unfeigned interest, whether he ever discovered the secret of the Indian jugglers "basket and mangoe tree" tricks? My uncle, an old Indian officer, who had witnessed them many times, said he never could satisfactorily account for them.—WM. HARDCASTLE.

[65182.]—**Hand Press.**—Can any reader give me any information of the Boomer press, or other hand press suitable for pressing hay or flore? Which would be the best with regard to portability, cost, &c., a screw press or a hydraulic?—NO SIG.

[65183.]—**Hydraulics.**—A bore hole, 5in. diam., is sunk 200ft., and then water is found which rises and throws a jet 5ft. above the ground. How can I find the velocity from the above particulars, and what shall I allow for friction? The tubes are flush-jointed inside.—JAS. ART.

[65184.]—**Practical Electric Bell Fitting.**—Will "F. C. A." kindly give details and sketch of the differential thermometer he mentions in No. 1,195, p 570, which is much used in hot-houses to give warning (by electric bell) of any departure either above or below any required temperature. It is the minimum which puzzles me; but an instrument to do both is what I desire to make or have made.—IL PENSEROSO.

[65185.] — **Defective Object Glass.** — Will "F.R.A.S." or any other reader kindly say what causes a (3¼in.) o.g. to show a pentagonal disc within and without the focal point, as viewed with astro. eyepieces, and give at the best focus obtainable five pale streaming rays? The chromatic correction is first class; but there is considerable spherical aberration.—J. C. L.

[65186.]—**Reflecting Galvanometer.** — To MR. BOTTONE.—I am making one of the above with bobbins 2⅜ diam. by 1in. deep. to use with a resistance box for practical testing. Will you please say what size wire to wind it with, and what the resistance of bobbins ought to be, and if it would be better to have a number of small magnets on the mirror or one piece of watch spring?—MC3.

[65187.]—**Half-Plate Rectilinear Lens.**—I wish to make a half-plate rectilinear lens. Can any of your readers inform me what lenses are required, diam., and focus, and size of fixed stop? I have an achromatic lens 1⅝in. diam., 6¾in. focus. Can I use it as one of the lenses? —ONE IN A FIX.

[65188.]—**Non-Sensitive Ink.**—Will some reader kindly give me the information how to make a dye or ink that will stand heat? I want it for printing tallies, &c. in greenhouse. To be used with indiarubber type. I have tried many ordinary inks, but they entirely disappear in heat.—G.

[65189.]—**Polishing Lathe.**—To "BIJLI."—Will you kindly give details with sketch of a polishing lathe for electro-plated goods, the main part of which could be constructed without the aid of a lathe, and which could be worked by foot?—R. GREAVES.

[65190.]—**Model Screw Steamer.**—Can any reader give me a plan to drive the screw of a small model steam boat by electricity? The size is 24in. long, 4in. broad, and 5in. deep. A sketch will oblige.—J. G.

[65191.]—**Air Pump.**—I have an old single-cylinder air-pump which I propose to reconstruct on Tate's principle, and I should like to know what are the best kind of valves and piston to adopt. Full particulars will oblige.—H. H.

[65192.]—**Potassium.**—Can any reader give me a process for the estimation of potash, otherwise than with $PtCl_4$? I always get my results too high with $PtCl_4$.—T. L. W.

[65193.]—**Indicator Diagram of Gas-Engine.** —Will some reader kindly inform me how to find the indicated H P. of engine from the following data?—

a = area of piston.
b = stroke.
c = number of revolutions.
d = number of explosions.
e = mean pressure on diagram.
f = mean pressure of compression of charge on diagram.

Also how to calculate the brake H.P. under these conditions—viz. a band passing half-round the flywheel, one end fixed to a frame and with a spring balance attached to other end of band.—N. M.

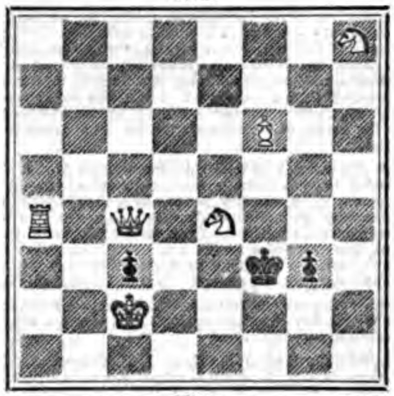
[65194.]—**White Positive Photographs.**—Can anyone tell me how I can produce an intensely white ground, and an equally sharp black picture in a positive photograph?—T. A. P.

CHESS.

ALL communications for this department must be addressed to J. PIERCE, Langley House, Dorking.

PROBLEM MXCIV.

Black.



White. [6 + 3

White to play and mate in three moves.

SOLUTION TO 1,092.

White.	*Black.*
1. Q-Q R sq.	1. Anything.
2. Q, R, Kt, or P mates.	

(Six variations.)

NOTICES TO CORRESPONDENTS.

CORRECT solutions to 1,092 by A. Wheeler, G. W. Middleton, Black Pawn (very good, but a trifle obvious), H. C. Haycraft, Link, J. Methuen, W. H. W., C Reader, J. Palmer, W. Jay, H. A. Lindfield, H. Fellows, T. A. Pringle, Bernard Green, T. H. Billington (very fair), A. Dean, and E. W. Barnett; to 1,091 by J. Kilbee, T. H. Billington (very fair), W. H. W., H. A. Lindfield, W. Jay, J. Palmer, and Link.

F. A. PRINGLE.—Thanks for the problem.

J. KISTRUCK.—In 1,092, if 1. Q-K B 2 there is no mate in answer to R-B 5.

WE deeply regret to have to record the death of Mr. Duffy, for many years the Chess Editor of the *Illustrated London News*, and formerly the Editor of "Westminster Papers." He was also well known as a problem composer. His loss will be much felt.

MR. MILES has now brought out "Chess Stars," a collection of sui-mates, selected from those of his own composition and from other masters. Altogether there are nearly 100 problems printed on large diagrams. We need hardly state that the strategy involved in these studies is very different from that in the ordinary problem. It is often, nevertheless, of a very high order, and takes us, as it were, into new and interesting chess scenery. We append the following fine example from Mr. Miles's book. The problem is by himself:—White, K-Q sq; Rs-K B 5, K Kt 6; Kts K 4, K R 5; P-Q Kt 2. Black, K-K B 6; R-Q R 8; B-K B 5; Kt-Q Kt 8; Ps-Q R 7, Q Kt 6, K 6. White to play and sui-mate in three moves. Solution 1. Kt-Q B 5, K B 7 (*a*); 2 R-Kt 3, K B 8; 3. Kt-K 4, P mates or disc. mate; (*a*) 1. P checks; 2. K-K sq, K-K 6 (best); 3. R takes B, Kt disc. mate. We have only to add that the price of the book is 2s. 6d. and can be procured of Mr. Miles, 3, Clarendon-road, Norwich.

ON Saturday, the 14th instant, Mr. Gunsberg contested 23 games simultaneously at the North London Chess Club. In 3½ hours he won 20 games, drew 1, and lost 2.

THE chess column of the *Hereford Times* is now conducted by Mr. Edwyn Anthony.

THE match at New York between Delmar and Lipschütz has resulted in a victory for Mr. Delmar by 5 games to 3.

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⁂ It must be borne in mind that no Displayed advertisements can appear in the "Sixpenny Sale Column." All advertisements must be prepaid; no reduction is made on repeated insertions and in cases where the amount sent exceeds One Shilling, the Publisher would be grateful if a P.O.O. could be sent, and not stamps. Stamps, however (preferably halfpenny stamps), may be sent where it is inconvenient to obtain P.O.O.'s.

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Advertisements *must* reach the office by 1 p.m. on Wednesday to insure insertion in the following Friday's number.

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*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to Hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, April 25, and unacknowledged elsewhere:—

A. P. SHAKESPEAR.—J. Mallins.—J. D. Greenway.—Rev. J. Rawlins.—N. C. Firth.—Amateur.—E. Isherwood.—Artist.—Dormi.—J. W. M.—A. R.—Warwick.—E. J. P.—Bottle Washer.—Anxious.—G.—One in a Fix.—H. Boardman.—Chemist.—A Sand Rat.—W. A. Abingdon.—D. Booth.—Star.—Tara.—X.—Esna Caralita.

C. P. J. F. (We have no recollection of the queries, and do not pretend to remember the subjects of those which are not inserted. Why not have repeated the questions as you have written to inquire? We should not be surprised, from the hint you give as to the nature of the queries, to find that both have been answered many times in back volumes.)—PHOTO. (Enamelling photographs, p. 597, Vol. XLV., and many other places in back volumes. See indices.)—STONY STRATFORD BIGNELL. (What is the communication about? Several diagrams of forge bellows in No. 1,141. See also p. 15, Vol. XLI.)—A CLEANER. (Why not watch the advertisements in the engineering papers? You would have to go as a fireman first on any railway, whether in Siam or elsewhere.)—R. H. R. (See answer to "Stony Stratford Bignell." There are several illustrations of forge bellows in back volumes.)—CAST IRON. (Will not one of those illustrated in recent numbers answer your purpose? See previous answer. One was illustrated so recently as p. 74.)—IRONFOUNDER. (Do not understand you. In Lancashire and Cumberland it is made from what is known as red hematite, and the pig is converted into Bessemer steel on the spot. Inquire of some of the dealers; they will specify suitable brands.)—M. ELDER. (The means adopted are described in many textbooks, have been described many times in back volumes, and are actually illustrated on the very page to which you refer.)—EGG SHELLS. (Some people use common black ink to colour the streaks in ebony; but if you have much to do adopt the plan of the piano keymakers and put the strips of ebony in hot decoction of logwood, and subsequently in a solution of sulphate of iron. Use a little Prussian blue in the polish, and the black will be as good as can be got.)—ESSENCE. (Tinctures are made by soaking the articles in spirits of wine. The scent is extracted from flowers by mixing them in layers with pure fat or wax, and then dissolving that in spirit with the aid of heat and cooling the fat out. The essential oils which the fat took up are thus left in the spirit.)—IGNORAMUS. (Why not procure one of the many useful treatises on arithmetic now published?)—DUBLIN. (You will find some of the devices in the works descriptive of marine engineering; a few in Knight's "Mechanical Dictionary"; but for a general idea of what has been done you must search the files of specifications lodged at the Patent Office. You can see them in Dublin.)—J. LEES. (You will have seen the replies in last week's number. Any dealer in wire ought to be able to answer such a question, and any dealer in sheet metal ought to be able to supply the Russian plates.)—WOULD-BE CHEMIST. (To make analyses of the raw materials, and of the finished products. 2. See answer to "E. O.," p. 180, last week. 3. Those are questions which you can answer yourself by reference to the advertisement columns. The price will depend on the conditions. 4. Depends on where it comes from. It is used for mixing with nitro-glycerine, and as a non-conducting composition.)—M. C. (Rubber stamps are made by forcing a mixture of indiarubber and sulphur into moulds, usually of plaster of Paris, by the aid of steam pressure, the heat of which also "cures" or vulcanises the rubber. The method has been explained many times. The ink is usually aniline violet mixed with a little glycerine. 2. For the jujubes, see indices. There are "gum" and "gelatine" makes.)—PETER ALLINSON. (Do you mean "gold paint" or regilding? Both have been described. The gold paint can be purchased with suitable varnish from any artists' colourman.)—ONE WHO WANTS TO BE INFORMED. (Ramie is the fibre of China grass, *Boehmeria nivea*. See indices.)—MENDHAM. (Yes, it is said to—the voyage especially.)—FARMER. (Try Crosby Lockwood and Son, Stationers' Hall-court, E.C. They publish a list of books that should suit.)—A. JONES, North Walsham. (Procure catalogues from such publishers as Crosby Lockwood and Son, Stationers' Hall-court, E.C., and L. U. Gill, 170 Strand, W.C.)—T. L. W. (How can any one say what is the matter with the solution without knowing of what the mixture consists? You will find all about blue prints in back volumes.)—PAUL HELLMAN. (It depends so much on the student! Huxley and Martin's work, at any rate, published by Macmillan and Co. Procure their catalogue.)—INVESTIGATOR. (Try Bettany's "Life of Charles Darwin," published by Walter Scott!—*ENGINEER. (Perhaps they can be found in "Llo . Register," or try the engineer on board.)*—CHUNAM. (Of the author or of the Sec., British Association, Albemarle-street, W.)—DEXTER. (Spooner's "Narrow Gauge Railways," E. and F. N. Spon, 125, Strand.)—YOUNG JOHN. (A good deal depends on the shape of the house to be protected, and something on the surrounding soil; but as the conductor gives good earth, probably it will be sufficient to protect the part to which it is attached.)—A. Z. (Must give some better idea of "cracks in farm boilers." What are the boilers like, and what also the cracks? If the boilers are of iron, cannot the cracks be rusted up?)—GEO. COOPER. (Cannot devote an illustration to such a subject. You might insert the pump at any convenient part, and make it, say, one-third the diameter of the cylinder and half the stroke of the piston.)—W. R. H. (Yes. You would find a great deal about the subject in Vol. XXVII., under the headings of "Properties of Numbers" and "Magic Squares." Such arrangements of figures are very old indeed.)—GUARD. (There is no really efficient means of cold-brazing. There is a cold-soldering with amalgam, for which see p. 81, Vol. XXXV., and the indices.)—DARLINGTON. (The lens must be ground to the required curves; but do you propose to make the glass as well? If you want only one or two, much better purchase.)—MAGNET. (If one magnet will hold the other, that will do. Soft iron will do for the original instrument.)—GEORGE MACBETH. (Your dimensions will do; but they are larger than necessary for a pocket instrument. The original instruments had electro-magnets. See indices for directions for making all kinds of telephones. 2. Is it a discovery?)—J. HY. W. (Apparently the well-known toy described in the text-books as the Cartesian diver. The figure is hollow, and just floats in the uncovered tube. The top of that is covered with bladder, and pressure on the bladder causes the diver to sink, because water is pressed into his body.)—A NOVICE. (You will find a wire-straightening machine that will suit you illustrated in No. 850; but it is generally done by drawing between a row of pins placed zigzag.)—BEATRICE. (Macaroni is a paste of wheaten flour—preferably made from hard wheat, drawn into the shape of long hollow tubes. Vermicelli consists of finer tubes or threads. It is stewed, mixed with milk, and grated cheese, made into puddings and baked, mixed with stews, and so on. Wholesome and nutritious.)—NORGATE. (Procure the pamphlets issued by the Emigrants' Information Office, 31, Broadway, Westminster. You should be able to see the window-bills at any post-office. You will find information in back volumes; but Manitoba seems to be the favourite now.)—MR. CRABTREE. (From any local bookseller in the Annual Report; but if you belong to a school, the secretary can most likely supply you.)—JOHN WELCH. (Level refers to surface. It might be bent and still level; but if bent it could not be straight.)—ENQUIRER. (Laxton's "Price-book" is published by Kelly and Co., Great Queen-street, W.C. Lockwood and Son publish another bearing their name at Stationers' Hall-court, E.C., and Spons publish an "Architects' and Builders' Price Book," at 125, Strand, W.C.)—STANDARD GRINDER. (For methods of painting blackboards, see p. 311, No. 1,002, or p. 457, No. 1,113. See also indices of back volumes.)—STEAM. (Why not apply to the chief engineer of the companies employing inspectors? You will find some useful information from one who knows on p. 535, No. 959. First of all you want what is known as a cast-iron constitution, or the work will soon settle you; then you must be well up in the technical details connected with boilers and engines, and know sufficient theory to work out the rules. If you think you have all these—especially the constitution—offer your services, and the chief engineer will settle about the examination.)—T. J. GANNON. (We really have nothing more to say. Look up your indices. You draw the long bow a little when you assure us you have been a subscriber 35 years! That is about 12 years longer than it has been in existence!)—A FARMER. (They do good to the ground; but, of course, they disturb growing crops sometimes, and then they become a nuisance, and must be destroyed.)

Harness' Electropathic Belt should be worn by everybody. It is guaranteed to generate a mild continuous current of electricity which will restore health, strength, and energy to the whole body, and promptly cure rheumatism, sciatica, nervous debility, liver and kidney diseases, ladies' ailments, sleeplessness, &c. Illustrated pamphlet, post free, containing copies of thousands of testimonials from royalty, physicians, clergymen, and all classes of society. Advice free, personally or by letter. Send for private advice form. Full particulars of Harness's World-famed Electropathic Belt will be sent (post free) on application to Mr. C. B. Harness, Consulting Electrician, The Medical Battery Company, Limited, 52, Oxford-street, London, W. (corner of Rathbone-place).

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Wanted, good back-geared Lathe, gap bed. Exchange DISSOLVING LANTERNS, Jewellery, Bicycle, Tricycle, or part cash, part exchange.—MECHANIC, 47, Fernhead-road, Westbourne Park.

Good Value Offered (cash or instruments) for all kinds of Scientific Appliances.—CAPLATZI, Science Depot, Chenies-street, near British Museum. Estab. 1852.

Washing and Wringing Machine (Taylor and Wilson), excellent order, except centre of one roller. Exchange for small harmonium.—JOHNSON, 19, Moxley, Wednesbury.

Wimshurst Machine, 17in. plates, well made, as described by Mr. Wimshurst, what offers? Stamp reply to W. STOREY, Rochdale.

38in. Royal Mail Kangaroo **Bicycle**, hollow rims, forks, Kelsey's patent bottom bearings, Nagel's saddle, cowhorn handle bars. Exchange anything useful to value of £3 15s. or offers.—W., 30, Howson-road, Brockley, S.E.

54in. **Bicycle**, in good order, hollow forks, bell metal hubs, Cradle spring, King of the Road lamp, 40s. or offers. Wanted 3½ slide rest.—SHELTON, Alexander-street, Kettering.

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Perambulator Fittings, Wheels, Springs, Bodies, Handles, Hood Joints, Rubbers, &c. Exchange joiner's or smith's tools.—LOWE, Orange-street, Nottingham.

A good one horse-power Horizontal **Steam Engine** for exchange.—Full particulars of S. H., 20, Castle-street, Reading.

Will exchange **Pediometer** for pedestrians, for 3½ slide-rest or castings, or taps and dies, value £1.—H. BEALE, 15, Market-hill, Cambridge.

Wanted, good Lathe and Scroll Chuck for optical work, Exchange ½ H P. Hugon Gas Engine, in capital working order, or sell.—NOAKES, Billingsgate-street, Greenwich.

Grand old **Violin**, case, two bows, and fittings, value 70s. Will exchange for good Winter's Machine or offers.—BISHOP, 17, Percival-street, Accrington.

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Sewing Machine, suit tailoring or similar trade. Take Cloth or useful exchange value 45s.—BROMBY and CO., Colchester.

12 years' "**Illustrated London News**," clean. Exchange County or Town Histories, Illustrated Books, or anything useful.—CLEARANCE, 3[illegible], Rignold-road, Camberwell.

Hot-air Engine, new, made by engineer, in working order, 2ft. high, cylinders 2½in., dia. ¾in., with water vessel and connections complete, burns gas. Offers.—MORLEY, Victoria-road, Diss.

Blackman **Air Propeller**, 36in., only been used 4 weeks, with pulley complete, ready for work, cost £17. Exchange offers invited.—W. HUTCHINSON, Liversedge, Yorks.

Pair of "Atlas" **Telephones**, new, cost £4 4s. Exchange for Tinman's Wiring Machine or self-centring Chuck.—Address below.

Pair of Gillett's **Magnetic Telephones**, with keys, cost respectively £1 10s. and 10s. Exchange for Wiring Machine or self-centring Chuck.—Address below.

Fittings for Albo-carbon Light, cost £2 10s. Exchange Wiring Machine or self-centring Chuck.—Address below.

Pair of **Magneto Generators and Bells** combined, cost £1 10s. Exchange Wiring Machine or self-centring Chuck.—PETER DOBSON, Leyburn, Yorks.

Electrical.—11in. cylinder Machine, on solid mahogany stand and frame, partially made, requires conductor, and cushion stand, with conductor, stand, pith balls, and electroscope. What offers?—WHEELER, Blackwellgate, Darlington.

Bicycle, 50in., good, with accessories. Offers to £3 10s. value. 4-air Musical Box, 25s. value. Part cash preferred.—17, Newland-street, Kettering.

Smith's **Fan Blast**, Anvil, and 5in. Leg Vice. Exchange for about 1½-horse Cylinder, complete, or offers.—[illegible], St. Mary's-street, Southampton.

3in. back-gear **Lathe Heads**, new, 50s. Exchange £3. Sliderest, 30s. Wanted, [illegible] Offers.—[illegible], 12, Savile-street, Hull.

Gramme Dynamo, [illegible] with Pacinnotti ring armature, 16 sections, adjust[illegible] new. Offers in Exchange; things requested.—HARRIS, [illegible], Nottingham.

Strong **Copper Boiler**, vertical, 17 by 7, fire-box, furnace door, 1 tube, partly [illegible], manhole, safety valve, worth 37s. Offers.—J. A. DICKSON, [illegible], Buccleuch-street, Glasgow.

5in. Screw-cutting **Lathe Castings**, complete set, all planed, headstocks bored, gap bed 6ft, 22 change wheels, for good Safety Bicycle.—9, Wellington-place, Bowdon.

Wanted, ½-plate **Bellows Camera and Lens**. Will give in exchange 3in. Astronomical [illegible] Drilling Machine, Violin.—OLIVER CORNWALL, [illegible], West Brighton, Sussex.

the lower portion of this wire. Fig. 68 shows an arrangement used in large private houses when it is desired to to be able to ring upstairs as well as downstairs; two pushes being placed in each room for this purpose. Pushes P¹ P² P³ ring downstairs, while pushes T¹ T² T³ ring upstairs. An indicator, H, and bell, B, are placed both at the top and bottom of the house, the indicator being of the form described for the previous figure. When wiring, a main wire, *m*, is run (as before) from one pole of the battery to the farthest push, and branches taken off at the most convenient points to the remaining pushes. A separate wire is then run from each of the pushes, those that come from the pushes that are to ring upstairs going to the top indicator, and the others to the bottom one. A return wire, *r*, is also run from the other pole of the battery to the top bell, branching off to the bottom bell as it passes. The front and back doors should preferably ring on to separate bells instead of the ordinary house bell; though, if the expense is objected to, they can, of course, be put on to the indicator. As to which pole of the battery the main wire from the pushes should be attached, provided the insulation is good, it practically does not matter which: but as it is best to keep to one way of wiring, it is advisable to conform to the conventional method of attaching it to the positive.

After the building has quite left the painters' and paperhangers' hands, the pushes, bells, and indicators must be fixed, a final test being made with the galvanometer to see that the wires are still in the same condition as when left at the completion of the wiring (see Article I.). When connecting up the pushes, care must be taken not to overturn the screws under which the wires are fixed, for with the majority of pushes as sent out the screws are very small, and generally screwed down hard; consequently when the screws are slacked out and the wires placed under them it is very rarely they will bear the turning necessary to get good contact. If the pushes are hard wood and the screws small, it will amply repay to take out the small ones, re-drill, and put in larger ones. Before cutting off the ends of the wires to connect to the push, a little of the slack should be worked back into the tube, thus allowing of the connection being made again should it break at any future time. The pushes having all been connected up, the next thing is to fix the bell and indicator. In this country the general practice is to place the bells with the gongs downward, though it is obvious they will work equally well in any position. A bell, however, adjusted for ringing in one position will, of course, require fresh adjustment if fixed in another. The best place for the bell that works in connection with the indicator is just above the indicator, which, like the bell, must be screwed to a wood block fixed at the time the house was wired.

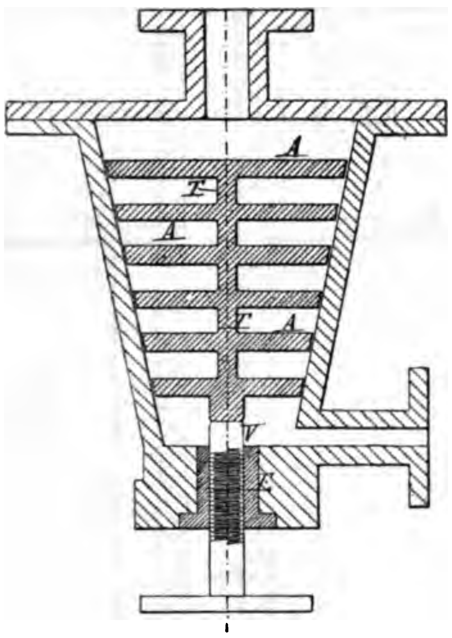
Nothing looks so bad as a bundle of wires all twisted and hanging about loosely, and if there has been any slovenly wiring in a house it will always be found in its most violent form at the indicator. The tubes carrying the wires should either end behind the indicator, and the wires brought over the top and fastened to their respective terminals, or else, if the battery is in a cupboard near, the tubes should end in the cupboard, and the wires continued on to the indicator, tied up into a neat cable. A very good way, however, and the one adopted by the writer, is to stop the tubes just beneath the ceiling above the indicator, and then to run a light, flat casing, neatly stapling the wires down inside in the order that they come out of the tubes. This method, besides having a very neat appearance, allows of the various circuits, so far as they branch off into the *tubes, being inspected at a glance.* Having fixed the indicator bell, and brought all the ends of the wire to the indicator, nothing now remains but to fix the right wires under the different terminals of the indicator. To do this the battery (having been previously charged) must be put into its proper position and connected up. The assistant must then be sent to the different pushes in succession, going from room to room in a pre-arranged order. At each room he holds the button of the push in till he gets the signal to leave go, when he proceeds to the next. Whilst the assistant is pressing the push, the ends of the wires must be touched in succession on any terminal of the indicator till the bell rings, when the wire that causes the bell to ring must be inserted under that terminal of the indicator which corresponds to the room the assistant is in. A small metal wedge should be included in the fitter's outfit, which (if no assistant is at hand) can be inserted between the springs of the push to close the circuit.

F. C. A.

(*To be continued.*)

RICHARD'S STEAM TRAP.

A FEW years ago, M. C. Richard, of Paris, patented in this country an improved steam trap, in which apparatus were arranged a number of small passages alternating with passages of large area, so that the steam, in passing into the trap, together with water of condensation to be discharged, was subjected to such successive expansions and corresponding losses of pressure that at the discharge opening for the water of condensation the pressure was so much reduced that no escape of steam took place.



The present improvements have for their object a simplification of the construction of such apparatus, whereby it is capable of being readily regulated and cleansed. For this purpose a conical or tapering casing is used within which are a number of loose discs or plates situated at small distances apart one above the other, and all formed in one with or connected to a central stem, the lower end of which rests upon an adjusting screw, lever, or incline provided at the lower smaller end of the casing where the discharge pipe for the water of condensation is situated. When the apparatus is at work, the series of discs or plates are so adjusted in position by the screw that a narrow space intervenes between the edges of each of the discs and the sides of the casing, so that the steam entering the trap, together with the water of condensation, at the upper large end of the same, is caused to pass alternately through the narrow spaces between the discs and the casing, and then into the comparatively large spaces between each two discs, being thus subjected to consecutive expansions. The discs being made of a metal that has a different coefficient of expansion from that of the metal of which the casing is made, it follows that the hotter the entering steam is the smaller will be the interstices between the discs and casing, owing to the increased expansion of the former, and consequently the greater will be the reducing action of the trap. The edges of the discs are made with exactly the same bevel as the taper of the casing, so that by lowering the discs by means of the screw, the interstices between the two can be reduced to an exceedingly small extent, and by lowering them still further they may be made to fit closely against the casing, thus forming an effectual shut-off valve, preventing all escape. On the other hand, by raising the discs up considerably by the screw they can be removed to such an extent from the casing as to allow the apparatus to be readily cleansed.

The figure shows in vertical section one arrangement of the invention. Within the conical casing of the steam trap are a series of discs, A, formed of a material that expands more readily than that of which the casing is made, and which are formed in one with or fixed to a central stem, T, of any suitable material, but by preference of iron or bronze. This stem rests at bottom upon an adjusting screw, V, passing through a screwed bush, E, in the casing, by which the stem, together with the discs, can be raised or lowered. The edges of the discs are turned so as to have exactly the same degree of conicity as the interior of the casing, so that when lowered by the screw V so as to touch the casing a tight joint will be made between them, while by raising the discs more or less from that position narrow passages will be formed between them and the casing for the escape downwards of the water of condensation as described. For cleansing the steam trap, the discs are raised so as to leave sufficient room between them and the casing for that purpose.

In a modification, a single disc of greater depth has three or more projecting circular ribs formed thereon having grooves between them, or, in other words, the central stem of the first arrangement is enlarged in diameter so as to reduce the spaces between the discs to grooves. This construction has the advantage of avoiding difficulties of accurate adjustment that may arise through the warping of the discs in the first arrangement. The screw rod is in this case provided at its upper end with a head by which it is connected to the disc by means of a divided plate secured to the underside of the latter, so that it is free to turn independently of the disc. The bush through which the rod screws is also screwed into the casing, thus allowing of a very accurate adjustment of the parts.

In another modification, the discs are constructed in a similar manner to those shown, but are made thicker towards the centre, to prevent warping. The taper of the discs and of the casing is made in the opposite direction, so that for cleansing the apparatus the discs are lowered instead of being raised. By this arrangement the easy and rapid accurate setting of the apparatus after cleansing is facilitated. Instead of a screw it is evident a lever might be used.

GAS LIGHTING BY ELECTRICITY.

BESIDES the specially-fitted burners, the apparatus necessary is an ordinary Ruhmkorff or induction coil, giving a length of spark in proportion to the number of jets provided with metal points, constituting so many interruptions in the circuit, and a battery to work the coil. For this purpose a one-fluid bichromate battery is used, provided with means for lowering the elements into the solution while the operation of lighting is going on, after which they may be withdrawn until again required. The whole process occupies but very few minutes, so that a battery once charged lasts a very considerable time. The current may, by means of switches, be directed into any desired circuit leading to any sun-burners or group of burners.

Fig. 1 represents the burner fitted with its two metal points, to which are attached the wires leading to and from the secondary terminals of the induction coil; the tap by which the gas is turned on may, of course, be placed

FIG. 1.

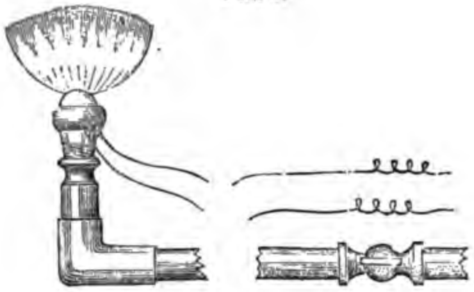


FIG. 2.

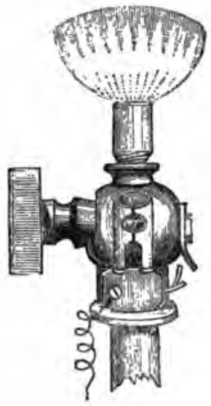
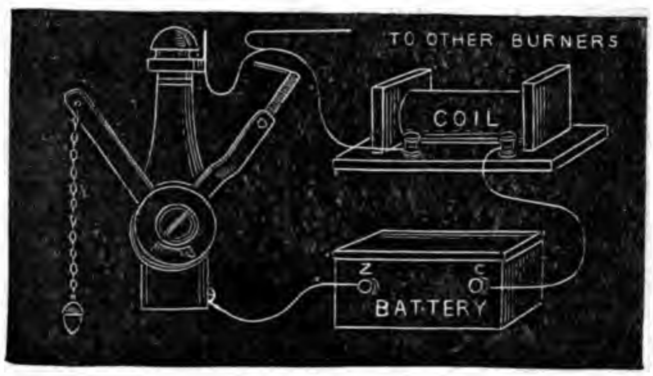


FIG. 3.



any convenient portion of the gaspipe. In United States the necessary high-tension ent is supplied from a static electrical hine, constructed with two ebonite plates, current being generated by induction. A lar machine is in use in this country for g fuses in collieries, &c.

individual gas-jets within reach of hand her system of lighting, worked upon en- y a different principle, is applied. The er is so constructed that in the act of turn- the tap the gas is ignited, and for this ose a short length of fine platinum wire is ered incandescent by the momentary pass- f an electric current. The plug of the er is so fitted, that as it is being turned a small jet of gas issues from it at the side, which becomes ignited as soon as it impinges upon the incandescent platinum wire, and as the tap is still further turned this lighted jet ignites the main jet, or what we may term the jet proper, itself then becoming extinguished, and the current automatically switched off the platinum wire. The whole of these operations are effected while the tap is being turned, and take considerably less time to perform than to describe. The battery consists of three or more medium-sized manganese and carbon cells, which, besides the burners and the conducting wires, constitute the whole of the apparatus required, and may be placed in any convenient and cool place. The exciting fluid used in these cells is a saturated solution of sal-ammoniac.

FIG. 4.

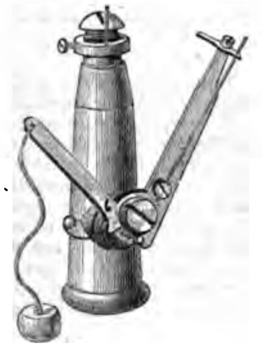
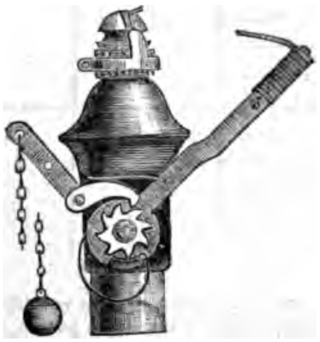


FIG. 5.



In Fig. 2 we illustrate a burner such as we have been describing, with its fine platinum wire stretched in front of the subsidiary aperture. Another form of burner has recently been introduced by Messrs. King, Mendham, and Co., of the Western Electrical Works, Bristol, in which the ignition of the gas is effected by means of a lever, which is made to move through a certain distance, and during its movement to come in contact with a projecting stud held by a ring fixed to the clay tip. These burners are made by the firm in a variety of forms, the same principle of action being carried out in all. The lever is provided at its upper end with a spiral wire spring, which yields to the rigid stud on its passage from one side to the other. Contact is thus always secured, while no opposition is offered by the lever during the movement. As the lever is pulled past the stud, a bright flashing spark is produced, which ignites the gas. The current required is generated by Leclanché batteries, such as are used for electric-bell ringing, thief alarm, and telephone working, and the spark is produced by interposing a primary induction coil in the wire circuit. Only one wire need be laid direct to the burner, as the gaspipe itself furnishes a path for the return of the current. Where more than one burner is connected to the coil and battery it is only necessary to extend the insulated wire from tip to tip, the gaspipes constituting, as before, the return path.

FIG. 6.

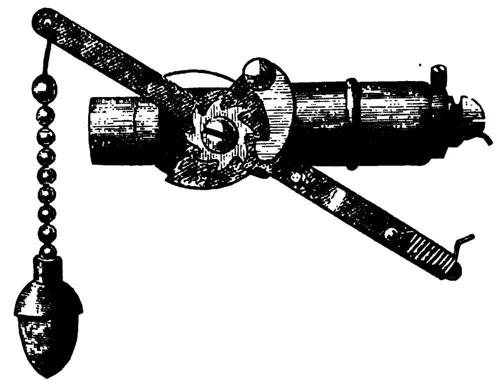
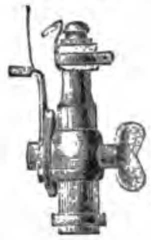


FIG. 7.

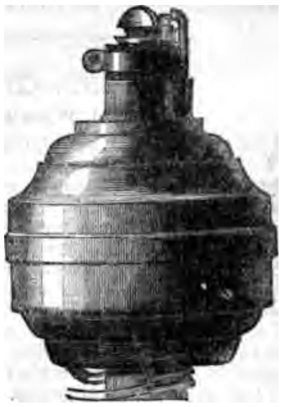


In Fig. 3 is illustrated the method of making the necessary connections between coil, battery, and burners. It is obvious that the connection between the zinc pole of the battery and the gaspipe may be made where most convenient, and the coil and battery may be placed together on a shelf in a cool place. The simplest form of these burners is shown in Fig. 4, where the lever is provided with a short piece of cord by which it is pulled past the vertical wire stem on the tip, a spring being fitted at the fulcrum of the lever to cause it to return to its original position upon the release of the hanging cord. This burner is supposed to be fixed in an accessible place, although by simply lengthening the cord of the lever, providing the tap is conveniently placed, the burner itself need not be within reach.

The burner illustrated in Fig. 5 is provided with a tap, and is so arranged that as one pull turns on the gas and ignites it, the next pull turns it off.

Fig. 6 shows a burner similarly constructed, but adapted for use over a billiard-table. This form of burner cannot be too strongly recommended, as by its use all risk of burning the cloth by dropping matches, wax, &c., upon it is entirely obviated.

FIG. 8.

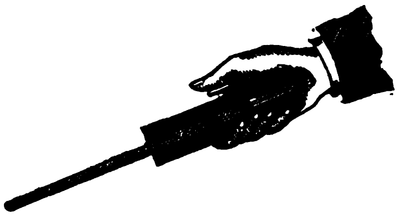


Another form of burner, also provided with a tap, is shown in Fig. 7; and this, as will readily be seen, must be fixed within easy reach of hand.

In Fig. 8 is represented yet another form of burner, by which the gas is turned on and ignited by simply pressing a button, and extinguished by a similar operation, so that a gas-burner may be lighted upon approaching a dark portion of a staircase or a corridor, and extinguished after passing. Any of these burners can be adapted to existing brackets or other fittings, and can be confidently recommended for use where a temporary light is required in any room, cellar, or in an outhouse where oils of an inflammable nature are kept, as it is utterly impossible that a conflagration can occur where there is no dropping about of lighted matches or paper. For bedroom or sick-room use they are equally useful, the gas being ignited without any trouble, and only when it is wanted.

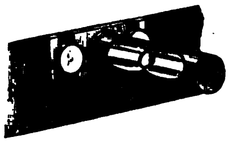
We have not yet made mention of the portable lighters, which are also comparatively recent inventions. In an early form of this lighter a battery was carried in the handle, which worked an induction coil giving the necessary spark; but in the most recent form the battery and coil have been replaced by an internal ebonite cylinder, the electric spark being produced by its rapid rotation. In this form there is no battery to get out of order, the electric spark being produced as required. In Fig. 9 we illustrate this form of lighter.

FIG. 9.



SPIRIT-LEVEL FOR CAMERAS.

A HANDY little spirit-level for use with cameras, &c., has been registered by Mr. W. R. Wynne, and is illustrated in the annexed engraving. It may be carried in a shallow pill-box placed in the pocket, or, perhaps more conveniently, in a hole bored in the tail-board of the camera itself. The slot is cut at an angle of 45° to enable the bubble to be seen when the reversing frame is used without shifting the level from its place; but the latter may be removed and replaced with the greatest ease. This little level will be useful in connection with other apparatus, and we may mention that the sole agent is Mr. Martin, Birkbeck Institution, Bream's-buildings, E.C.



GEARING.—XIV.

Helical Wheels.

WE have seen, in a former article that a considerable amount of rubbing action is inseparable from the gearing together of wheel teeth of ordinary construction, and that such rubbing must necessarily take place on all the acting portions of the faces and flanks away from the line of centres, notwithstanding that the *total action* of a pair of wheels upon each other is in effect that of rolling contact only. It is, of course, desirable that this rubbing shall be diminished as much as possible. The more nearly the path of contact can be made to approach a straight line perpendicular to the line of centre, the less will be the obliquity of the line of action of the teeth, and the less the amount of sliding present. This reduction might be effected by diminishing the pitch; but then this would also weaken the gear, and is, therefore, not permissible. So long ago as 1674 Dr. Hooke, a Cambridge professor, suggested the introduction of stepped wheels, with the object of reducing the rubbing friction upon the tooth flanks without weakening the teeth themselves. Obviously, in stepped wheels, which are formed on the principle of the juxtaposi*tion of a num*ber of toothed discs, each placed *a little in advance of its fellow* circumferentially, one pair of tooth flanks and faces will no sooner have touched upon the line of centres than the contact will almost immediately cease, and the pair on the succeeding slice will come into contact. Thus, if in Fig. 96 A and B represent the axes of two stepped wheels in gear, the distances P P′ would represent their pitches. The contact of a pair of teeth, as ordinarily formed, begins in advance of the line of centres, and as the profiles slide over each other the sliding action diminishes until the pitch point is reached, where it is *nil*, and then gradually increases until contact finally ends at some distance beyond the line of centres. The conditions which govern the amount of rubbing action were fully explained in Art. IV. But in Fig. 96 the effect of cutting the wheels into five slices is as though we had divided the pitch P P′ among five teeth, reducing the angle of the arc of contact correspondingly, while yet the tooth *thickness* remains unreduced. Contact of each slice can only take place very close to the line of centres, the minute dista
one step to its next fellow—in this ca
—alone preventing the contact fro
that of a mathematical point. Hence,
numerous the slices, the nearer of c
approach to the condition of simpl
sought after.

FIG. 96

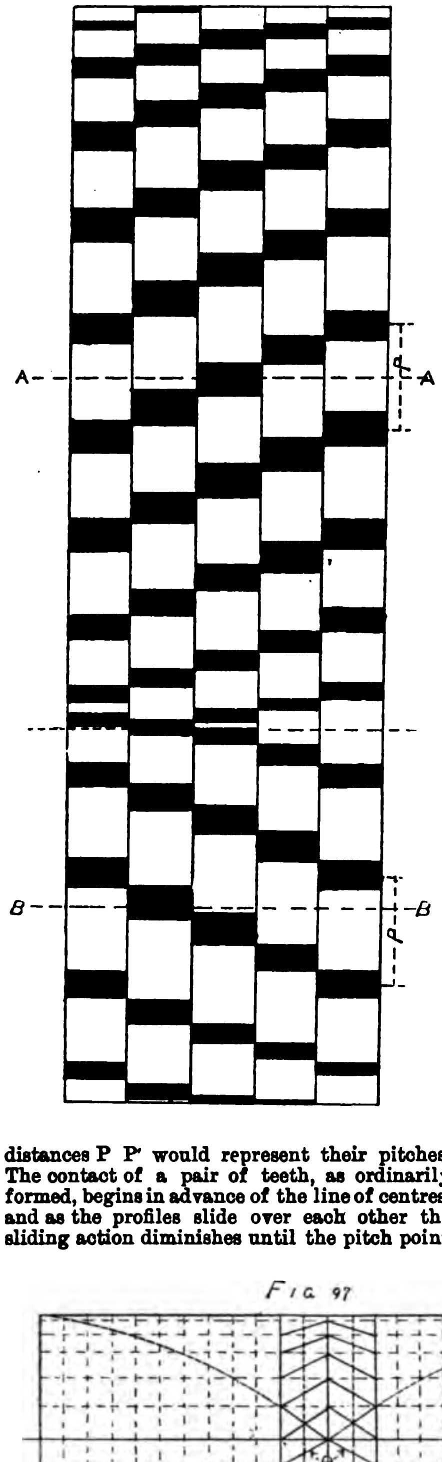
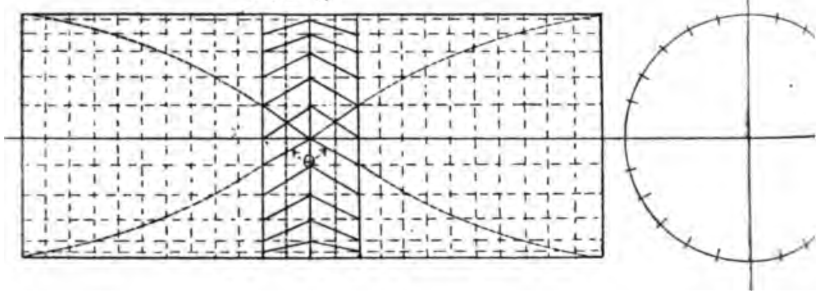
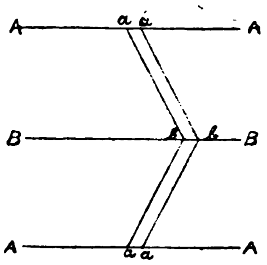


FIG 97



There are grave practical objectio
form of gear, though it has been, an
sometimes used for special work. The
ing of the teeth is a source of weak
the patterns and moulds are not read

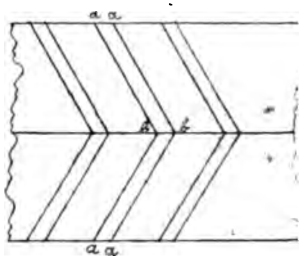
FIG 98.



But the *principle* embodied therein
first importance, and appears to have
the true helical gears.

If the stepped teeth be now modi
the screw or helical form—if the
made, not only more numerous, but i
number, that is, obliterated by bein
into a continuous screw, we get *heli*
Neither are these so much a novelty
may suppose, having been patented

FIG 99.



White, of Manchester, so long since
The invention proved a failure from
mic point of view, chiefly, it must be
from the difficulty of making and
complete pattern wheels of this fo
introduction of the wheel-moulding
has so much simplified the constru
gear wheels, saving the cost of comp
terns, which in these forms are more
some to make than the plain spur wh
I think they must be credited with th
sive employment of helical gears i
years. For helical wheels are mould
as quickly in these machines as are
gears, and are now fully recognised a
ciated as altogether within the range
tical work.

In a pair of helical wheels, ther
have teeth whose points of contact
petually changing, though always
the *pitch point*, and rubbing of the
thus avoided, simple *rolling* contact
place. The points of contact travel

tooth to the other as the wheels re-

nising the true character of these as belonging to the family of screw et us pursue the subject on that When treating of these gears, we rticle XI. page 25) that if two heels, having right- and left-handed respectively, were set in gear, the rela- itions of their axes would be equal to *rence* between the angles of the helices. re, at whatever angle we set the teeth l wheels, so long as the angles are each, we get parallel shafts, since the easured in relation to the wheel-face is plement of that measured relatively to . We are, therefore, not tied to any particular for the teeth of these

difference in the "handing" of the creates an important distinction be- he spiral and the helical gears. For e threads of a pair run in the same , either both right or both left hand, iral gears, p. 25, Fig. 78, there is no of surfaces, but *sliding* altogether, excessive friction and wear, so that heels doing heavy duty become polished ed along their tooth faces, and do not g. But having screws of opposite hand, lical gears, there is no sliding at all, ing only, as just now noted. So that n their fundamental principle of con- n, there is really no point of similarity spiral and worm gears on the one hand, helical wheels on the other.

er, as a matter of practice, gears are if ever, now constructed with helical of one hand only, because of the result- onal pressure on the axes, due to the y of the teeth. But by making the ctional lengths of two distinct screws angle, but right- and left-handed re- ly, the diagonal pressure of one that of the other (Fig. 97), wherein the elementary *double* helical form.

l wheels being true screw gears, it is that they can be designed on the basis crew, as shown in Fig. 97, which figure the connection between these and the screw gears quite manifest. But we not think of proceeding to strike out heels in this fashion. It would be too ome, and we do not want to know the tch, nor the divided axial pitch, nor ily the normal pitch, but the circum- l pitch only, and this, like the normal nust be alike in two wheels gearing r, and the tooth angles must also be So we simply decide on the circumfer- itch and tooth angle, and take no note the other dimensions. Then the angle rmined jointly by the pitch and the the condition being that as contact t the centre or apex of a tooth, it shall ce at the margins of the next follow- n Fig. 96. In a wheel of coarse pitch onsiderable depth, the tooth angle will ter than in a shallow wheel of fine pitch. y the angle θ in Fig. 97 may range 0° to 140°.

e actual striking out of these teeth, t methods will probably be pursued in t shops. Since they form such ex- short sections of complete screws, it that in wheels of large diameter and y deep they are reduced practically to t teeth set diagonally. But in pinions ll size, and of considerable depth, the f the teeth is very apparent. The g of this twist, be it much or little, is e matter. Remembering that the centre screw on any plane perpendicular to is always *radial*, we can mark out rical, or nearly symmetrical, teeth on h plane, and connect them with screw presenting the tooth points. Thus in let A A represent the outer faces of a wheel blank, whether prepared for a e pattern or a machine block, and B the long the centre of the same. Let *a a* t the tooth points on the wheel faces, the same on the joint B. Then a piece steel, a clock spring unwound for , laid close to the block, and reaching to *b*, will give by its edge the curves of th points with accuracy. Or, again, a f paper (Fig. 99) having the proper ls marked on, will, when glued around the wheel blank give the screw outlines of the tooth points. And as the portions *a a* and *b b* stand to each other in the relation seen in Fig. 100, the tooth centres on any section running to the centre C, it follows that the total effect on the profiles of the teeth is to give them the twist peculiar to the screw. This twist is developed during the working of the inter-tooth spaces by the aid of a templet, similarly to that shown in Fig. 72, p. 594.

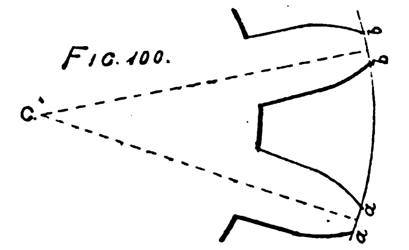


FIG. 100.

In Figs. 101 and 102, I have drawn portions of two wheels of different diameters, but of the same pitch, in order to show the manner of their projection, and the influence of diameter on the twist of the teeth. To render the projection quite clear, I have left sharp angles both at roots and points. But in practice the roots are alwuys provided with hollows for strength, and the points are rounded slightly to facilitate smoothness of entry into gear.

FIG. 101.

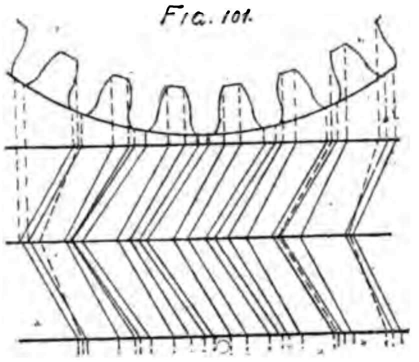
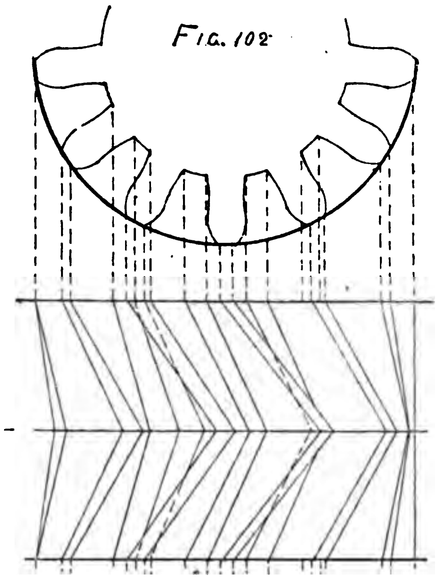


FIG. 102.

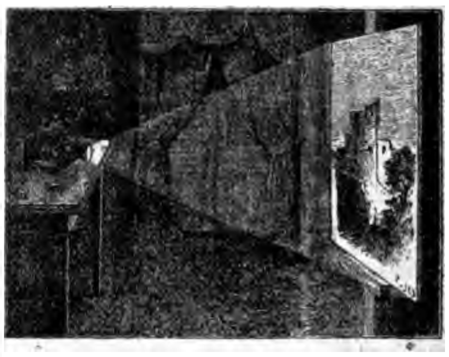


In neither of these wheels could teeth having straight flanks be used. But in wheels of larger diameter, and not very deep, the teeth need not be marked in place, but worked straight through as though for a spur wheel, and nailed on at the proper angles. But when the twist is only slightly perceptible, it should be imparted, if the most perfect results are to be obtained from the application of the helical principle.

J. H.

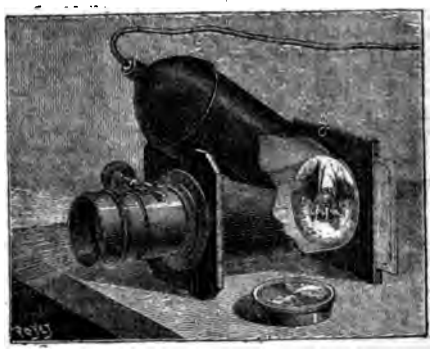
TROUVE'S ELECTRIC MEGASCOPE.

IN the magic-lantern and the projecting apparatus usually employed, transparent slides have to be used. It can be easily imagined how useful would prove to have a method of making projections of opaque objects, such as photographs affixed to cardboard, medals, and various apparatus of small dimensions. The physicist Charles introduced into lecture courses an apparatus called the megascope, by means of which the projection of opaque bodies was effected. The objects placed outside of a dark room were brilliantly illuminated by the sun, and a lens properly fixed in the shutter projected an enlarged image upon a screen. An artificial light was soon substituted for the sun, and at the beginning of the present century the effects produced by the megascope had considerable success. The use of the apparatus was not confined to the projection of statues, bas-reliefs, and medals upon a screen, but was extended to the projecting of living persons, who were strongly illuminated by Argand lamps. Since that epoch a large number of megascopes have successively appeared.



We shall now make known to our readers an electric apparatus constructed by M. Trouvé under the name of the anxanoscope. This apparatus, which is lighted internally by means of one or two small incandescent lamps, is very useful for projecting photographs, drawings, medals, &c. It consists of two cylindrical tubes, fitted together at a certain angle. One of these tubes is provided at its upper part with a lamp and parabolic reflector, and the other contains an ordinary photographic objective (Fig. 2). At the angle formed by the union of the two tubes is placed the object to be projected by reflection on the screen, say a landscape, a photographic portrait as shown in the figure, or a chromo-lithograph. The most remarkable projections are those of medals and coins, and especially the works of a watch in motion.

There is another model made that differs from the one just described in the addition of a second cylinder containing another electric lamp placed in the focus of a second parabolic reflector. A bichromate of potash battery of four elements, or a battery of Bunsen cells, may be used for supplying the incandescent lamps.—*La Nature.*



PHOTOGRAPHY WITHOUT A LENS.

THIS question, to which at first but little heed was paid, tends to acquire importance since some new and very interesting results have been shown, proving the utility that may be made of this simplification of photographic appliances. It is very certain that we cannot achieve the rapidity and sharpness obtained in negatives taken with lenses; there is, however, an important advantage to be gained from the fact that with one single apparatus we may, without changing our position, obtain images of various sizes. The only alteration required in the apparatus is to lengthen or shorten the distance from the camera front to the plate, and to vary the size of the opening, using an aperture of from $\frac{3}{10}$ to $\frac{5}{10}$ of a millimètre for small images, and [illegible] to the other, and the ways of the ordinary the most important researches and studies on this interesting question, has recently pointed out a formula showing what should be the diameter of the holes to correspond with different focal lengths. Thanks to the improvements recently introduced in the construction of this little piece of apparatus by Messrs. Dehors and Delandres, portable photography is rendered complete, without having to carry a set of lenses such as would be necessary when we desire to take views including varying quantities of the subject. One of the most curious results that we have seen is by Capt. Colson. He has reproduced an engraving, and the copy shows no lines whatever. It would be supposed to be a copy of a mezzotint. Unless magnified to double the size, no trace of a line can be seen. This fact shows the possibility of transforming line or point images with continued half-tones; just the inverse of the process discovered some years since, of transforming photographs having continuous half-tone into line images for the engraving and block printing processes. We cannot too forcibly direct the attention of experimenters to this very interesting question of photography without a lens, the limit of the application of which cannot be foreseen. It is, moreover, certain to render greater service in proportion as the rapidity of our sensitive plates is increased. What limits its use at present is the length of exposure required in consequence of the small size of the aperture admitting the light. It results from this, that we can only operate on still subjects; but there is nothing to prove that we shall not arrive at instantaneity, and in this case we can foresee the great use that may be made of this simplification of photographic apparatus.—Leon Vidal in *Photographic News.*

DR. RICHARDSON ON IDEAL FOODS.*

Selection of Foods for Wealth and Felicity.

At the Memorial Hall, on the 20th ult., Dr. B. W. Richardson brought to a close the course of six lectures on the above subject; Mr. A. F. Hills in the chair.

Taking for his subject, "The Selection of Foods for Wealth and Felicity," Dr. Richardson said that in his last lecture they had studied the process of digestion, and had passed on to consider those foods which would work best in the digestive organs; those which would supply the most power to the body after digestion; those which accorded most with the taste of individuals, especially of the young; and, lastly, those which would convey the least disease. They would now pass to the two remaining questions, of Economy and Felicity from food, dwelling in the first place chiefly upon economy that might be called domestic, or that which referred to the individual; and he would leave them to follow out the lesson as applicable to the nation at large. All thoughtful people had agreed that the greatest economy of food was that which was derived from the plant world for sources of supply; and all thoughtful men had come over to the view that this perfect economy of food was compatible with good health. That was to say, all thoughtful men and women who had given the subject proper consideration, for he was not dealing with those who spoke off-hand and had not inquired as to the relative values of food, nor were conversant with the various facts put before them in those lectures. Turning back nearly a century, they would look at the sayings and arguments of one particular man, who, though he could not be called a vegetarian, yet certainly, by his life and works, did more to improve the national and domestic idea with regard to food than any man in history he was conversant with. This man, the illustrious Benjamin Thompson, commonly known as Count Rumford, was an intellectual genius of the highest order—a man of science, and, at the same time, a great social scholar, who turned his attention to the profoundest scientific questions one day, and the next day would be studying the simplest facts relating to our daily life. To Count Rumford they were indebted for the first idea of what was called the great theory of the correlation of forces, for the best information on the subject of clothing, and for the best exposition of the simplest facts of food and economical subsistence. Count Rumford had once the feeding of the whole of the town of Munich: his titles, and much of his fame, were won there; and he states that nothing struck him more, during a time of great privation, when he himself had to feed people—nothing impressed or surprised him so much as the fact of the very small quantity of food that was required by human beings to support life and health, and the very trifling expense at which many thousands could be fed, and the strongest could be maintained. After five years' experience of feeding the poor of Munich, he came to the conclusion that the most satisfying and most nourishing foods, as well as the cheapest, were composed of a mixture of the following edibles, which might be put into a soup—viz., pearl barley, peas, potatoes, and siftings of fine wheaten bread, with the addition of vinegar, salt to taste, and water, in proper proportions. These were his staple foods during the whole of the great trial which he made of feeding the large town of Munich. Count Rumford was not a vegetarian: he took small quantities of animal food to the end of his life, but he very much depended on vegetable food; and in some cases, where he recommended animal food to be used, he stated that he used it more as a flavour than as a staple food. In the foregoing selection of Count Rumford's they had the foundation of an ideal food, if they made thereto the addition of fruit. He would take pearl barley, peas, potatoes, and wheat, and compare them with animal food as to the question of economy. Bearing in mind what they had already learned, they could, if desired, substitute haricot beans for peas, and oatmeal for the wheat, so as to modify the food, did occasion require. By weight, these staple foods represented twice the vital value of the primest animal food. He was not herein referring to price, but vital value—value for work done in the animal economy. As to price, the articles derived from the vegetable world referred to would cost 5d. for 4lb. Four pounds of animal food, possessing half the vital value, at 10d., would cost 40d. This was the distinction between the two. As near as he could possibly reckon, the cost of feeding the poor of Munich by Count Rumford for five years would be eight times more economical than an exclusively flesh diet would have been. This, of course, was not a fair comparison, because nobody would live exclusively on animal diet. Most persons would divide the amounts into equal parts, and spend 20d. on animal food, and 2½d. on vegetable food, so that it would be 22½d. for four meals, or about 5½d. a meal. That was how the matter stood for mixed foods; but, considered in that way, if Count Rumford were right, these persons would still be extravagant, for from vegetable food alone four meals would cost but 5d., instead of 5½d. for one meal. Suppose they improved on this vegetable food, and added 2d. a meal for fruit in season, so as to provide luxuries as well as might be called necessities, then 5d. for the four meals would reach, by the addition of 8d. for fruit, to 1s. 1d., or 3¼d. for each meal, instead of 5½d. for a mixed meal, or 10d. for a flesh meal out and out. He believed that this was a fair amount of saving, that would be attained by the vegetarian system by a strict selection from the choicest vegetable foods for necessities, with fruit added to them as luxuries; and that other varieties of fruit, grain, and vegetables could be treated in this way, and would be used with the ideal foods on which this nation would ultimately live.

Coming to the second part of the lecture, dealing with happiness and felicity in connection with food, he was bound to say at once, as a physiologist, that what was commonly called happiness—lightness of heart, rapidity of thought, and all else which sprang from a happy life—was connected almost entirely with what they took as food. That happiness was best sustained by those foods which ministered quickest, and with least trouble, to the digestion, and therefore to the wants of the economy. A man might, however, be a vegetarian, and might live the most perfect life in respect to food—might lead an ideal life in that respect—and yet, from some great remorse, some crime, or misfortune, might still be, in a sense, unhappy. It was not to that he referred. He meant that happiness which led one to think that time was too short, and that made one akin with all the world. That class of happiness largely depended upon food—being fed well, fed properly, not over-fed, and those foods taken which assimilated best in the stomach, passed most easily into the blood, which best built up economy, and best fitted it for the work which it had to perform. If they took foods which were not properly digestible, and which, when taken into the body, produced trouble, then there was anxiety of mind. There were times when the worst troubles came, and yet the mind was serene; but another day came, with less trouble, or no trouble at all, and yet the mind was very depressed and unhappy; and the distinction often depended very much upon the food that was taken. It might be that atmospheric variations had something to do with it; but food turned the scale. Food and drink were the two marked agencies for keeping up serenity of mind, or producing want of serenity. They would remember that, on the occasion of their last lecture, their chairman, Sir James Hannen, had told them that what struck him most, in his change of diet from animal food to an almost vegetarian system, was the state of happiness which it produced, as compared with what he felt before. He had stated, they would no doubt remember, that this was one of the most marked features of the change; and that he really had experienced it to such an extent, that it was a source of the greatest gratification. This had been expressed by many persons; he had heard it expressed by many besides Sir James Hannen. He had felt it also in his own life, and most when he was nearly a vegetable feeder, and he scarcely remembered the time when a too exclusive flesh diet influenced him to any great extent. There was a distinct nervous system running parallel with the viscera, which was composed of a series of centres or ganglia from which the nerves passed in all directions, and these centres of the nervous system sent their fibres to all the great organs of the body, the heart, liver, stomach, and intestinal canal. There was no part of the body more largely supplied with these nerves than the stomach and parts concerned in the digestion, whereby they were supplied with nerve force for digesting the food taken; and if they taxed that nervous system too much, then came the depression which, when felt, rendered them unhappy; for the modern view of happiness was that the condition of the nervous system which caused happiness had no connection with the higher intellectual faculties, but sprang from these organic nervous centres. Some persons, desperately unhappy, always believing something was going to occur, always dreaming of death, were called hypochondriacs, which meant that their complaint lay beneath the chondria—in the region where the disease was seated. Anything which interfered with or exhausted the nervous system, which in turn ministered to the stomach, led to the depression which they called hypochondria. The primary point they had to settle in regard to food was that they should give the stomach such food that digestion should be carried out most rapidly, the smallest quantity of food possible being present to perform all the work which the bodp had to undertake. Did an animal diet or a vegetable diet conduce most to this favourable condition of the digestive organs? As yet physiologists had not made any series of inquiries bearing on this point. They had most carefully studied the digestion of animal food by artificial processes. They could pretty well tell the relative times of digestion of the different animal foods. Many years ago Dr. Beaumont, a Canadian physician, made a series of observations in this direction; but, the patient on whom he experimented being an unhealthy one, the results were not so reliable as might otherwise have been the case. Vegetable foods which went to support the heat and energy of the body, such as sugars and starches, were more readily digested and utilised than fats derived from the animal world; he had no doubt himself as to that point. In regard to the structure-building foods, were those derived from the animal or vegetable kingdom the most easily digested? Hitherto the idea had been that the animal foods were the most easily digested, and all the textbooks stated this to be so; arguing in this way, that a food which had already passed through the system of one animal must be more fitted for digestion by another animal than a crude vegetable food. He was not prepared absolutely to pronounce upon this belief. There was a good deal to be said in regard to the digestion of animal food by persons who had lived largely thereon for a considerable number of years; the most that he could say was that if the young, from early youth, were brought up to a vegetarian diet exclusively, they would digest such diet just as well as any other. As to the last order of foods which built up the harder parts of the body, the skeleton, it mattered not from which source these were supplied, whether from the animal world or the plant world. The lecturer then summarised the arguments of his previous lectures, and concluded by stating that the ideal food of man was one which could be taken directly from the world of plants, and adapted by scientific combination to all the wants and necessities of the great human family.

The chairman then rose and said:—My friends, we have come to the conclusion of a most interesting course of lectures; and I think we vegetarians, as a body, and the public at large, owe Dr. Richardson a vote of thanks for the way in which he has brought this great question before us. I think it will be the verdict of all who have listened to his addresses that he has treated the question with absolute impartiality, sitting as a judge upon the bench, and bringing up before him the evidence which touches upon this question from all points of view. I had rather hoped, myself, that in this concluding lecture we should have heard a little more of the ideal in food. The doctor has given us much from the physiological point of view, much from the economical point of view; but on the great subject of thought with which the title of the lecture deals, "Ideal Food," we have not had quite so much as I should have wished. Permit me, therefore, for a few moments, to put before you a few thoughts upon the ideal in foods. For the ideal is that innermost idea, that essential part of the original plan whereon creation is founded, which is the one thing needful for those who harmonise the verdicts of science and religion; who believe that, when you look out upon nature, you find the revelation of a truth that is four-square; and that the highest religious teaching, the highest scientific teaching, all that is best in the spiritual, psychical, intellectual, and physical planes—but form and harmonise one absolute, com-

tion of a number of toothed *disc,*
a little in advance of its fellow circumfer-

plete truth, which is the expression of God's will. We claim that such an ideal exists even in the "beggarly elements" of eating and drinking. This is taking the very highest view; it is the raising of the question of eating and drinking to the moral plane. It is the echo of the famous maxim, "Whatsoever ye do, whether ye eat or drink, do all to the glory of God." What, then, is ideal food? I believe that we may conceive the inspiration of a food that is in itself vital—that has in it the power of life—and that the real expression of ideal food is "vital food," or that which is capable of increasing directly our powers of life. This is a truth which has hitherto been untouched by science altogether. I cannot prove it to you this evening. You cannot disprove it. If it be true, it opens up vistas of possibility which cannot be estimated to-day. For now we live such short, scant lives. All our powers are limited, simply because we have so small an initial force with which to carry out our aspirations and purposes; but if there be such a thing as ideal food, containing in it a revitalising power, so that the springs of life may be perpetually renewed, instead of perpetually drained and exhausted, then we are for the first time beginning to understand something of the secret of life. Take the most powerful, the most gifted being within your knowledge, in any direction of development of thought—music, for instance—a born genius like Otto Hegner, or Josef Hoffmann; and there you find a boy of some fourteen years capable of producing, by the power of genius, that which baffles the skill of men who have spent their lives in the study of this particular art. What is such genius, but the concentration of inherited power in that particular direction? Conceive, then, in your minds this splendid initial power continually developing; and then you begin to come within the region of the Ideal, within measurable distance of Infinity. You begin to realise the power of Omniscience and Omnipotence. How do you find all power developed? It is simply by the determination of vital force in any direction—by the action of will. Vital force may be loosely termed the instrument with which will-power works. Spiritual or will-power represents the highest value of force—the controlling, dominating force. Vital force is a lower expression of the same will-power, just as animal life represents a lower range of human life. It is often said that a man has great "individuality": he may not be particularly intellectual, but he has a large share of that supreme will-power which, under proper conditions, moulds all else. And so the development of any power is determined by will-power, acting primarily through vital force. Take the lowest case, the athlete, the cricketer, the runner, the boxer, the swimmer, or even the billiard-marker. Each attains his skill by persevering practice—by the steady determination of vital force in one direction. Take the philosopher: you will find it is by the continual determination of his mental power in one direction that he achieves his purpose. In painting or music the same truth is repeated. If you only have sufficient reserves of vital force, which you can determine in any given direction, then you find that almost infinite possibilities lie open before you; and I, for one, believe that this splendid possession is the natural inheritance of every man and woman as children of the eternal God. We have, then, to find a food which shall not bear with it for ever the taint of decay, so that each day seems to be but one step along the pilgrimage of death.

"'Tis Life, not Death, for which we pant;
'Tis Life whereof our nerves are scant,
More Life and fuller that we want."

The teaching of religion has always been that death came into the world as the penalty for sin; and if we can destroy sin out of the world, I for one know no reason why the sting of death should not follow. You may not believe it. I am putting before you an Ideal, and the future alone can prove how far it is instinct with truth. Within my knowledge this possibility of vital food has never been discussed, much less put to the proof; and yet the suggestion is but the formal repetition of the first recorded commandment given to man in reference to food: "And God blessed them, and God said unto them, Behold, I have given you every herb which is upon the face of the earth bearing *seed*, and every tree in the which is the fruit of a tree bearing *seed*; to you it shall be for meat. And God saw that everything was very good." Take the seed of any plant, and you will find it contains that principle of life which makes it grow; but if you boil it or bake it, or pass it through the fire, you will so destroy that power of life that it will cease to be able to grow—you have dissipated that curious thing, Life, though you could not taste it nor see it there. Therefore, I say, it seems to me abundantly probable that this power of life, when received into our system, may produce some effect different to food which has had that power destroyed; and, therefore, such vital food as fruit, grain, and nuts, with their power of life undestroyed by fire, may, by degrees, so increase our physical power as to open up all possibility of life before us. You may say, This is absurd! I can only answer, "It may be true: Prove all things, hold fast that which is good." And, lastly, we know that vegetarianism does not destroy life, does not inflict pain, is not connected with cruelty; and all this presents a higher ideal to our minds than the ordinary diet of fish, flesh, and fowl. But I should also wish that we should be able to reach on to a higher point still, where we should gain even more; because we can see, in our own experience of vegetarians, that they are not always the most capable, not always the most healthy of our friends; and I, for one, believe there is such a thing as an unwise vegetarianism, and such a thing as a wise vegetarianism; and I boldly claim the right of the individual worker in this great cause to experiment freely, perhaps rashly, on his own person —*fiat experimentum in corpore vili*—in the endeavour to find out the ideal, or absolute will of God. Because of this thing, and this one thing alone, I am fully convinced, possessed, inspired if you will —that, if we can lay hands upon the perfect Truth of God, we have within our grip the power which will lift us up to all possibilities of perfection, which will give us all things that are good—health, wealth, wisdom, joy, peace—for certain and for ever, because we have become subject to the will of God.

MACHINE DESIGNING.—I.

By Prof. JOHN E. SWEET.*

ONE of the most important and one of the first things in the construction of a building is the foundation, and the laws which govern its construction can be stated in a breath, and ought to be understood by everyone. Assuming the ground upon which a building is to be built to be of uniform density, *the width* of the foundation should be in proportion to the load, the foundation should taper equally on each side, and the centre of the foundation should be under the centre of pressure. In other words, it is as fatal to success to have too much foundation under the light load as it is too little under a heavy one. Cannot we analyse causes and effects, cost and requirements, so as to formulate some simple laws similar to the above by which we shall be able to determine what is a good and what a bad arrangement of machinery foundation, framing, or supports? A vast amount of work is expended to make machines true, and the machines, or a large majority of them, are expected to produce true work of some kind in turn. Then, if this be admitted, cannot the following law be established?—that every machine should be so designed and constructed that when once made true it will so remain, regardless of wear and all external influences to which it is liable to be subjected. One tool-maker says that is right, and another that it cannot be done. No matter whether it can or cannot, is it not the thing wanted, and if so, is it not an object worth striving for? One tool-maker says that all machine tools, engines, and machinery should set on solid stone foundations. Should they? They do not always, for in substantial Philadelphia some machine tools used by machine builders stand upon second floors, or, perhaps, higher up; and of these machine tools none, or few at least, except those mounted upon a single pedestal, are free from detrimental torsion where the floor upon which they rest is distorted by unequal loading. But to first consider those of such magnitude as to render it absolutely necessary to erect them—not rest them—on masonry, is due consideration always taken to arrange an unequal foundation to support the unequal loads?—and they cannot be expected to remain true if not. When one has the good fortune to have a machine to design of such extent that the masonry becomes the main part of it, what part of the glory does he give to the mason? Is the masonry part of it always satisfactory, and is not this resorting to the mason for a frame rather than a support adopted on smaller machines than is necessary? Is it necessary even in a planing machine of 40ft. length of bed and a 30ft. table? Could not the bed be cast in three pieces—the centre a rectangular box 5, or 6, or 7ft. square, 20ft. long, with internal end flanges, ways planed on its upper surface, and ends squared off—a monster perhaps; but if our civil engineers wanted such a casting for a bridge they'd get it. Add to this central section two bevel pieces of half the length, and set the whole down through the floor where your masonry would have been, and rest the whole on two cross walls, and you would have a structure that if once made true would remain so regardless of external influences. Cost? Yes; and so do Frodsham watches—more than "Waterbury." It may be claimed—in fact, I have seen lathes resting on 6 and 8ft., engines on 10, and a planing machine on a dozen. Do they remain true? Sometimes they do, and many times they do not. Is the principle right? Not when it can be avoided; and when it cannot be avoided, the true principle of foundation building should be employed. . . . . A strange example of depending on the stone foundation for not simply support, but to resist strain, may be found in the machines used for bevelling the edges of boiler plate. Not so particularly strange that the first one might have, like Topsy, "growed," but strange because each builder copies the original. You will remember it, a complete machine set upon a stone foundation, to straighten and hold a plate, and another complete machine set down by the side of it and bolted to the same stone to plane off the edge; a lot of wasted material and a lot of wasted genius, it always seems to me. Going around Robin Hood's barn is the old comparison. Why not hook the tool carriage on the side of the clamping structure, and thus dispense with one of the frames altogether?

Many of the modern builders of what "Chordal" calls the Hyphen Corliss Engine claim to have made a great advance by putting a post under the centre of the frame; but whether in acknowledgement that the frame would be likely to go down or the stonework come up I could never make out. What I should fear would be that the stone would come up and take the frame with it. Every brick mason knows better than to bed mortar under the centre of a window sill; and this putting a prop under the centre of an engine girder seems a parallel case. They say Mr. Corliss would have done the same thing if he had thought of it. I do not believe it. If Mr. Corliss had found his frames too weak, he would soon have found a way to make them stronger.

John Richards, once a resident of this city, and probably the best designer of wood-working machinery this country, if not the world, ever saw, pointed out in some of his letters the true form for constructing machine framing, and in a way that it had never been forced on my mind before. As dozens, yes hundreds, of new designs have been brought out by machine tool-makers and engine builders since John Richards made a convert of me, without anyone else, so far as I know, having applied the principle in its broadest sense, I hope to present the case to you in a material form, in the hope that it may be more thoroughly appreciated.

The usual form of lathe and planer beds or frames is two side plates and a lot of cross girts; their duty is to guide the carriages or tables in straight lines and carry loads resisting bending and torsional strains. If a designer desires to make his lathe frame stronger than the other fellows, he thinks, if he thinks at all, that he will put in more iron, rather than as he ought to think, how shall I distribute the iron so it will do the most good.

To illustrate what I think a much better way, I have had made these crude models (see Fig. 1), for the full force of which, as I said before, I am indebted to John Richards; and I would here add that the mechanic who has never learned anything from John Richards is either a very good or very poor one, or has never read what John Richards has written or heard what he has had to say.

Three models as shown in Fig. 1 were exhibited; all were of the same general dimensions and containing the same amount of material. The one made on the box principle, *c*, proved to be 50 per cent. stiffer in a vertical direction than either *a* or *b*, from twenty to fifty times stiffer sidewise, and thirteen times more rigid against torsion than either of the others.

However strong a frame may be, its own weight and the weight of the work upon it tends to spring it unless evenly distributed, and to twist it unless evenly proportioned. For all small machines the single post obviates all trouble, but for machine tools of from twice to a half-dozen times their own length, the single post is not available. Four legs are used for machines up to 10ft. or so, and above that legs various, and then solid masonry. If the four legs were always set upon solid masonry, and levelled perfectly when set, no question could be raised against the usual arrangement, unless it be this: Ought they not to be set nearly one-fourth the way from the end of the bed? or to put it in another form: will not the bed of an iron planing machine 12ft. in length be equally as well supported by four legs if each pair is set 3ft. from the ends—that is, 6ft. apart—as by six legs, two pair at the ends and one in the centre, and the pairs 6ft. apart? There being 6ft. of unsupported bed in either case, with this advantage in favour of the four over the six: settling of the foundation would not bend the bed.

It is not likely that one-half of the four-legged machine tools used in this country are resting upon stable foundations, nor that there ever will be; and while this is a fact it must also remain a fact that they should be built so as to do their best on an unstable one. Any one of the thousand iron planing machines of the country, if put in good condition and set upon the ordinary wood floors, may be made to plane work winding in either direction by shifting a moving load of a few hundred pounds on the floor from one corner of the machine to the other, and the ways of the ordinary turning lathe may be more easily distorted still. Machine-tool builders do not believe this, simply because they have not tried it. That is, I suppose this must be so, for the proof is so positive, and the remedy so simple, that it does not seem possible they can know the fact and overlook it. The remedy in the case of the planer is to rest the structure on the two housings at the rear end and on a pair of legs about one-fourth of the way back from the front, pivoted to the bed on a single bolt as near the top as possible.

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* The substance of a lecture delivered before the Franklin Institute.

A similar arrangement applies to the lathe and machine tools of that character—that is, machines of considerable length in proportion to their width, and with beds made sufficiently strong within themselves to resist all bending and torsional strains, fill the requirements so far as all except wear is concerned; that is, if the frames are once made true they will remain so regardless of all external influences that can be reasonably anticipated.

Among wood-working machines there are many that cannot be built on the single rectangular box plan—rested on three points of support. Fortunately, the requirements are not such as demand absolute straight and flat work, because, in part from the fact that the material dealt with will not remain straight and flat even if once made so; and in the design of wood-working machinery it is of more importance to so design that one section or element shall remain true within itself, than that the various elements should remain true with one another.

The lathe, the planing machine, the drilling machine, and many other of the now standard machine tools will never be superseded, and will for a long time to come remain subjects of alteration and attempted improvements in every detail. The head-stock of a lathe—the back gear in particular—is about as hard a thing to improve as the link motion of a locomotive. Some arrangement by which a single motion would change from fast to slow, and a substitute for the flanges on the pulleys, which are intended to keep the belt out of the gear, but never do, might be improvements. If the flanges were cast on the head-stock itself, and stand still, rather than on the pulley, where they keep turning, the belt would keep out from between the gear for a certainty. One motion should fasten a foot-stock, and as secure as it is possible to secure it, and a single motion free it so it could be moved from end to end of the bed. The reason any lathe takes more than a single motion is because of elasticity in the parts, imperfection in the planing, and from another cause infinitely greater than the others, the swinging of the hold-down bolts.

Should not the propelling powers of a lathe slide be as near the point of greatest resistance as possible, as is the case in a Sellers lathe, and the guiding ways as close to the greatest resistance and propelling power as possible, and all other necessary guiding surfaces made to run as free as possible?

A common expression to be found among the description of new lathes is the one that says "the carriage has a long bearing on the ways." Long is a relative word, and the only place I have seen any long slides among the lathes in the market is in the advertisements. But if anyone has the courage to make a long one they will need something beside material to make a success of it. It needs only that the guiding side that should be long, and that must be as rigid as possible—nothing short of casting the apron in the same piece will be strong enough, because with a long, elastic guide heavy work will spring it down and wear it away at the centre, and then with light work it will ride at the ends with a chattering out as a consequence.

An almost endless and likely profitless discussion has been indulged in as to the proper way to guide a slide-rest, and different opinions exist. It is a question that so far as principle is concerned there ought to be some way to settle which should not only govern the question in regard to the slide-rest of a lathe, but all slides that work against a torsional resistance, as it may be called—that is, a resistance that does not directly oppose the propelling power; in other words, in a lathe the cutting point of the tool is not in line with the lead screw or rack, and a twisting strain has to be resisted by the slides, whereas in an upright drill the sliding sleeve is directly over and in line with the drill, and subject to no side strain.

Does not the foregoing statement "that the propelling power should be as near the resistance as possible, and the guide be as near in line with the two as possible," embody the true principle? Neither of the two methods in common use meets this requirement to its fullest extent. The two-V New England plan seems like sending two men to do what one can do much better alone; and the inconsistency of guiding by the back edge of a flat bed is prominently shown by considering what the result would be if carried to an extreme. If a slide such as is used on a 20in. lathe were placed upon a bed or shears 20ft. wide, it would work *badly, and that which is bad,* when carried to an extreme, cannot well be less than half bad when carried half way.

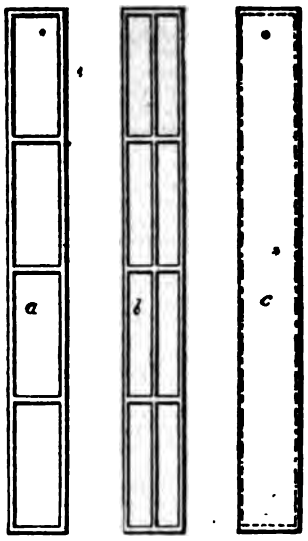

FIG. 1.

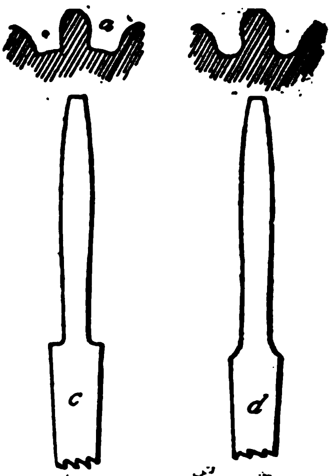

FIG. 2.

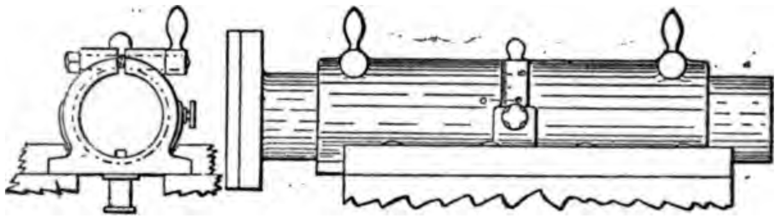

FIG. 3.

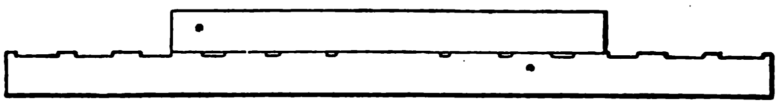

FIG. 4.

The ease with which a cast-iron bar can be sprung is many times overlooked. There is another peculiarity about cast iron, and likely other metals, which an exaggerated example renders more apparent than can be dene by direct statement. Cast iron, when subject to a bending strain, acts like a stiff spring, but when subject to compression it dents like a plastic substance. What I mean is this: if some plastic substance, say a thick coating of mud in the street, be levelled off true, and a board be laid upon it, it will fit, but if two heavy weights be placed on the ends, the centre will be thrown up in the air far away from the mud; so, too, will the same thing occur if a perfectly straight bar of cast iron be placed on a perfectly straight planer bed—the two will fit, but when the ends of the bar are bolted down the centre of the bar will be up to a surprising degree. And so with sliding surfaces when working on oil. If to any extent elastic, they will, when unequally loaded, settle through the oil where the load exists and spring away where it is not.

The tool-post, or tool-holder that permits of a tool being raised or lowered and turned around after the tool is set, without any sacrifice of absolute stability, will be better than one in which either one of these features is sacrificed. Handiness becomes the more desirable as the machines are smaller, but handiness is not to be despised even in a large machine, except where solidity is sacrificed to obtain it.

The weak point in nearly all (and so nearly all that I feel pretty safe in saying all) small planing machines is their absolute weakness as regards their ability to resist torsional strain in the bed, and both torsional and bending strain in the table. Is it an uncommon thing to see the ways of a planer that has run any length of time cut? in fact, is it not a pretty difficult thing to find one that is not cut, and is this because they are overloaded? Not at all. Figure up at even 50lb. to the square inch of wearing surface what any planer ought to carry, and you will find that it is not from overloading. Twist the bed upon the floor (and any of them will twist as easy as two bass-wood boards) and your table will rest the hardest on two corners. Strap, or bolt, or wedge a casting upon the table, or tighten up a piece between a pair of centres 8 or 10in. above the table, and bend the table to an extent only equal to the thickness of the film of oil between the surface of the ways, and the large wearing surface is reduced to two wearing points. In designing it should always be kept in mind, or, in fact, it is found many times to be the correct thing to do to consider the piece as a stiff spring and the stiffer the better. The tooth of a gear wheel is a cast-iron spring, and if only treated as would be a spring many less would be broken. A point in evidence:

The pinions in a train of rolls, which compel the two or more rolls to travel in unison, are necessarily about as small at the pitch line as the rolls themselves; they are subject to considerable strain and a terrible hammering by back-lash, and break discouragingly frequent, or do when made of cast iron, if not of very coarse pitch, that is, with very few teeth—eleven or twelve sometimes.

In a certain case it became desirable to increase the number of teeth, when it was found that the breakages occurred about as the square root of their number; when the form was changed by cutting out at the root in this form (Fig. 2) the breakage ceased.

a, Fig. 2, shows an ordinary gear tooth, and *b* the form as changed; *c* and *d* show the two forms of the same width, but increased to six times the length. If the two are considered as springs, it will be seen that *d* is much less likely to be broken by a blow or strain.

The remedy for the flimsy bed is the box section; the remedy for the flimsy planer table is the deep box section, and with this advantage, that the upper edge can be made to shelve over above the reversing dogs to the full width between the housings.

The parabolic form of housing is elegant in appearance, but theoretically right only when of uniform cross section. In some of the counterfeit sort the designers seem to have seen the original Sellers, remembering the form just well enough to have got the curve wrong end up, and knowing nothing of the principle have succeeded in building a housing that is absolutely weak and absolutely ugly, with just enough of the original left to show from where it was stolen. If the housing is constructed on the brace plan, should not the braces be straight, as in the old Bement, and the centre line of strain pass through the centre line of the brace? If the housing is to take the form of a curve, the section should be practically uniform, and the curve drawn by an artist. Many times housings are quite rigid enough in the direction of the travel of the table, but weak against side pressure. The hollow box section, with secure attachment to the bed and a deep cross beam at the top, are the remedies.

Raising and lowering cross heads, large and small, by two screws is a slow and laborious job when done by power. Counter-weights ancing the cross head, with metal straps han chains or ropes, large wheels with iti-friction journals, and the cross head by one post only, changes a slow to a quick nent, and a task to a comfort. Housings hollow box section furnish an excellent the counter-weights.

ioving head, which is not expected to move ader pressure, seems to have settled into , and when hooked over a square ledge at a pretty satisfactory form, too. But in iachines built in the form of planing s, in which the head is traversed while as is the case with the profiling machine, ier-head form is not right; both the pro- screw or whatever gives the side motion e as low down as possible, as should also be e.

is a principle underlying the Sellers of driving a planer table that may be in many ways. The endurance goes far any man's original expectations, and the ion, very likely, lays in the fact that the contact is always changing. To apply the inciple to a common worm gear it is only y to use a worm in a plain spur gear, with n cut at an angle the wrong way, and set m shaft at an angle double the amount ian at 90°. Such a worm gear will, I fancy, a dozen of the scientific sort. It would found a convenience to have the head of g machine traverse by a handle or crank to itself, so it could be operated like the t of a lathe, rather than as is now the case e end of the cross head. The principle be to have things convenient, even at an al cost. Anything more than a single to lock the cross head to the housing or ns should not be countenanced, in small at least. Many of the inferior machines irked improvements over the better sorts, handiness goes, while there is nothing to he handy from being good and the good

we consider that since the post-drilling first made its appearance, there have been lasdell's quick return, the automatic feed, ven spindles, back gears placed where they be, with many minor improvements, it is to assume that the end has been reached; n we consider that as a piece of machine g, considered in an artistic sense entirely, ient post drill is the finest the world ever Porter-Allen engine not excepted, which g a good deal), is it not strange that of all cal designs none other has taken on such ous forms as this.

hing that would seem to be desirable, and inary skill might devise, is some sort of itch by which the main spindle could be instantly by touching a trigger with the any drills and accidents would be saved . Of the many special devices I have seen on a drilling machine, one used by Mr. ght be made of universal use. It is in the a bracket or knee adjustably attached to , which has in its upper surface a V into ound pieces of almost any size can be l, so that the drill will pass through it ically. It is not only useful in making irough round bars, but straight through nd collars as well.

adial drill has got so it points its nose in itions but skyward, but whether in its best not certain. The handle of the belt shipper, that I have seen, follows around within f the drill as conveniently as one would

e one suggestion I have to make in regard iaping machine best illustrates the subject taining true wearing surfaces, I will leave I reach that part of my paper.

c, Fig. 1, illustrate the models shown by set, which represented three forms of lathe ner construction. The box form *c* proved per cent. stronger in its vertical direction ther *a* or *b*, fifty times stronger sidewise and twenty times stronger than *b*, and more iirteen times stronger than either when to torsional strain.

g. 2, represents an ordinary pinion tooth, hows one of the same size strengthened by out metal at the root; *c* and *d* were models g the same width of teeth extended to six he length, showing what would be their er if considered as springs.

3 shows the suggestion in regard to shaper id Fig. 4 the method of cutting away the a planer so as to reduce the wearing surface bed to the same extent as the table. In achines the suggestion was made to cut out es by milling, and in large surfaces, such ning-machine bed, cast out the spaces and with soft metal.

(*To be continued.*)

EXPERIMENTS ILLUSTRATING THE PRINCIPLE OF THE DYNAMO.*

THE great development of electricity in recent years, especially in the line of electric illumination, has served to add lustre to the name of the immortal Faraday, and to show with what wonderful completeness he exhausted the subject of magneto-electric induction. Since the close of his investigations no new principles have been discovered. Physicists and electrical inventors have merely amplified his discoveries and inventions, and applied them to practical uses. The number of those who are familiar with the discoveries of Faraday and their bearing on modern electrical science is not only large, but rapidly increasing, but there are those who are still learners, to whom new things, or old things placed in a new light, are ever welcome. To such the simple experiments here given may be an aid to the understanding of induction as developed in dynamos and motors.

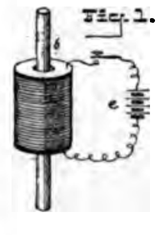

Fig. 1.

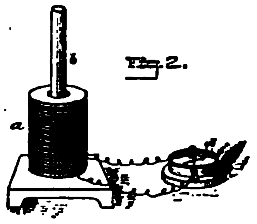

Fig. 2.

Anyone at all acquainted with electrical phenomena knows that a hardened steel bar surrounded by a coil of wire which is traversed by an electric current becomes permanently magnetic. It is perhaps unnecessary to reiterate the accepted theories of this action, as they are well established and appear in almost every textbook of physics. The fundamental magneto-electrical experiment of Faraday was exactly the reverse of the operation of producing a magnet by means of an electrical current. That is, it was the production of an electrical current by means of a magnet and coil.

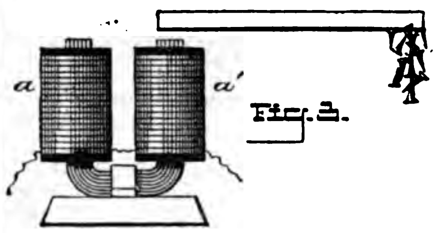

Fig. 3.

In the first instance, the magnetising power of the electric current is employed to bring about the molecular change in the steel bar, which manifests itself in polarity. In the second instance, the magnetised steel bar is made to generate an electric current in the wire of the coil. In the first instance, the current moving in the wire of the coil induced magnetism in the steel. In the second instance, the movement of the magnetised steel within the coil induced a current in the wire.

The method of magnetising a bar of steel is clearly shown in Fig. 1, in which *a* is a helix of

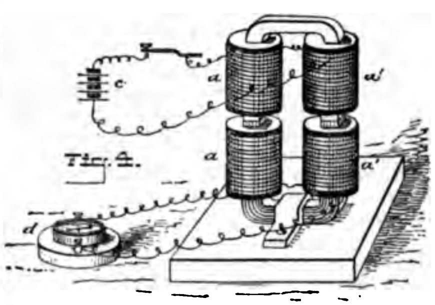

Fig. 4.

six or eight ohms resistance, *b* the bar of hardened steel, and *c* a battery of four or five elements. A key is placed in the circuit, but the ends of the wires may be made to serve the same purpose. By closing and opening the circuit while the steel bar is within the coil as shown, the bar instantly becomes magnetic. When the coil is disconnected from the battery and connected with a galvanometer, *d*, as shown in Fig. 2, and the magnet *b* is suddenly inserted in the coil, the needle of the galvanometer will be deflected; but the action is only momentary. The needle returns immediately to the point of starting. When the magnet is quickly withdrawn from the coil the needle is deflected for an instant, but in the opposite direction, and, as before, it immediately returns to the point of starting. It is obvious that if these electric pulsations can be made with sufficient rapidity to render them practically continuous, and if they can be corrected so that pulsations of the same name will always flow in the same direction, the current thus produced may be utilised.

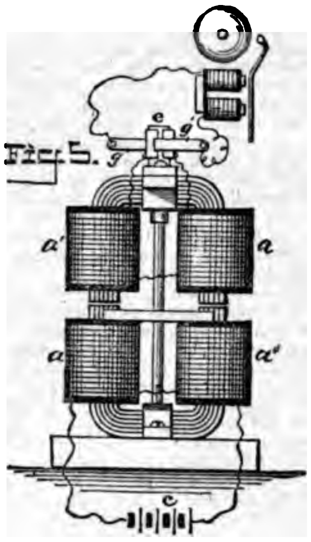

Fig. 5.

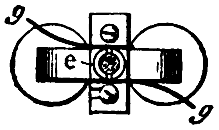

Fig. 6.

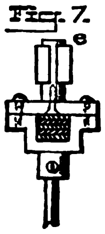

Fig. 7.

Before proceeding further with the consideration of magneto-electric induction, it will be necessary to briefly examine the subject of magnetic induction, as it is intimately connected with the action of the dynamo. In Fig. 8 is illustrated the usual experiment exhibiting this phenomenon. An electro-magnet like that described on page 184 is connected with a suitable battery, and a bar of soft iron is held near but not in contact with one of the poles of the magnet. It becomes magnetic by induction, the end nearest the magnet being of

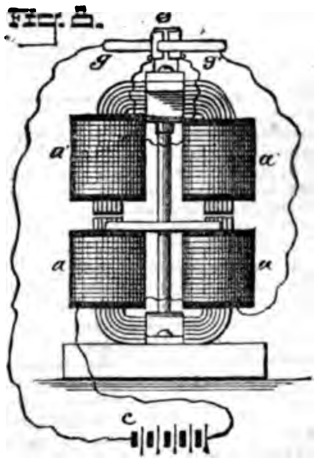

Fig. 8.

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* By GEO. M. HOPKINS, in the *Scientific American.*

a name different from that of the pole by which the induction is effected. The end of the bar remote from the magnet exhibits magnetism like that of the magnet pole of the magnet.

The relation of magnetic induction to magneto-electric induction is clearly shown by the experiment illustrated in Fig. 4. In this case two electro-magnets are arranged with their poles in contact. One of them is connected with a galvanometer, and the other with a battery. When the circuit of the upper magnet is closed, the core of that magnet becomes magnetic, the core of the lower magnet becomes magnetic by induction, and the galvanometer needle is deflected. When the circuit of the upper magnet is broken, the galvanometer needle is deflected in the opposite direction, showing that the results are precisely the same as in the experiment illustrated by Fig. 2. In this case no mechanical movement is necessary, as the magnetism is introduced into the coils of the lower magnet by induction. It is thus shown that it is not necessary to move any matter to secure magneto-electric induction.

In Fig. 5 is shown an arrangement of electro-magnets in which one is fixed, while the other can be revolved. It is a device intended simply for showing how two ordinary electro-magnets may be utilised to advantage in experiments in induction. To the polar extremities of the fixed magnet is fitted a wooden cross bar. having in its centre an aperture for receiving the vertical spindle, the lower end of which is journalled in the clamp that holds the fixed magnet to the base. The upper end of the spindle is provided with a yoke for holding the movable magnet. The cross bar which clamps the magnet in the yoke is held in place by two screws, as shown in Fig. 7, and to the centre of the cross bar is attached a wooden cylinder, *c*, axially in line with the spindle. To the wooden cylinder are secured two curved brass plates which are connected electrically with the terminals of the coils, *a a'*, of the movable magnet, one plate to each coil. Two strips of copper, *g g'*: held upon opposite sides of the cylinder, complete the commutator. The copper strips are connected with any device capable of indicating a current—in the present case an electric bell—and the coils, *a a'*, of the fixed magnet are connected with the battery, *c*.

By turning the upper magnet, the following phenomena will be observed:—(1) When, by turning the movable magnet, its poles are pulled away from the fixed magnet, the departure of the induced magnetism from the core of the movable magnet produces an electric pulsation in the coil which operates the electric bell. When, by a continued movement of the magnet in the same direction, the poles exchange position, another electrical impulse will be induced, and the bell will be again operated. (2) Examining these impulses by means of a galvanometer introduced into the circuit, it will be found that they are of the same name. (3) When the magnet is turned a little faster, these two impulses will blend into one, so that for each half of the revolution of the magnet the bell yields but one stroke. (4) By whirling the magnet quite rapidly, the current through the bell magnet is made practically continuous, so that the bell armature is drawn forwards towards the magnet and held there.

From what has been said, it will be seen that all of the positive electrical impulses are generated upon one side of the poles of the fixed magnet, and all the negative impulses are generated upon the other side of the fixed magnet, and that the curved plates of the commutator conduct all of the positive electrical impulses to one of the strips, *g g'*, and all of the negative impulses to the other strip.

In Fig. 8 is shown an arrangement of connections to convert the device into a motor.

Allport's Patent Door Buffers. — These buffers are made in two patterns—one a series of blunt pyramids, the other a disc, and being constructed of rubber which will preserve its resiliency, will be found useful for attaching to all sorts of door frames to prevent the noise occasioned by slamming. For heavy doors and railway carriages the disc is recommended, and it has the advantage that, being of rather thick rubber, it acts as a spring, and prevents the rattling of the door if the latch should happen to have too much play. Any door fitted with a spring, and provided with these buffers can be closed noiselessly, and is held firmly—thus avoiding the unpleasant rattling which is often so annoying to the inhabitants of the room or the traveller in the carriage. The "buffers" are sold with brass plates, we believe, by "all ironmongers."

THE Lancashire and Yorkshire Railway Company is fitting 941 passenger coaches with Pope's gaslight, and has ordered two sets of gas plant complete, to produce the requisite gas.

THERE are nearly twenty-five thousand railway carriages now lighted, chiefly on the Continent, on *Pintsch's oil-gas system.*

SCIENTIFIC NEWS.

THE "Dun Echt Circular," No. 155, gives the ephemeris of comet Sawerthal up to the end of May. The position on May 6, Greenwich midnight, is given as R.A. 23h. 36m. 55s., N. Dec. 29° 45·6'; the brightness less than half that at time of discovery.

Dr. J. Palisa, of Vienna, discovered another minor planet (No. 275) on April 15. No. 273, discovered by him on March 8, has been named Atropos.

By the death of Thomas Russell Crampton we lose one of the best-known of our engineers, civil and locomotive. Crampton served under the elder Brunel, the Messrs. Rennie, and (now) Sir Daniel Gooch; but although his locomotive—the "Liverpool"—obtained for him the grand medal in the Exhibition of 1851, his system never received much recognition in this country, though locomotives of his pattern have been doing good work on many French railways for years. Mr. Crampton is best remembered, perhaps, as the father of submarine telegraphy, for he superintended the construction and laying of the first successful cable between Dover and Calais. Much of Mr. Crampton'e best work was done abroad, and he was the possessor of not a few honours awarded by the Governments and scientific societies of the Continent. Mr. Crampton was born at Broadstairs, Kent, in 1816.

The centenary of the Linnean Society is to be held on the 24th inst., when the Linnean gold medal will be presented to Sir Joseph Hooker. Eulogies will be delivered by Prof. Fries on Linneus, by Sir J. Hooker on Robert Brown, by Prof. Flower on Darwin, and by Mr. Thiselton Dyer on George Bentham. The annual dinner will follow in the evening at the Hôtel Métropole, and the next day the president of the society, Mr. Carruthers, F.R.S., will hold a reception at Burlington House, when the Linnean collections and relics will be exhibited.

The Council of the Marine Biological Association have elected Mr. Gilbert C. Bourne, Fellow of New College, Oxford, and Assistant to the Linacre Professor, to the post of Director of the Laboratory at Plymouth and Secretary to the Association.

Last Friday Mr. Wimshurst lectured at the Royal Institution on "Influence Machines," and exhibited several machines of his manufacture, including one with twelve plates, each 30in. in diameter, which gives sparks 13⅜in. long. Either shortly or in the course of next winter we shall have something more about these machines; but meantime, by way of "encouraging the others," we quote the concluding passage of Mr. Wimshurst's lecture:—"I may be permitted to say that it is fortunate I had not read the opinions of Sir William Thomson and Prof. Holtz, as quoted in the earlier part of my lecture, previous to my own practical experiments; for had I read such opinions from such authorities I should probably have accepted them without putting them to practical test. As the matter stands, I have done those things which they said I ought not to have done, and I have left undone those which they said I ought to have done, and by so doing I think you must freely admit that I have produced an electric generating machine of great power, and have placed in the hands of the physicist, for the purposes of public demonstration or original research, an instrument more reliable than anything hitherto produced."

The Trinity House have just completed the erection of the largest electric light in the world at St. Catherine's Lighthouse, Isle of Wight. The dynamos and lamps are by De Méritens, and the driving power is provided by Robey's semi-portable engines.

The Belgian Society of Electricians offer a prize of 250fr. for the best essay on the elementary principles of electricity. The competition is open to all electrical workmen, but more especially to those who have not received a technical education. The essays need contain neither mathematical formulæ nor the demonstration of fundamental laws. Further information can be obtained from M. Lagrange, 26, Rue Villian XIII., à Bruxelles.

We learn from a Newcastle pap
another battery has been patented whic
to give "continuous light at a low c
with little weight." Miners' lamps
appears, made in two sizes—"the first, w
only 3lb., to give light for 16 hours.
second size, weighing 4½lb., to give 3
light. The cost of the light is about
three shifts for the second lamp, which
cheaper (?) than the cost of the ordi
light. For ordinary lighting it is a
that in large towns where gas is less th
per 1,000ft. the electric light costs rat
than gas, but when the price of the
above that rate the electric light is ch
be the cheaper. The acid used is a se
paration, but in other respects the m
are those generally used." If the bat
been patented, how can the acid be a
preparation"?

In a recent issue of the *Bulletin de l*
Belge d'Electriciens, M. Ernest Géra
note on tubular magnets. He points
if a ring of soft iron of the same sectic
magnet itself be laid on the top of the
as to be in contact all round, it is
firmly than is the case when it merel
on edge, although in the latter case c
made at only a single point. M. Gérar
that this result can be explained by
ing the distribution of the lines of for
field.

The following fifteen candidates ha
selected by the Council of the Royal Sc
be recommended for election. The ba
take place on the 7th of June:—Mr. T. A
Mr. J. T. Bottomley, Mr. C. V. Boys, Pr
Church, Prof. A. G. Greenhill, Sir W
Jervois, Prof. C. Lapworth, Prof. T. J.
Prof. J. H. Poynting, Prof. W. Rams
T. P. Teale, Mr. W. Topley, Mr. H.
Prof. H. M. Ward, and Mr. W. H. White

Sir Thomas Francis Wade, the Pre
the Royal Asiatic Society, has been el
the newly-founded Chair of Chinese
bridge. Sir Thomas, who is now resi
Cambridge, recently presented to the Un
Library his valuable collection of Chine
and MSS.

A rare collection of beetles has be
sented to the Corporation of Folkest
their new Art Museum, just complet
cost of £7,000.

Messrs. Kammann and Jerschina, of
have obtained a patent in this countr
method of making printing type of
hardening paste or artificial stone, co
of a mixture of fine quartz powd
hydraulic cement, moistened and sti
with an aqueous solution of water-gla
to form either a semi-fluid or a doughy

"Improvements" in metal plates
construction of shells, flues, and fireb
steam-boilers have been patented by M
of Bury, Lancashire. The plates are "st
ened" by rolling, stamping, hamme
otherwise forming dimples or bulges
entire surface of the plate, corres
hollows or depressions being thereby p
on the opposite side of the plate.

A Washington correspondent states t
dence is about to be filed at the Unite
Patent Office which bids fair to pro
typewriters are not such novelties as so
them to be. Drawings and specification
ing the invention of a typewriter, w
styled a typographer, were deposited
as 1829, the certificate of registratio
signed by Andrew Jackson. The
patent record was destroyed in the
Office a dozen years ago. The drawing
time-stained patent closely resemble t
struction of modern typewriters. The
patent of all appears to be one filed
British Office in 1714—No. 395.

The College of Physicians of Phila
has forwarded to the mayor an earnest
against the introduction of water gas
city, based upon an investigation of the
ous properties of the gas and the a
results which have already followed it
other parts of the United States. The
posed to be supplied is a mixture of t
coal-gas to one part water-gas, and wo
tain about 15 per cent. of carbonic oxi
physicians by the "College" say that

of an illuminating gas containing more than 10 per cent. of carbonic oxide would be attended with great risk to the health and life of the citizens of Philadelphia.

Dr. W. Stanley Armitage says he has found semolina a useful food in cases of diabetes—quantities can be eaten without sugar being detected.

Mr. Curran, referring to some cases of heart-disease, says that elderly people whose hearts are weak or flabby, and who live in "populous cities pent," should dine betimes and sparingly. They should, further, eschew butcher's meat as far as possible, and take to soups and farinaceous food instead, and they should, above all, never go to bed with a distended or overloaded stomach.

In a recent number of the *Comptes Rendus* is a paper on "The Velocity of Sound," by MM. J. Violle and Th. Vautier. From the experiments described it is placed beyond doubt that the velocity of the sound wave diminishes with its intensity; also that the pitch of the sound has no influence whatever on the velocity of its propagation. The slight differences observed appear to be due solely to the different intensities of the sound wave in the respective cases.

M. F. Forel describes in the *Comptes Rendus* his experiments with photographic plates on the penetration of light in the waters of the Lake of Geneva. With chloride of silver he found the "absolute darkness" limit at 45 mètres (148ft.) in July, and at 110 mètres (361ft.) in March. The water of the lake is much clearer in winter than in summer, the difference being almost entirely due to the larger quantity of organic matter held in suspension during the latter season.

At the meeting of the German Physicians, known as the Wiesbaden Congress, Dr. Binz, of Bonn, read a paper on "Alcohol as a Remedial Agent," in which he referred to expressed opinions and upheld the efficacious virtues of alcohol—contending that it has an especial value in heart failure and lung disease; that it is consumed in the organism, and that it operates as a controller of pyrexia and fever. Dr. Binz, however, holds that the consumption of alcohol between meals, especially in the form of beer, is in Germany a "national evil," while at the same time he regards it as an invaluable aid to the physician.

Jordan's Improved Photographic Sunshine Recorder.—Mr. Jordan, whose simple but active photographic sunshine recorder has now en before the public for some years, and the ords from which are published daily, brought ore the Royal Meteorological Society an "im-ved" instrument in which he has overcome the ling objections which some observers raised to earlier instrument. It will be remembered t in the former the trace was recorded in a ight line at the Equinoxes only; at other times as more or less curved, and the day's record sisted of two parts (a.m. and p.m.), which could be joined so as to form a continuous trace. has been remedied in the new instrument by structing two semi-cylindrical cameras, into ch the sensitised chart is inserted. These are rranged on a triangular frame that while one s the south-east sky the other faces south-t; the former receives the direct solar rays n sunrise till noon, the other those experienced ween noon and sunset, and, as the rays pass ugh a minute aperture at the centre of the meter of each semi-cylinder, the trace (when instrument has been adjusted for latitude) is ays straight. It still consists, however, of two s, but these can easily be fastened together so o give a continuous chart for each day. The rument is a great improvement on the one inally brought forward, but is probably more ensive. The question whether a photographic "burning" recorder is the better instrument recording sunshine is likely to be discussed ly for a long while to come; but as photo-hic recorders Mr. Jordan's instruments are qualled for simplicity and efficacy.

R. ASSHETON SMITH is commemorating her sty's Jubilee in a remarkable manner. He aused to be planted on the slopes of Moel ven mountain a plantation composed of 630,000 . Nearly 200 men have been constantly em-d since the Jubilee in planting the trees, h will be so arranged as to represent the words ilee, 1887." Each letter measures 200 yards and 25ft. wide. The first tree of the letter J lanted on Jubilee Day.

LETTERS TO THE EDITOR.

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[*We do not hold ourselves responsible for the opinions of our correspondents. The editor respectfully requests that all communications should be drawn up as briefly as possible.*]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, *332, Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

⁂ *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

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HELIOSTAT WITHOUT CLOCKWORK—ENERGY AND FORCE—BARLOW LENS—STAR MAPS—THE DISCOVERY (?) AT THE LICK OBSERVATORY IN THE TRAPEZIUM OF θ ORIONIS—AN IMPOSSIBLE DISTANCE—DEFECTIVE OBJECT-GLASS.

[28688.]—"IGNOTUS" (letter 28551, p. 170) invites me to criticise his design for a heliostat without clockwork. If the two conical frusta were exactly in adjustment—that is, if the axes of the two cones were precisely coincident and parallel to the earth's axis—the parallel rays of a star after their double reflection would be parallel to the axis of the earth too. But it would be difficult to obtain such reflecting frusta made with sufficient accuracy for optical purposes. Possibly reflecting surfaces might be bent into the conical form with sufficient accuracy to reflect the sun's rays for generating heat to work a solar engine or the like. But the cones would have to be of very much wider angle than they are drawn by "Ignotus" in his diagram (where he depicts the sun with the very remarkable declination of 76° 30′ North, or thereabouts), and when the sun was on the Equator the contrivance must fail altogether, unless the sunlight were reflected so as to pass *twice* across the axis. I find no fault with "Ignotus's" geometry; but, practically, I think it would be found that a conical surface of adjustable angle could not be made with sufficient accuracy even to drive a solar machine, to say nothing of its application to optical purposes.

Mr. Wm. J. Grey says (in reply 65036, p. 176) that Mr. Clodd "must be exceedingly ignorant of mechanics." My own impression is that Mr. Clodd's knowledge of mechanics is, at least, on a par with that of Mr. Grey himself; but he employs the terms "force" and "energy" in his "Story of Creation" in a sense carefully defined by him, and for a specific purpose. It is as though I should say that anyone was exceedingly ignorant of mathematics who used the symbols ′ and ″ on a drawing for feet and inches, their true signification being minutes and seconds of arc. I purposely make no reference here to recent arbitrary changes in the terminology of kinematics and dynamics.

"Achromatic" (query 65086, p. 178) can *not* convert "an achromatic o.g. 1¼in. diam. 22in. focus" into a Barlow lens, for the simple but sufficient reason that the focus of the latter is a negative one. It is the essence of the principle of the Barlow lens that it renders the convergent rays from the objective less convergent; while "Achromatic's" subsidiary objective would only make them more so, and so diminish, instead of increasing, the power of his telescope.

In reply to the series of questions put to me by "Finsbury" (in query 65096, p. 178), I may tell him that I know of no planisphere, old or recent, which gives all the stars visible to the naked eye at Greenwich; inasmuch as the considerable number so visible could never be intelligibly included in any planisphere of a portable size at all. Philip and Son, of Fleet-street, London, publish a small planisphere showing the brighter stars; but there must be distortion increasing with the star's N.P.D. in all such things. In the next place, the best catalogue I know of for your correspondent's purpose is the "Greenwich Nine-Year Catalogue of 2,263 Stars for 1872." The Zodiacal stars are, of course, included in this. The corrections for precession and proper motion are given for each star, as also the logarithms of *e*, *f*, *g*, *h*, and *e′*, *f′*, *g′*, and *h′*, for use with the constants to be found on pp. 296 *et seq.* of the *Nautical Almanac*, so as to find its apparent R.A. and Dec. for any given instant. Thirdly, I am ignorant of any single map such as "Finsbury" asks for; but Proctor's "Larger Star Atlas" gives everything he requires in its series of maps. Fourthly, I know of no Zodiacal maps on which the coordinates of latitude and longitude are marked. Plates XXI. to XXVI. of Proctor's "Seasons Pictured" delineate the entire Zodiac, the Ecliptic running horizontally through them all; but they give the R.A. and Dec. of the stars, and not their latitudes and longitudes. Finally, a very little consideration will show that R. A. and Dec. can never be convertible into geocentric longitude and latitude—in fact, those terms are meaningless in any such connection. The north declination of γ Draconis is 51° 30′, and hence that star will be vertically overhead on the parallel of 51° 30′ latitude N. But it will, in the course of the 24 hours, be in the zenith of *every* place having that latitude, so that any attempt to connect it with longitude must be meaningless.

In connection with Mr. Monck's letter (28658) on p. 188, I may say that I think that the sooner the observatory on Mount Hamilton is handed over by the Lick trustees to the most able staff of observers organised by Prof. Holden, the better. The desultory star-gazing to which the great equatoreal has so far been devoted has simply furnished subjects for sensational paragraphs in the Californian newspapers. It is *not* one of "the observers" (using that word in the sense of one of the regular staff of the Observatory), who found the star to which your correspondent refers, at all. Mr. S.W. Burnham saw both the 5th and 6th *comites* of θ Orionis on Mount Hamilton with 3¼in. (Vol. I. of "Publications of the Lick Observatory," p. 17).

How in the world can it be "not more than 3,000 or 4,000 miles from the June solstice to the frigid zone"? as stated by Mr. Hampden, in letter 28661 (p. 188). The only parallel to this which occurs to me takes the form of a reminiscence of a question which, as a small boy, I once heard the clown in a circus put to the ringmaster, whom he asked: "How far is it from Westminster Bridge to the First of August?"

Quite possibly either the crown or the flint lens of "J. C. L.'s" object-glass (query 65185, p. 201), is not homogeneous. He might test this by covering in succession different parts of the objective with a patch of sticking-plaster, and noting whether in any particular position of such piece of plaster his pentagonal disc and streaming rays disappeared. Or this may be a diffraction phenomenon incidental on abominably bad figuring of the lenses, or on their being in contact in one part and not in others. I strongly suspect that his object-glass is, at the best, but a rubbishing affair.

A Fellow of the Royal Astronomical Society

THE STARS IN THE TRAPEZIUM OF θ ORIONIS.

[28689.]—MR. MONCK (letter 28658, p. 188) seems labouring under some misapprehension. Everyone acquainted with the matter of course knows that the 5th and 6th stars in the Trapezium were seen by Mr. Burnham, and the angle and distance of the sixth from its primary measured, on the occasion of his stay at Mount Hamilton for the purpose of determining the atmospheric condition there in the autumn of 1879. They were seen in broad daylight with his 6in. refractor, which is not "one of the smaller telescopes in use at the observatory," but which is, and has been for a long time, installed at the Washburn Observatory. Equally, of course, everyone knows that the supposed new star could not be one of the old six. If Mr. Monck had not written quite so hastily, he would have seen that that portion of the first volume of the *Publications* of the Lick Observatory relating to Mr. Burnham's measures of double stars is a simple reprint, with a few omissions, of the "Report to the Trustees of the James Lick Trust," printed at Chicago in 1880. On seeing the diagram of the supposed new star in the *Sidereal Messenger*, I at once wrote to the editor of that periodical, to the ENGLISH MECHANIC, and to Prof. Keeler, of the Lick Observatory, pointing out that Clark's star was identical with one shown by myself in a diagram in the ENGLISH MECHANIC for January 13th, 1882. An extract from Prof. Keeler's letter in reply (dated March 26th) may be of interest. He says: "The star numbered '6' in the tracing [from my diagram] certainly has the same position as that seen by Mr. Clark, and there can be little doubt as to their identity. The star is probably, as you say, variable, as I cannot conceive of its being visible with such apertures as you mention. It is certainly beyond the range of our 12in. equatorial, which is the finest glass of its size that I ever saw. We have used the large telescope [36in.] very little, as its use would interfere with the work of construction."

April 30. **H. Sadler.**

P.S.—On page 17 of the first volume of the Lick Observatory *Publications*, in "α Aquilæ easy with ⅓in., β Orionis with ½in.," the apertures should be 1⅓in. On page 28, for "La Caille 9234," read "La Caille 9534." On page 29, the place of H. 3375 should be 0h. 27m. 50s. — 35° 39′.

THE TRAPEZIUM OF ORION.

[28690.]—I HAVE not yet seen the first volume of the *Publications* of the Lick Observatory, referred to by Mr. Monck (letter 28658, p. 189); but I presume the fifth and sixth stars in the Trapezium of Orion were measured with the 12in. refractor at Mount Hamilton, where these would not be difficult objects with that aperture.

With reference to the faint star in the Trapezium recently picked up with the 36in. refractor, I had a private communication lately from a friend with whom Mr. Alvan G. Clark, the discoverer, called on his way home from Mount Hamilton, and, speaking of this discovery, Mr. Clark described the star as *very faint*, so that, being an experienced observer, it is not probable that this star has been seen before by anyone; but we shall doubtless hear something more about it further on.

Belfast, April 28. **I. W. Ward.**

THE LATE LUNAR ECLIPSE.

[28691.]—PERHAPS not the least interesting series of sketches of the various and varying phases and appearances of the phenomena were made by Mr. Fornander, of the Ceylon Survey Department (draughtsman), who, however, lays no claim to any knowledge of science or astronomy. In so far as they are accurate, they are probably none the less valuable on that account, as they represent, in colours, exactly what he *saw*. The "amorphous mass" of colouring of the shadow in the middle, spoken of by Captain Noble at the meeting of the Royal Astronomical Society, is well shown in the sketches by an observer who *saw* it, but could have no idea what *caused* it. I saw it myself distinctly, but to my eyes, looking through a good field-glass, the darker patch seemed to be as unstable in position as it was irregular in shape. I *thought* I saw it flutter rapidly, and looked steadily and often through my glass to decide this point. I can, however, only say that it *seemed* to me to move and go in and out perceptibly.

Our John's monomania is well known; but at the risk of being classed with the other "unalterable villains" of science, I must say that I think even his common sense would have been touched had he stood with me on the morning of the 29th January last watching this phenomenon from beginning to end. Practically I stood on the equator, on the top of a revolving ball, with a clear sea horizon of about 200° south, west, and north. Knowing the sun, from the commencement of the eclipse, to be as far below the horizon behind me as the moon was above the opposite horizon in front of me, and watching the whole see-saw business, as the earth turned with me to the sun, but away from the moon—which, nevertheless, had a rapid eastward movement of its own through the earth's shadow (well marked by its ever-increasing distance from Saturn)—only an idiot could have refused the evidence of his senses, for the truth of the natural phenomenon of a rotating earth was *felt* as palpably as it was *seen*. **R. W. J.**

THE SOUTHERN COMET.

[28692.]—CEYLON, 25th March, 4h. 45m. a.m. (= G.M.T., 24th March, 11h. 25m. p.m.). This comet (discovered by Sawerthal) was seen as follows:—Place, about 2° east of δ Capricorni, with which, to the unaided eye, it compared as a 3rd mag. star. In field-glass the nucleus showed up as a large, white, brilliant disc; tail very bright, 3° long, widening out to about ½°. **R. W. J.**

COMET SAWERTHAL: ALPHA (1888).

[28693.]—KINDLY allow me to correct a printer's error which got into my letter (28636, on p. 167).

For "between 3 and 31 Pegasi," read "between ζ (zeta) and 31 Pegasi."

I suppose the two small stars could not be shown in the tail so very well. The two small dark spots at an angle of about 45°, with a line joining the three stars, represent the positions of the stars in the tail as seen here; but without this explanation they will, in all probability, be overlooked.

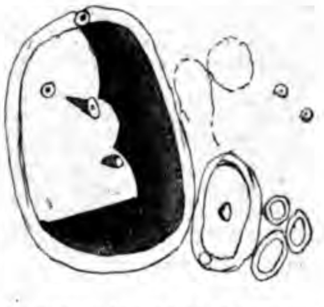
David Booth.

26, Servia Mount, Leeds, April 23.

CLEOMEDES—R CORONÆ.

[28694.]—I AM glad to find from "Jason's" note on p. 79, that my letter of Dec. 9 last was of use to him. I fancy that the sketch I forwarded therewith must have fallen out when the letter was opened, for, as it was but a diagram, I do not think there could have been any difficulty as to reproduction. I inclose another copy. Perhaps Mr. Stanley Williams could give some more information about this object. The floor of Cleomedes, under a high light, presents various interesting light and dark markings, and "Jason" would find something for useful study in them. I hope he will be able to re-observe his "spectre," and throw light upon its substantive existence, or the reverse.

The following are observations of that remarkable variable star R Coronæ, made here, with opera-glass or telescope, though generally with the former. I have sometimes conjectured that this star exhibits minor fluctuations of a more or less periodic character. Has anyone else anything to say upon this point? Certainly the star exhibits numerous slight fluctuations. So far as I can make out, it is a mistake to say that it remains *constant* at maximum for long periods. The truth rather seems to be that, while at the maximum phase (which phase continues during periods of most variable length) it fluctuates more or less continuously, and exhibits in these fluctuations light changes of varying amount. The standard employed in my observations has usually been π Coronæ, rated at 6·0. My observations do not reveal any variability in π Coronæ. Arg. and Heis agree in their mag. for it (6), and it is 6·2 in the D.M., while the "estimated" Harvard mag. is 5·9. The "photometric" H.P. result, however, is higher, being 5·6; but this is the only discordant mag. I have seen.



1885.	August	14	6·2	Light orange, π 6·0
1886.	March	9	6·2	
"	"	27	6·3	
"	"	29	6·3	
"	"	31	6·5	
"	April	4	6·2	Pale orange
"	"	6	5·9	Compared with π direct
"	"	8	6·1	
"	"	9	as before	
"	"	11	a little below π Coronæ	
"	"	17	"	"
"	"	25	6·4	
"	May	1	6·4	
"	July	24	full 6 mag.; I think > π	
"	"	27	6·2	
"	"	31		Orange
"	August	1	6·1	
"	"	2	6·1	
"	"	3	6·2	
"	"	19	6·3 or so	
"	"	26	6·4	
"	Sept.	4	6·1	
"	"	14	6·3 or 6·4	
"	"	15	6·4	
"	"	22	6·2	
"	Oct.	19	6·4 about	
"	"	31	6·4	
"	Nov.	3	6·5	
"	"	20	6—7	
"	"	29	6·3	
"	Dec.	1	6⅓	
"	"	28	6·0	Equal π Coronæ
1887.	Jan.	3	6·2	
"	"	19	6·0 or 6·1	
"	Feb.	1	6·2	
"	"	3	6·1	
"	"	18	6·2	
"	"	26	6·2	
"	"	27	6·3	
"	March	15	6·6	
"	"	25	6¾	
"	"	27	7 mag. about	
"	April	13	not seen in o.g.	
"	"	24	7·0	
"	"	25	Hardly, if at all, seen in o.g.	
"	May	2	not seen in o.g.	
"	"	12	*min. vis.* in o.g. (7½ ±)	
"	"	17	not seen in o.g.	
"	Aug.	9	" "	
1888.	Jan.	22	About 7 mag., or a little over	
"	March	4	6·6	
"	"	31	6·5	

Glasgow. **S. Maitland Baird Gemmill.**

OCCULTATION OF STARS.

[28695.]—ON Monday, April 16, three telescopic stars were occulted by the moon within ten minutes. The first about 8h. 5m. (a passing cloud interfered) about 130° from north point (true). The second at 8h. 10m. 40s. at about 50°, and the third at 8h. 12m. 10s., about 20° from true north point. The position of the moon, then five days old, by the *Nautical Almanac*, was at 8h. R.A. 5h. 46m. 33·80s., the variation in 10min. being 21·408s. The N.D. 20° 15′ 51·1″, the variation in 10min. being 27·73″.

The occultation of χ^2 Orionis was not
account of clouds.
The last star to be occulted was the bright
none of the three are given in Proctor
The aperture used was a 3¾in. Dollond.

Hendon, April 30. **P. F.**

METEORIC DEBRIS IN THE ATMOSPHERE.

[28696.]—DR. BURDER (p. 169) think
is not probable that any great quantity of
dust can exist in the upper air because the
with the earth's atmosphere of a great qu
meteoric particles would be attended wi
ing phenomena of combustion which c
escape notice; but a little consideration
that this is not necessarily the case. Som
to the size of a meteoric particle capable
the light of a 6th-magnitude star may be
from the consideration that a standard can
at the distance of a mile, appear only a little
than a first-magnitude star. A first-magni
is (according to Pogson's scale) one hund
as bright as a sixth-magnitude star; the
incandescent body at a distance of 100 mil
only appear as a sixth-magnitude star if
with a light about equal to that of an elect
of 100 candles power. As only the larger
enter the earth's atmosphere to a depth
70 miles above the sea-level, it may be
that few of the meteors seen, except tho
appear in the observer's zenith, are seen
distance than 100 miles. One may cons
pretty safely assume that a meteor whic
visible to the naked eye is larger than th
of the carbons which is rendered incand
an arc-light of 100 candles power. For t
spheric absorption has to be taken into acc
a mass of carbon such as is used for elect
ing purposes gives off more light whi
driven into vapour than other substance
have been experimented upon. Again, th
of the electric light is not exposed to
mendous bombardment of cold air, whi
tend greatly to accelerate the disintegr
meteoric bodies in their passage through
as well as to cool their surface by removing
candescent matter as rapidly as it is forme

To all except exceptionally keen-eyed o
the sixth-magnitude star corresponds to a
limit of vision, and such a faint point
would probably not be seen if it were
motion. We may therefore assume that
bodies smaller than the incandescent en
carbon of a 100-candle power electric lam
enter the earth's atmosphere without at
attention as a meteor visible to the na
Small telescopic meteors do enter the earth
sphere in great numbers, as all constant te
observers know, especially those who observ
morning hours. The only effect produce
number of dust particles encountered by th
in a day were quadrupled, or say, multi
20, would be that the general illuminatio
heavens would be slightly increased. Such
in the blackness of the sky from night
have frequently been noticed and speculat
by excellent observers. I do not assert th
observed differences of illumination can
explained by differences in the amount of t
due to the impact of meteoric dust; but
that this is a very probable explanation,
we have evidence showing that the amount
meteoric particles encountered does vary fr
to time.

When the earth passed through the ta
great comet of 1861 no meteoric display a
general attention; only three observers—
Australia, one at Liverpool, and the lat
Webb at Hardwick—noticed anything ex
nary. It was not known at the time that
passing through the tail of the comet, or d
more observers would have noted the faint
of light in the heavens which these three ol
noticed, and identified as connected with th
comet, because all the streaks pointed
nucleus, and slowly moved amongst th
closing up like the ribs of a fan as th
watched by the English observers, who not
phenomenon in the evening after the ea
passed through the centre of the tail; wh
Australian astronomer, who observed a fe
earlier as the earth was entering the tail, sa
open out. The streaks of light were so fai
if the matter of the comet's tail had bee
evenly distributed, the slight general inc
the illumination of the heavens would c
have escaped notice.

We know but little at present as to th
occupied by the débris of meteors in falli
the upper atmosphere to the earth's surfa
judging by the time during which the du
Krakatoa remained in the upper air, it
probable that fine dust takes many month
a year or two, to descend. We have only to
that the amount of meteoric matter which
the earth's atmosphere during a period o
month or two is greater than the amoun

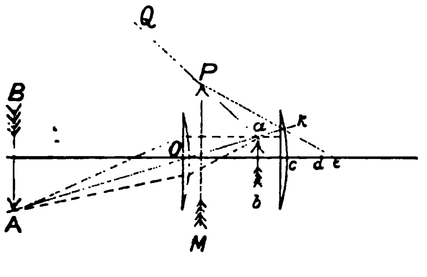
sinks down during the same period, and there will necessarily be an accumulation of meteoric débris in the upper air which might sensibly affect absorption, and colour the light which reaches the surface of the eclipsed moon after passing through the earth's upper atmosphere.

A. Cowper Ranyard.

EYEPIECES—PHYSICAL ABERRATION AND DISTORTION.

[28697.]—WE propose to explain the effect of the two kinds of spherical aberration mentioned in letter 28579.

Let A be any point of an object placed before an object-glass whose centre is at O. Join AO



and produce it, then an image of A is formed somewhere on this line, as at *a*. Let this line produced meet in K the eye-lens whose centre is at C, and whose axis is in the line O C. Now, if the eyelens had no aberration, all rays from O would be refracted to a common point E, which is named the "ocular point," and the virtual image of *a* will lie somewhere in E*k* produced backward. It will also lie in C*a* produced; therefore it lies in the intersection of E*k* and C*a*, as at P.

The above is Ganot's construction; but he has not followed it up to show what will be the form of the image PM of *ab*. However, it may easily be shown that, according to this construction, when the thickness of the lens is neglected, it will be a straight line, when *ab* is straight.

(If the Editor permits, I will send a demonstration of this in another letter, in a form applicable to other purposes beside the present.)

This, then, is what will be the form of the image supposing that A O K is refracted by the eyelens without aberration. In consequence of aberration, however, it will, as a matter of fact, be refracted to some point D nearer to C than E is, and this quantity D E is what we called the "real" aberration, inasmuch as it is the aberration from a real focus E, and its effects are easily seen, for if DK be joined and produced, it will meet C*a*—not in P, but in some point a good deal further off, as at Q, so that the image will be no longer a straight line resembling *ab*, only magnified, but it will be distorted into a curve, and the quantity PQ is called the "linear distortion."

Moreover, the effect of removing P to a greater distance will be that when the instrument is focussed for distinct vision at the centre of the field, Q will be out of focus, and very considerably so, thereby producing an ever-increasing indistinctness as we approach the edge of the field.

Nor is this the only effect, for, as K D C is greater than K E C, the image will subtend a greater angle than if it were similar to *a b*. There will, therefore, also be what is called "angular distortion"; for example, the image of a square will not be seen as a square, but as a figure with curved sides convex towards the centre. It is this aberration D E, therefore, which introduces distortion of both kinds, neither of which would exist but for it.

It is a great gain, therefore, when we can do anything to remedy this "real" aberration; we make the image more distinct, and more like the object, instead of looking like a caricature of it. The most effectual way of doing so will be by using a composite lens, corrected for distinct spherical aberration, like an o.g. It is also partially remedied, but not so completely, by a Huyghenian, which, however, has the advantage of giving a much larger field, and a still better result may be got by *two* composite lenses, as mentioned in the letter of "Prismatique," Aug. 5.

As to the effect of the "virtual" aberration, it is obvious enough, and so it will suffice to remind the reader that it is the aberration of the dotted rays whose origin is at *a*.

W. G. Penny.

EYEPIECES—SATURN.

[28698.]—IN looking back through a number of old volumes of "E.M." at the various communications upon astronomical eyepieces, I have been struck with the fact that in many instances their action has been studied under impossible conditions—that is, conditions that cannot obtain in practice—the rays being often shown impinging upon the first surface of the field lens from directions that no mirror or object-glass ever could send them; and then we are treated to a long series of calculations as to the consequences, which serve rather to mystify and confuse than simplify and explain, and, being based on non-natural data, are of no real value.

I think the manner of action of the lenses of any eyepiece can be well comprehended without mathematical formula and with simple reasoning. Let us consider the action of the ordinary Huyghenian. It is evident that an image must be formed in the focus of the eye-lens under all conditions, and, therefore, the problem becomes more especially one as to the action of the field-lens. Now, in regard to the spherical aberration, it will simplify it to consider the field-lens as made up of two lenses—one central and the other an annular margin only. Then the central inner lens will have a longer focus than the outer ring, and also will form a smaller image. The rays from margin cross sooner than from centre, and, therefore, impinge again nearer the margin of eye-lens, thus increasing the spherical aberration. The focus is adjusted for the least circle of aberration of the crossing rays, and we thus see that we get a larger image than we should if the spherical aberration were eliminated, and also that the aberration is increased, and spurious discs larger than with a single lens. Now to look at the chromatic aberration. It is evident that the blue rays will be bent more than the red, and therefore the whole field-lens will, with an achromatic pencil converging upon it, make a smaller blue image a little nearer the field-lens than the corresponding red image—that is, the blue rays will cross sooner than the red. The result of this is that the blue rays reach the eye-lens nearer the margin than the red rays. They are therefore bent more inwards, since the outer part is more strongly refractive than the inner, and thus we get the partial compensation which makes the Huyghenian nearly achromatic.

In Vol. XXIX. letter 15597, "A. J. S." gave particulars of a form of e.p. consisting of the ordinary Huyghenian lenses with the addition of a plano-concave, all adjustable as to distance apart. Considering its action as above, it seems to me it should introduce compensation for the spherical aberration, since the concave will produce opposite aberrations to the convex field-lens, and present an image at focus of eye-lens almost free from spherical aberration, leaving just enough outstanding for the eye-lens to put right. Having tried one of these e.p., I consider it gives smaller and neater discs than other e.p.'s, and with the further advantage of a considerable range of power in one eyepiece. There is, however, a loss of light from the third lens.

In letter 22389 Mr. Penny proposed an eyepiece composed of a plano-convex and plano-concave of equal foci at twice their focal distance apart. I cannot make anything of this. The distortion seems increased, not diminished, as he claims, and I found, to see at all, I must keep the eye some inches away from the eye-lens—a condition both unpleasant and incompatible with steady vision.

I see Dr. Terby on using higher powers and getting better definition finds the shadow of ball of Saturn on rings is straight. I have looked carefully at this shadow during present season, and have never seen it otherwise than straight. I believe the opinion that it is curved, and the variation in the curve, is simply the result of a sort of self-deception combined with an optical illusion, and perhaps also seeing the planet out of the centre of the field of a distorting eyepiece. It is examined with too low a power, and the observer's anxious desire to see something combined with the well-known fact that a straight line adjacent to a curve often looks curved itself creates the idea of concavity. I have no doubt Dr. T. will also find that his *masses sombres* on the crape ring are another mistake due to bad definition or defects in his own eye. It seems to have escaped observation that last year when first mentioned these irregularities escaped notice until the planet was far past opposition and rapidly sinking in the west. That they have been seen since by several other observers is explicable in the same manner as the observations of non-existent stars by even practised observers. It seems to be human nature to see whatever we are told is there. London air does not permit one to be positive in such delicate matters as the crape ring; but the phenomena would have to be of astounding magnitude to be visible here at all, and rapid changes require very strong testimony. We are not dealing with a cricket ball, but a hugh globe. If some of the alterations in the ring system we have had described were real, they must have shattered the whole to fragments.

E. Holmes.

DIRECT TRANSFORMERS OR INDUCTION COILS.

[28699.]—I AM obliged to Mr. Harcourt and to "Engineer, Govan," for directing me to their prior letters on this subject. Mr. Harcourt (Dec. 14, 1888) suggested the use of two wire cores united at one end by a yoke, an armature in front being used for "make and break." He, however, abandoned the idea on account of a statement by "Sigma" to the effect that though horseshoe magnets have greater attractive power at the poles, they have not such an extended influence as bar magnets. In other words, "Sigma" meant that in a bar magnet the *extent* of magnetic field is much greater than in a horseshoe magnet, the lines of force in the first case being scattered all around from either pole, while in the second they are concentrated into the small space between the poles.

I would point out to Mr. Harcourt that the very essence of electro-magnetic induction consists in getting the max. No. of lines of force to thread *through* the helix of wire.

We don't want any external field at all; our object is not to have the "field" sprawling all over the place, such as would give good "mag. figures," and which means so many lines of force running to waste, as they do in the present absurd style of transformer.

Mr. Harcourt will pardon my suggesting that he hit on the right thing without exactly knowing why, or he would hardly have abandoned it for the reason he did.

Next, "Engineer, Govan" (p. 148), refers me to Jan. 6, 1888, where he expresses surprise that a closed magnetic circuit is not used in "Ruhmkorff coils."

After my first letter (Ap. 6) he suggests (Ap. 13) the use of two cores, yoked at both ends, thus obtaining a perfect magnetic circuit, but necessitating the use of a separate commutator.

My second letter and sketch (Ap. 20), though appearing after his, were in reality sent in before (*vide* date, Ap. 9).

It will be seen that without introducing any material resistance into the magnetic circuit, the necessity for separate commutator does not exist. The cores and back yoke should have been drawn thicker.

May I ask "Engineer," Mr. Harcourt, and our other competent electricians to join me in this crusade against the present unscientific form?

I have not yet been favoured with any criticism *re* nomenclature, "direct" and "alternate" transformers (*vide* Ap. 6).

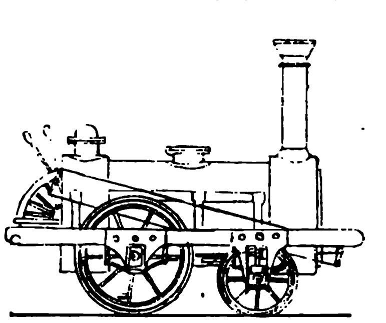
W. Perren-Maycock, A.S.T.E.

59, Church-road, Homerton, E.

THE "PLANET" LOCOMOTIVE.

[28700.]—SEEING a letter (28630) requesting a sketch of the "Planet," I beg to inclose same, and also some particulars.

It was the ninth locomotive built for the Liverpool and Manchester Railway by Mr. Stephenson, was carried on four wheels, leaders, 3ft. in diameter; drivers, 5ft.; distance between wheel centres, 5ft.; length of engine, 15ft.; boiler, 6ft. 6in. long, and 3ft. diameter, containing 129 tubes 1⅝in. diameter; heating surface of firebox, 87¼ft.; of the tubes, 370ft.; cylinders, 11in.; piston stroke, 16in.; weight of engine empty, 8 tons; loaded, 9 tons; tender, 4 tons—total weight, 13 tons. This engine took a train, 76 tons in weight, from Liverpool to Manchester, in 2 hours 39 minutes, on the 4th Dec., 1830. The greatest speed attained on level ground was 15½ miles per hour.



S. S.

OVERWORK.

[28701.]—YOUR correspondent calling himself "A Yachtsman" (letter 28656) should be made to serve ten years on the Metropolitan Underground Railway, at, say, 13 hours a day. He might then, with a little more knowledge of what he is talking about, write again to the ENGLISH MECHANIC, stating how he liked it, and whether he would care for another ten years to try longer hours.

That is the dreary, monotonous life the improvement of which he is doing his best to prevent, and which is made more dreary in the majority of by the knowledge that it must probably go on only for ten years, but until the end of existe

The sailor's lot is no doubt hard, as "A Y man's" men could probably tell us far better he; but the remedy is to try and improve i to prevent other improvement. "A Yachtsm himself also does not appear to know much practically of what even that is like. He does not endure the hardship. If he had the slightest sense of manliness, therefore, he would see that a letter like his comes with a very bad grace indeed from an effeminate being who cowardly goes snugly down below while his men "would be on deck all night," and then wakes up refreshed in the morning to write letters to the ENGLISH MECHANIC on a subject about which from personal experience he has not the remotest conception. Patience may be a virtue, but there is a limit to all things.

An Employer, who is also a Man.

OVERWORK.

[28702.]—YOUR correspondent, "A Yachtsman," does not seem to me to have grasped this subject from any point of view. Mr. Stretton has already set him right from the point of view of safety to the railway travellers; let me point out to him that he does not know what "overwork" is. It is, no doubt, true that masters and crews of vessels are often compelled to keep at work for long periods of time; but let "A Yachtsman" try working in a factory at the same monotonous details from Monday morning until Saturday night, from year's end to year's end without cessation (beyond a few hours for sleep) or respite for a brief holiday, and he will then know what "overwork" is. In the ordinary sense of the term, there is no "overwork" where there is variety of occupation—no matter how long the eyes are kept open.

Nun. Dor.

MICROSCOPICAL.

[28703.]—IN answering the question of "A.S. L." (letter 28643), it is necessary to ask whether an e.p. power of 100 to the inch of aperture in telescopes is not as delusive as very deep eyepiecing to microscopes? Dr. Abbe, in his paper on the "Relation of Power to Aperture," says that a power of 30 to the inch is the highest useful power for a telescope object-glass, and adds that if you apply a power of 300 to a 3in. object-glass on a fixed star, it shows a decided disc; but when the same power of 300 is used with a 9in. aperture the disc at once vanishes to a point, thus proving it to be spurious. As this seems to dispose of the value of a corresponding power being applied to the microscope, it only remains to determine the happy mean between objective and e.p. as applied to microscopic vision only.

If I may use my own experience as a guide, I should say the happy mean would be the one that brings up the power of a dry object-glass of large aperture to about 800 to 1,000 diameters, and that of an oil immersion to about 1,500, and would vary in proportion to the focus of the objective used. With the Zeiss apochromatic $\frac{1}{4}$in., for instance, I can use an e.p. of 18 power with great advantage, bringing it up to 886 diameters, being the proportion of $^{17}/_{50}$; with a very fine $\frac{1}{8}$in. by Swift and Son, of about the same aperture, I generally use an e.p. of 12 power, making about a 1,000 diameters, or the proportion of $^{12}/_{84}$; while with a $\frac{1}{12}$in. oil immersion I restrict myself to an e.p. power of 8, making 1,500 diameters, being the proportion of $^{8}/_{125}$. These appear to me to be maximum figures, beyond which it serves no useful purpose to go, and indeed on objects like organisms in water, eyepieces of two-thirds the power I have given will be much better, as giving greater brilliancy to the image.

Of course, it is possible to use a much deeper e.p. in each case than any I have named without breaking down the image; but nothing is gained thereby except size at the expense of light. In estimating the value of magnifying power, it should be remembered that nothing has yet been discovered that exceeds the 1-200,000 of an inch in thickness, and this can be easily seen with a power of 800 diameters, provided the angle of light from the object is sufficient to stimulate the optic nerve. With regard to the $^1/_{40}$in. of Smith and Beck, it is a dry objective, and consequently under 1·0 N.A., and I can see no utility whatever in using such a glass. To me it is but a commonplace of microscopy to say that you can draw out no more light from one end of the tube than can be got in at the other, and the theoretical limit of the separating power of a dry objective being 1-96,000 to the inch, and in practice much less, what is the use of a glass that gives 2,000 diameters with the lowest eyepiece, when you can see well all that can be seen with such a glass with less than 1,000? The result can only be to give a dull field instead of a brilliant one, and to destroy that crispness of image which is such a delight to the eye.

When, however, you come to an objective such as an oil immersion $^1/_{12}$in., you can push the magnifying power to 1,500 diameters, not because the glass is of a shorter focus, but because it has a larger aperture, and consequently a capacity to [illegible] detail.

[illegible] "A. S. L." is in error in supposing that [illegible]'s apochromatics are more for the Eng[illegible]eign tubes, my list giving the same [illegible]creased charge is really for a glass of the larger focus but the same aperture, and they explain it by saying that the trouble of correcting for the longer focus is greater.

I had no means of comparing the $\frac{1}{4}$in. with the $\frac{1}{8}$in. of the same aperture, it being "Hobson's choice" with me to take the $\frac{1}{4}$in. or none; but the $\frac{1}{4}$in. will certainly not work on a shorter tube than 10in., and the correction collar is for different thickness of cover-glass only. An English objective has certainly a much greater range of correction, and I can use my $\frac{1}{8}$in. with advantage from 6in. up to 11in. or 12in. by shifting the correction collar; but I believe the apochromatics have more lenses, and perhaps that would account for the limited range of adjustment.

T. F. S.

[28704.]—MANY thanks to Mr. Nelson for his kind reply *re* aperture. His comments anent dark ground illumination with the Abbe illuminator puzzled me, till on referring back to my note I saw that, either by my own carelessness or by a printer's slip, the word "scarcely" had been dropped—I had meant to say "I can 'scarcely' get dark-ground illumination," &c., and thence I drew the logical inference that the aperture of the glass in question must at all events be over N.A. 1·0. However, on making a fresh trial, and this time taking care to use rays parallelised by means of a bull's-eye (I seldom take this trouble with the Abbe, as it works so well without), I now find I cannot get any perceptible approach to darkground illumination at all. But as the effect of using parallelised rays is to bring the focus of the condenser closer to the object (the front lens of the Abbe touching the slide, only the thinnest film of oil intervening), and consequently to bring still more marginal rays into action, it seems that this experiment contradicts what I stated in my last. I can only ascribe the discrepancy to a possibility that on the previous occasion I had not truly centred the image of the flame.

All this only further confirms my estimate that the aperture of the $\frac{1}{18}$ is *well* over N.A. 1·0. I may here mention that the water angle I gave (127°) was the mean of many determinations—the extremes being 110°, when the droplet of water on the front lens was very distinctly too flat, and 135° and 140°, when it was more than a hemisphere. Now, even discarding ·10 of aperture for chance sources of error not recognised, ought not an objective of N.A. 1·08 to resolve Amphipleura pellucida with ease?

Not that I am very anxious to resolve diatoms. One naturally likes to try a newly purchased lens in all ways.

I am extremely sorry to see Mr. Nelson call in question the undoubted advantages of penetration. In the surgery in which most of my days are passed there is an old Hartnack and Prazmowski's microscope with objectives 4 and 7. The latter is an old-fashioned triplet—its angle is 85°, and power about $\frac{1}{6}$. Now, this objective has much penetration (oblique rays making objects stand out as if seen binocularly), a flat field, and long working distance—works well with thick cover glasses. I use it constantly for the pathological work of which I do a great deal, and find it admirable in virtue of the very qualities Mr. Nelson seems to despise. Compared with a Zeiss E of my own, I often give the French power the preference for its greater penetration.

Medical men who have to mount specimens of fluids and tumours, &c., rapidly and roughly, and to rapidly "spot" the nature of the specimen, will always bear witness to the advantages of low angle, penetration, and long working distance. I sincerely hope that many first-class opticians will not follow Zeiss's changed lead, as exemplified by the ominous list of apochromatics quoted by Mr. Nelson.

Fras. D'Agen.

[28705.]—I AM glad to find that Mr. Nelson endorses my suggestions; in fact, his letter (No. 28672) is almost a paraphrase of my own letters, Nos. 28619 and 28643. I do not, however, see that "100 per inch" in telescopes is "all nonsense"; it is what experience has shown to be the limit with object-glasses of moderate aperture, corrected as perfectly as possible.

Mr. Nelson, in fact, in the very next sentence, fixes, or rather suggests, a precisely equivalent limit for microscope objectives in saying no lens ought to be pressed more than ten times its initial power.

If this is right, our leading opticians must be woefully mistaken in making eyepieces that bring up the total magnification of, say, $\frac{1}{15}$ to 10,000, which, I notice, is the figure given in a list that lies before me. So far as my own experience goes, I certainly think there is more lost than gained by the use of the deepest eyepieces supplied by a few makers, and I find that 1,800 with an $\frac{1}{14}$ gives me about the best working limit, thus confirming Mr. Nelson's remark. Mr. Nelson's criticism of nominal "quarters" that were really "sixths" may, I hope, induce some practical optician to defend his craft from what amounts to a charge of obtaining money by incorrect representations.

In the case of objectives "with correction," the power will be varied by altering the correction so that if the equivalent focus is marked on them, it should be stated whether such focus is for uncovered objects or for a definite thickness of cover glass.

Mr. N. refers to inconsistencies in the magnification given in the opticians' lists. I had observed the same thing, and was therefore careful to state that the table I gave was deduced from an inch objective. The making a $\frac{1}{10}$ of 65° magnify with a No. 1 eyepiece 125, while a $\frac{1}{6}$ of 95° magnifies 150, is not the only peculiarity in the list in question. For all objectives, from the 1½ to the $\frac{1}{10}$, the eyepieces are 5, 8, 15, 20, 25; but for the 2in. they are 5·5, 9, 17, 22·5, 28; and for the 4in., 4, 6·4, 12, 16, 20. I suppose that the different construction of the low-power objectives alters the position of the back focus with reference to that of the eyepiece, and causes a difference; but I should much like to see the matter cleared up.

Opinions of course differ; but, with experience of the best as well as of the cheaper makes of both patterns, I should say that in freedom from vibration and accuracy of movement, the "Jackson limb" surpasses the other, especially after "wear and tear" has begun to show its effects, so that I doubt whether *that* dictum will fall to rise no more.

Penetration means, in fact, simultaneously seeing objects in different planes, which, in one sense, must be equivalent to an objective having no exact focus at all, nevertheless (notwithstanding theory), such objectives prove good lenses to work with, as Mr. Nelson, of course, knows by experience. Why a "thin stage for oblique illumination" is a mistake I don't quite see.

A. S. L.

CERTIFICATES FOR ENGINE-DRIVERS.

[28706.]—IN my letter, No. 28592, page 125, in your issue of 6th April, I referred at length to the Steam-Engines and Boilers Bill which was intended to introduce the system of examination and certificates for engine-drivers. I pointed out that it was impossible to speak either for or against the measure until it was clearly known what kind of examination the men would be required to pass; and also that it would be impossible for some of the best practical engine-drivers in the country to pass a severe scientific examination.

In your last issue, page 187, I observe the fact recorded that the House of Commons refused the second reading by 147 votes to 96. I listened attentively to the debate, which, however, was of the most tame and uninteresting character. Those who were in favour of the measure appeared unable to bring forward any reason why such a law should be passed. Sir. Michael Hicks-Beach clearly pointed out that of the 57 cases of explosions in the year not one would be touched by the Certificate Bill. To that statement there was and could be no reply. It is very possible that few, or probably none, of the members who supported the Bill really knew its object, or why it was introduced. Instead of a measure to prevent boiler explosions, it was a Bill to prevent engine-drivers taking the places of others at the time of a strike.

Even if the Bill had been read a second time, the object of its promoters would not have been attained, as a draft copy of a clause was shown to me which it was intended to add in committee, suspending the operation of the Act during such disputes or strikes.

If anything *can* be done to reduce the number of explosions, by all means let it be done; but under cover of a "Boiler Bill" do not let us be saddled with a weapon to assist strikes. On the other hand, I trust that railway servants will never again allow themselves to be misled into unnecessary strikes, which always on railways end in disaster.

Clement E. Stretton, C.E.

40, Saxe Coburg-street, Leicester, April 28.

GRADIENTS.

[28707.]—WOULD any practical railway engineer or surveyor who is as familiar with the subject as Mr. Rous-Marten, of New Zealand, appears to be, tell me candidly, if he were called upon to give evidence before a Committee of the House of Commons, or put upon oath in any law court in England, and required to describe upon a sheet of foolscap a section-diagram of the 160 miles from Peterborough to Doncaster, would he draw it, with its imperceptible "ups" and "downs," in a horizontal line from end to end, or would he describe it on the paper as a segment of a curve, with a declination of 6,400ft. from a tangent line joining the curve at either extremity? Is there any engineer's office in the whole United Kingdom that possesses a section-diagram which conveys the impression that such a configuration was even possible?

Now, what is the cause of this tremendous disparity between facts and theory? How does the astronomer get over these evidences, in black and white, against his description of what he consideshould be the shape of one, or two, or three hundred miles of iron rails? "Oh," says he, "to the eye of common sense a level surface is a flat surface; but our superior intelligence, of course, would describe *such* a 'level' as a curvature." And he smilingly assures the engineers who planned and constructed the railway that the 6,400ft. decline *must* exist on the said 160 miles. Only it is not to be looked for, but simply taken for granted, out of respect to Sir Isaac Newton!

I cannot and will not believe that the scores and hundreds of practical men who know the shape of railways as well as they do their right hand from their left are all conspiring to conceal the truth, and afraid to say whether my view of the subject is right or wrong. Would it not be much more creditable to those who are opposed to my remarks if they would render all further discussion unnecessary by specifying some conclusive proof that all practical experiments fully justify the popular theory? It is very easy and sounds very well to make a "direct challenge." But neither "Sigma" nor anyone else has referred to any proof at all bearing on the subject. It is surely not incumbent upon me to profess acquaintance with stellar physics in the Antarctic regions! There is a degree of common justice and impartial dealing which every correspondent may consider his due. There is no one who would more readily confess himself beaten than I would. But it is not courteous to say "my letters are hardly worth space," simply because I do not feel called upon to acquiesce in meeting "challenges" which are not intelligible or calculated or intended to promote the truth. I do not for a moment suppose that any offence is meant; but the subject is sufficiently important, and the mere fact of my being so considerably in the minority ought to entitle me to every consideration. If I am defeated, let it be done openly, and no complaint shall be made by me; but till I am made to understand what correspondents like Mr. Rous-Marten mean by saying such and such a line is "virtually level," and my opponents can produce from two to twenty practical men who will undertake to show that "virtually level" distances are demonstrably *curves*, can I be expected to abandon my convictions merely for the sake of allowing my opponents to claim the victory? If so, there is an end to all discussion.

John Hampden.

FLAT EARTH v. ROUND EARTH.

[28708.]—YOUR excellent remarks in this week's number on Mr. Hampden's extraordinary views on the "flat earth" theory are, I fear, lost on that gentleman. He only recognises one standard of authority—viz., the Bible. Kindly allow me brief space to show that gentleman that ages ago the Prophet Isaiah was fully cognisant of the rotundity of the earth. I simply, without further comment, refer him to Isaiah xl. 22.

Thomas May.

[28709.]—IF, as Mr. Hampden says (p. 190), "curvature must begin somewhere," must not flatness, too, begin somewhere?

I beg to submit that when he has convinced half-a-dozen men of average eyesight that three marks, equally elevated above a gutter of still water, a mile long, are in a straight line, he should write again as on the above page, and not sooner. The North Kent line's tunnel between Higham and Strood, I have noticed, contains such a gutter, of above two miles, that might suit him perfectly.

E. L. G.

THE ORIGIN OF LIFE, OF ANIMALS, AND OF PLANTS.

[28710.]—I SUBJECT this theory to the criticism of the readers of the "E. M."

In the days before life was the air was filled with poisonous gases, such as carbon monoxide and the oxides of nitrogen, hydrogen, sulphur, and phosphorus. All the forces of Nature were raging, storms accompanied by winds, displays of electricity, and probably other forces of which we are ignorant. Under these circumstances, compound substances would be resolved into their elements and combined with others unceasingly, so that every possible compound would be produced. Among these was produced a green, slimy substance called chlorophyl, and another transparent jelly-like mass called protoplasm, consisting of carbon, hydrogen, oxygen, nitrogen, sulphur, and phosphorus. These two substances mixed, fell to the ground, and were able to move, thus becoming our ancestor. Some of it fell on dry land and perished, some on the marshy ground near the sea. Here the mixture, aided by the sunlight, found it was able to decompose the carbon dioxide into carbon, which it took to itself, and oxygen, which it liberated. Blown about by the wind, it sought to make a covering for itself, so the protoplasm collected from the swampy ground some materials, and formed around itself a covering of cellulose, thus rooting itself to the ground and becoming a plant. Another portion of the two substances fell into the sea and sank to the bottom. Here the chlorophyl, unaided by the sun's rays, was unable to split up carbon monoxide and take to itself the carbon, but had to absorb oxygen, which took away some of its carbon. Thus it would have starved had not a gust of wind uprooted some of the plants on the shore and thrown them into the sea, where they sank to the bottom, for the sea then was of much less density than now, owing to the heat and the amount of gas it held. Wafted to and fro at the bottom of the sea, the plant at last stuck in the jelly-like mass of our ancestor. He found he was able to take away some of the carbon of the plant, and so was able to replace the ravages of the oxygen, and so it became an animal. The sharp critics of the "E. M." will probably discover mistakes in this theory; and if they do, so much the better, for it is a very true saying, "it is by blunders we learn."

Satine.

TIGERS AND TELEOLOGY.

[28711.]—IS there any explanation of the great natural fact that the *Felidæ*, from the lordly tiger down to our domestic cat, possess large *self-destroying* instincts? They actually hunt for and devour their own juvenile kindred. A tigress and her cubs, hotly pursued by their male guardian, often meet with their destruction by the rifle in their hasty flight from the forest. Again, whole tribes of cannibal man, acting on the same suicidal law, kill and devour their wives, or any other fat women. Many of the South Sea Islands have been depopulated by the growing impetus to infanticide—or rather to abortive practices, to avoid the cares and troubles of maternity. Thus we see extermination *sui generis*, as frequently as the great struggle for its preservation. As John Stuart Mill remarked, there is an immense amount of cruelty in the course of nature, though some men will have it that all is harmony!

Eos.

MAINTAINING SPRING FOR SMALL TURRET CLOCK.

[28712.]—ON reading letter 28663, p. 188, in print, I find that my explanation of the operation of "winding" is incorrect—it having been mixed with that of another motion. After the words "as simple as possible," the following should be substituted:—

Let Fig. 7 represent the internal gearing of Fig. 1, S the sun-wheel, P the planet-wheel, and R the ring with internal teeth. Suppose, now, the train to be at rest, and the wheel P at its highest point. When S is turned in the direction of the arrow, to wind up the weight, it will constrain P to rotate on its axis in the opposite direction, and simultaneously to roll round R in the direction of the arrow B. As the circumferences of circles bear the same ratio to each other as their diameters, and P being equal in diameter to S, each is equal to one-third the diameter of R; P, therefore, will require to make three revolutions on its axis to roll round the larger circle, making, at the same time, one complete orbital rotation round the centre S, so that S will require to make three revolutions on its axis to cause B to do likewise, and, in addition, one more or four revolutions to maintain its relative position to P, as the latter revolves round it. Thus S and the winding arbor will make four revolutions to one rotation of the barrel. Again, suppose, &c.

Fig. 6 and the dotted arrow in Fig. 7 must be neglected.

May I trouble you to insert this correction, apologising, at the same time, for my clumsiness?

April 26. **A. Marson.**

GEOMETRIC CHUCK.

[28713.]—I WOULD give a few words in reply to F. N. Massa (letter 28621). I have used both the geometric chucks in general use, that is Hartley's (Plant's) and Ibbetson's.

I have done some very fair work with the former in geometric patterns; but its powers are very limited, having only a few set trains of wheels, and these soiling the hands greatly in their manipulation. Ibbetson's chuck and the powers of its variations of trains of wheels not only for integral numbers, but also for fractional, is an instrument infinitely superior in every way, and so cleanly to manipulate, although if well made it is expensive. "The Index" to this chuck, by Sir T. S. Bazley, is an invaluable addition to its extended use, showing the ready means of calculating any variety of train of wheels without difficulty.

I do not think the "Cooke chuck" of much utility after those chucks above mentioned. It is expensive, and very limited in power of geometric variety. I saw the principle adapted to a common eccentric chuck nearly 50 years ago; the front division wheel was simply connected with a fixed wheel on the lathe head, or similar to the F.M.W. of the present chucks. Thus, when the chuck was rotated the front division wheel rotated also; but with a different ratio. I have only seen the photograph of Cooke's chuck; but I have seen a beautiful Ibbetson chuck made by that firm. A much superior instrument to this class of chucks is the epicycloidal cutting-frame, which is capable of immense variety; and if this is used in connection with the spiral apparatus a far greater variety of curves may be produced. I use both these in connection with the Ibbetson chuck, which makes a rather complicated arrangement; but the results are sometimes remarkable. The advantage is that it gives a slow motion to the geometric chuck when on the lathe, the ordinary more rapid revolution of the heavy geometric being very objectionable. I have also a table for working the geometric chucks in a horizontal position, which is far superior to the vertical position when on the lathe; but this is specially for scratching patterns on glass either for cutting in the pattern with fluoric acid, or making transparencies with different coloured films of collodion or varnish.

Amateur.

CURIOUS ALLOYS.

[28714.]—THERE are a great number of trade secrets in China and Japan of centuries' existence which those hitherto exclusive countries have managed to conceal. Neither I nor any other European can tell "H. B. F." about them, most of which have been handed down (as in India) as valuable hereditary knowledge, the weaving of Dacca muslins, and the enamelled jewellery of Rajpootana, being now confined to the few surviving artisans of half-a-dozen families.

Eos.

TUBERCULOSIS IN MILCH CATTLE.

[28715.]—"CARINO" (letter 28680) says: "This disease is being propagated in a broadcast manner, and the seed of consumption is sown in children at an early age." I would like much if "Carino" would refer to *one* case of consumption traceable either to milk-drinking or flesh-eating. Although the bacillus tuberculosis is found in cattle, we have yet to learn if disease has ever been communicated to the human organism from that source.

The only test is the microscope. A long article giving full details of the process of preparation was given in a former number of the "E. M." I do not know of any books on the subject; but an important article on the necessity of greater care being taken by market inspectors to reject carcases suspected of tuberculosis appeared in the *Scotsman* a few months ago. As no necessity has yet arisen, tests for bacilli are not recognised in courts of law.

Some information on this subject might be got from the Jews. It is well known that their death-rate is lower than the general rate. Circumcision, absence of pauperism, and their hygienic rules are, no doubt, important elements in this immunity from disease and death; but *possibly* the great care exercised by the Jewish inspectors of meat (see Dr. Richardson's lecture in this week's "E. M.") reduces their death-rate in the matter of tuberculosis. In the first place it is necessary to ascertain if they have less of this disease than we (Christians) have, and, if so, inquiry must be made, in the second place, if the careful inspection of their butchers' meat has anything to do with this partial immunity.

I read the other day that Dr. Richardson, in one of his lectures, had assigned the use of gas as a cause of consumption. I would like very much to know on what facts or statistics this assertion is based. Can any of "ours" give them? For anything I know to the contrary the opposite *may* be the case, and it might be asserted with equal force that gas and the products of its combustion were decidedly antagonistic to the development of bacilli tuberculosis.

B.Sc., Plymouth.

The Bar-Lock Type-Writer.—Messrs. W. J Richardson and Co., of 12-14, Queen Victoria-street, E.C., are introducing a new form of type-writer, which embodies the latest improvements in these useful instruments. The machine has 72 keys, giving capitals and small letters, but as the arrangement is the same for each size, the "board" is soon mastered. The principal feature of the machine is that from which it derives the name—a device at the printing point which receives, and so to speak "locks" each type-bar, thus securing perfect alignment. The type-bars are arranged in a semicircle, and when their keys are depressed (the depression being less than ½in.) they strike on a ribbon at one point, and at the same time are "locked" in position, so that side and end displacement are impossible, because the levers fall between pins on a little rack. The impression, or printing, being made by a downward stroke of the levers or type-bars, what has been printed can be seen without shifting any part of the apparatus, and as this machine is a development of previous inventions of a similar kind, it goes without saying that it is an improvement, and is possibly the best type-writer in the market. At any rate, the makers claim that it will print or write as fast as anyone can work it, and having seen it, we can say that they have not claimed too much.

REPLIES TO QUERIES.

⁂ *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[64529.]—**Rust in Water Pipes (U.Q.)**—If the pipes were in a suitable position, and not too large, you might fill them (when dry) with black Japan, run out and allow to dry (the lower end, of course, to be stopped up). This is only a suggestion, and perhaps might answer your purpose.—PRINCIPIA.

[64547.]—**Problem.** — Having gone through the process again, I find myself in error, and get the same results as "Reymond." I forward my series in a modified form, which I think the simplest consistent with convenience of calculation. It is—

$$(n-1)\,\underline{|n-1} - (n-2)\frac{\underline{|n-1}}{\underline{|2}} + (n-3)\frac{\underline{|n-1}}{\underline{|3}}$$

$$-\,(n-4)\frac{\underline{|n-1}}{\underline{|4}} +,\ \&c.$$

of which the law is obvious, and I think "Reymond" will be able to see how it is obtained. I don't feel quite certain I understand what is meant by arrangements round a circle; but, as I conceive it, if there are n soldiers arranged at equal distances round circle, each such arrangement must cover n arrangements in a straight line; ∴ the number of ways n things can be arranged round a circle is $= \frac{\underline{|n}}{n}$; thus $n = 3$, number $= \frac{\underline{|3}}{3} = 2$. With better understanding we might do more. Of course, the terms of the above series are to be subtracted from the whole number of permutations, as it embodies the arrangements forbidden by the conditions. Another problem would be that "no soldier shall be either again preceded or followed by the one who originally preceded or followed him," and "Reymond" will find he gets another series by applying similar means.—J. C.

[64547.]—**Problem.**—I soon saw I had counted, as "F.S.S." says, the whole arrangements instead of the *de*rangements. But his figures on page 193 are no more reliable than on page 107. By beginning each of his rings of three and of four with the same letter he will find they are all alike. In fact, the rings of three and four each admit but one complete derangement—namely, inversion. The ring of five admits eight, thus—

a c b e d	a d b e c	a e b d c
a c e b d	a d c e b	a e c b d
a c e d b		a e d c b

The full table of derangements up to twelve is this—

Men (n)	Ranks with no man in his first place.	Ranks with no man followed as at first.	Rings with no man followed as at first.
2	1	1	0
3	2	3	1
4	9	11	1
5	44	53	8
6	265	309	36
7	1854	2119	229
8	14833	16687	1625
9	133496	148329	13208
10	1334961	1468457	120288
11	14684570	16019531	1214678
12	176214841	190899411	13469897

Each of the second column (which Whitworth has named *sub-factorials*) may be got from the figure above it by multiplying by n, and alternately subtracting or adding 1—that is, adding $(-1)^n$. Each in the third column, that already given by "Reymond," is the sum of two in the second, and each, if multiplied by n, gives the next in column 2. Lastly, any figure of column 4 subtracted from the corresponding one of column 2 will give the next in column 4. Whitworth's "Choice and Chance" is a good new book on all these classes of problems, giving proof; but [illegible] column 4 by a complicated series, lik[illegible] "J. R." and "Reymond" for column [illegible].

[64702.]—**Evolut**[illegible] it permissible to ask "H. B. F." what he [illegible] by "self-evolution"? The reply which he [illegible] was only a little bit of harmless stupid[illegible] perhaps I should say want of understandi[illegible] H. B. F.'s" question to "F.R.A.S." is [illegible] ece of unmitigated impertinence, as he [illegible] he will but take the trouble to refer back [illegible] letters of "F.R.A.S."; or, at any rate, those [illegible] his "confession of faith." Allow me to [illegible] end a perusal of Dr. Dallinger's Fernley [illegible] he is at once an Evolutionist and a di[illegible]—NUN. DOR.

[64823.]—**Discolo**[illegible]—"Intermediate" had better send his object-glass to an optician—the maker, if known. He could do it himself, but it would not be "good business."—T. J.

[64842.]—**Water Tap.**—"J. W." can adopt either of the methods he suggests, if he thinks it necessary to grind the seat of the water tap; but I should try whether a rubber washer (instead of leather) would not effect a cure.—NUN. DOR.

[64867.]—**Gilding on Glass.**—This querist will find information about gilding on glass in the last volume, p. 261. He should also see the indices of the back volumes.—NUN. DOR.

[64868.]—**Painting Figures on Clock Dials.**—A good "ink" is best lampblack mixed with oil of lavender and a little spirit varnish. Another is ivory black, a little pure wax, and turpentine; but the latter is more useful for filling in engraved (sunk) figures. Apply with a fine brush. As to the enamel, colour some white lead to suit, and use that. If very bad, better procure a new dial.—NUN. DOR.

[64869.]—**Solution for Removing Whitewash.**—If you must remove it, try hot water and a brush; but perhaps going over with a bass broom will effect all that is desired.—NUN. DOR.

[64875.]—**Optical Illusion.**—This query is correctly signed. Why does not "Duffer" employ some one to make the apparatus for him? The directions given on p. 477 last volume are ample—that is, for any one with a little brains.—NUN. DOR.

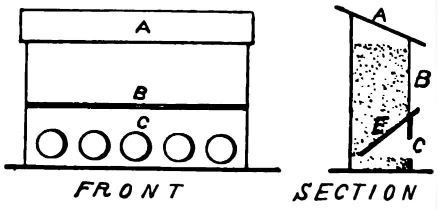
[64878.]—**Linen and Collodion.**—Collodion is not very "stiff"; but what is the object of the querist?—PHOTO.

[64884.]—**Lemons.**—Nothing better than lemons for bile, unless it is the chiretta mentioned by our friend "Eos." But why take the lemon-juice in tea—one of the worst possible things any one can take into his stomach who is at all bilious? Why not try rum and milk? A little brandy will often bring away bile, or carry it off.—M. D.

[64944.] — **Chemical.** — I beg to inform "Chemist" that I meant precisely what I wrote. If his chemical knowledge is derived only from Roscoe's shilling primer, it is, perhaps, not wonderful that he should be ignorant that potassium chlorate fuses before it is decomposed.—SM.

[64955.]—**Chloride of Zinc Soldering Fluid.**—I see Mr. Stanley offers to send privately (of course) the recipe of "the new German fluid," which claims to be, &c. If Mr. Stanley thinks he has got anything valuable or new, it is a pity he does not publish it at once. He might discover that he has found another mare's nest, of the same pattern as that headed "To Weld Steel," on p. 130, which is stale, stale, dreadfully stale. Perhaps Mr. Stanley will publish this wonderful German recipe.—T. MAUDSLEY.

[65004.]—**Poultry Hopper.**—A, lid; B, glass; C, bottom portion of front with a number (according to size of box) of holes; E, inclined board fixed from end to end, but leaving a space between its edge and back of box. When the grain is put in, a portion falls through the space upon the bottom of box (as shown); the poultry peck at it through the holes at C. As fast as the poultry eat the grain a corresponding quantity falls down in its place. By having a portion of the front of glass you can see at a glance when the hopper is empty.—J. W. M.



[65019.] — **Gas Engine.** — Many thanks to "Engineer" for his reply. Since inserting the query, I have considered the matter of the small gas engine well, and as I should get so little power out of it I have decided not to make it. The larger engine (for which I require the governor) is made from Dorrington's castings, and runs beautifully, and has a cylinder about 5in. by 7in., and is fitted with a piston valve for admission of gas and air, and an igniting valve, much the same as the engine shown last week in the query column. Will you kindly say if you require more particulars, and also say if I could make it compress the gas? A reply will greatly oblige.—W. O. S.

[65027.]—**Perspective.**—I do not think that it has been distinctly enough mentioned by correspondents who have replied to this query, that while a correct perspective drawing or a good photograph gives an exact representation of an object on a vertical plane, it is correct to the eye if viewed from one point only—viz., the point of sight, which in a drawing can be easily determined while the drawing is being made, and, strictly speaking, ought to be marked upon it, and in the case of a photograph it is at the same distance from the picture as the focal distance of the lens from the plate, and, as a rule, directly opposite the centre of the horizon. In the case of parallel perspective, where horizontal lines represent lines in the object parallel to the plane of the picture, they appear, when looked at from the point of sight, to have the same convergence as they approach the sides of the picture as the objects themselves appear to have, the supposed errors arising chiefly from placing the eye in a wrong position when looking at the picture. Many photographs are taken with such short-focussed lenses as to make it difficult, if not impossible, to see them in correct perspective with the naked eye, and it is doubtful if a really satisfactory photograph can be taken with a lens of shorter focus than 10in. or 12in.; even then, to get a correct idea of its perspective it ought to be looked at with one eye only, so that it may be seen from the correct point of sight. Those who may have condemned the perspective in an apparently distorted photograph may be greatly and agreeably surprised at the improvement observable when it is viewed from even an approximation to the correct point of sight. Short-sighted people have a great advantage in this, as such photographs offend chiefly from being taken with lenses of too short focus.—G. H. S.

[65027.] — **Perspective.** — Both querist and correspondents in reply seem to have their reasonings shrouded in a fog concerning what should be the exact representation in perspective of a straight line. It is wrong to suppose, as has been done in two replies, that the principle of the querist's idea exists in theory, though it is to be overlooked in practice. In reality it exists no more in the one than it should in the other. Those who have read anything of descriptive geometry or of perspective itself must be aware that it is in the alphabet of that science that a straight line is always the perspective of a straight line, whatever be its position towards the plane of the picture, and it is so in the strictest geometrical sense, and not merely approximately. The perspective outline of any given object or figure is the same thing as what is known in the theory of projections as the *projection of the figure*, the plane of projection being the plane of the picture in this case. In order to comprehend the nature of perspective, we have only to conceive a vertical plane (denoting the picture-plane) to be placed between the eye and the objects to be delineated, and to suppose, moreover, that this vertical plane is a transparent substance, as glass, which affords us a view of the objects. If we now suppose visual rays to proceed from the eye to all points in the objects to be represented, the intersection of those rays with the vertical picture-plane will form an outline, which will be the perspective of the given objects on that plane. To consider now what should be the perspective of any straight line belonging to the given object, we have to reflect that the assemblage of rays, drawn from the eye to that line, will form of themselves a plane surface, or rather will be included within such a surface, and will be so whatever be the position of the line with regard to the eye. The picture being supposed to be a plane, the perspective of the straight line will consequently be formed by the intersection of one plane with another, which by elementary geometry is a straight line. In the query under consideration the houses on one side of a street are supposed to be all of the same height, and the uppermost line of the continuous "blocking course" forms the horizontal straight line whose perspective, from a standpoint on the opposite side of the street, is sought to be obtained. In order now to take a correct view of the solution of this question we have only to imagine the visual rays to proceed from the observer's eye to the line of housetops, and the assemblage of such rays will form in themselves a triangular plane, whose intersection with the vertical picture-plane will be the perspective required, and will consequently be a straight horizontal line. It is, no doubt, a fact that the line of housetops will appear gradually to descend as we extend our view towards the right or the left, owing to the effect of varying distance in the several successive points which form that line; but where the correspondents have gone astray in their reasonings is in overlooking the fact that this very same effect of varying distance will occur in the picture itself to the very same extent, for both one and the other are plane surfaces. It is to be borne in mind that all points on a plane picture are not situate at equal distances from the eye, no more than they are so on the plane of the street houses themselves. Assume now that the line of housetops has been represented in the picture by a line exactly straight and horizontal, and let the picture be supposed to be placed in the proper position relatively to the eye. The points on the picture which are directly opposite to the eye are nearer to the eye than those situate wards the edges of the picture, and in the very me proportion, point for point, as those of e objects they represent. Hence the effect of varyg distance in the successive points of the line will ccur in the picture. The line will not appear be exactly straight, but will seem to have a ownward tendency on both sides, and exactly in e same degree as the object it is intended to enote; wherefore, the horizontal straight line is he proper perspective line to employ in this case. f "Art Student" belongs to the modern "Pre-aphaelite" school of painters—who go in for an xtraordinary accuracy of details, albeit they tterly discard both grace and form,—and in his esire for exactness he had already formed his esign such as it should appear in the impression n his eye, it would then be necessary for him to ndeavour to have his picture folded into the form f a sphere, so that, with the eye in the centre of he sphere, each point in the picture would be ituate at the same distance from the eye. To nderstand scientifically whether such a thing is apable of being performed, it will be necessary to onsider what are termed "developable surfaces" —i.e., unfoldable surfaces. There exists a remarkble class of surfaces—such as cylindrical and onical ones—which, when unfolded, or imagined to be so, become plane surfaces. Thus, it is easy to perceive that if the surface of a cylinder be imagined to be unfolded, it will become a plane ectangular parallelogram, and, on the same suppoition, the surface of a right cone becomes the ector of a circle whose radius is equal to the side, nd whose arc is the circumference of the base of he cone, the conical surface being thus equal to his plain surface, which is its development. he condition which characterises this class was etermined by Euler, who showed that all surfaces apable of development must satisfy a certain ifferential equation (which see Lacroix Calcul., me. ed., page 238), and which equation is satisfied n the two cases already mentioned as simple xamples. Whether the picture could or could not e folded into the required form depends upon whether the surface of a sphere is or is not a evelopable surface, or whether it does or does not atisfy the aforesaid differential equation; but, as t does not, the object in view is impossible of accomplishment.—VLADIMIR.

[65058.]—**Blowpipe Solder.**—The following re very useful recipes for making soft solders of ifferent fusibilities:—

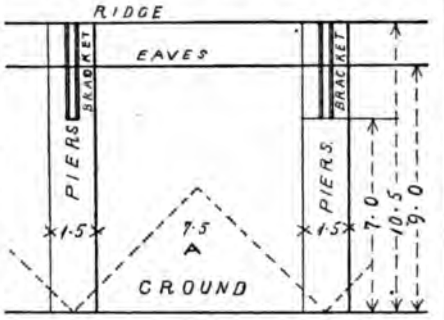
No.	Proportions.			Melts at about	Description.
	Tin	Bismuth	Lead		
1	1	—	5	510°Fah.	
2	1	—	3	480 "	
3	1	—	2	440 "	Plumber's sealed.
4	1	—	1	370 "	
5	2	—	1	340 "	Best tinman's.
6	4	—	1	365 "	
7	6	—	1	380 "	
8	4	1	4	320 "	Very fusible.
9	2	1	2	290 "	
10	1	2	2	235 "	
11	5	3	3	200 "	Melt in boiling water.

—J. W. M.

[65063.]—**Vertical Sundials.**—Can "W. J. R.," ho gave such a comprehensive and able reply to bove query in the issue of the 27th ult., kindly ive me a geometrical method of determining the our-lines in a South declining dial?—ILIAD.

[65076.]—**Gold Extraction.**—The Metallurgical Laboratory, King's College, Strand, is open aily, and on one evening in the week. The work of each student is arranged to suit his own special equirements, hence the date of commencing work and the time spent in the department are practically immaterial to us. By arrangement he may work for one, two, three, or more months, every ay, or on one, two, or three days a week only. A prospectus, or any further information, may be obtained, either personally or by letter, from Prof. Huntington, or from—WALTER G. MCMILLAN, Demonstrator.

[65080.]—**Shed Roof.**—If piers are bonded well to 9in. wall, the whole weight of latter, except triangular portion marked A, would assist the piers to resist overturning. Taking brickwork at 1cwt. per cubic foot, the resisting dead weight would be as follows:—7·5 × 10·5 × ·75 = 59·06cwt. (cube foot), 9in. walling per bay, less $\frac{9{\cdot}0 \times 4{\cdot}5 \times {\cdot}75}{2}$ = 15·19cwt. due to A, leaving 43·87cwt. nett. Add weight of pier 1·5 × 1·5 × 10·5 = 23·62cwt., leaving as effective dead weight 43·87 + 23·63 = 67·49cwt. walling. The centre of gravity of his weight is at about 4·8ft. above ground. The orce exerted by the cast-iron brackets and corruated iron roof in the way of overturning this wall, may be calculated as follows:—$\sqrt{6^2 + (10{\cdot}5 - 9)^2}$ × 9 = 55·8ft. area, one bay corrugated roof. $\frac{55{\cdot}8 \times 3\text{cwt. per 100ft.}}{100}$ = 1·67cwt. corrugated roof. The centre of gravity of this weight occurs 4·16ft. from a vertical plane of centre of gravity of wall —*i.e.*, it occurs 3ft. from face of brick piers. The centre of gravity of the cast-iron brackets (2·5cwt.) appears to be about 2ft. from face of piers—*i.e.*, about 3·16 from vertical plane of c.g. of wall. The horizontal stress brought transversely on the wall by the weight of roof and brackets together is as follows:—$\frac{1{\cdot}67 \times 4{\cdot}16 + 2{\cdot}5 \times 3{\cdot}16}{3{\cdot}5 \text{ short arm of bent lever}}$ $= \frac{14{\cdot}85}{3{\cdot}5}$ = 4·25cwt. overturning horizontal pressure. This 4·25cwt. horizontal pressure is due to the oblique tension on top flange of bracket, and occurs at a level of 10·5ft. above ground-line. Similarly, its counterforce of 4·25cwt. horizontal back-pressure is due to the oblique compression or thrust of the bottom edge of bracket, and occurs at 7ft. above ground-line. If these counter-pressures were at the same level, they, being of equal intensity, would neutralise each other. But, as it is, the higher one obtains the advantage over the other by reason of its longer leverage from the ground, which is really the fulcrum. Thus the resultant height of the centre of overturning horizontal pressure is no further above the ground than the upper pressure is above its counter-thrust —viz., 3·5ft. in present case. In order for any wall to be stable, the half width of its base must bear a larger proportion to the height of centre of horizontal resultant pressure above ground than the weight of the said horizontal pressure bears to the effective dead-weight of the wall. In the case before us, the half-width of base = 1·16ft. which is $= \frac{1{\cdot}16}{3{\cdot}5}$ = say $\frac{1}{3}$ of height of c.p. above ground. But the horizontal thrust into the effective deadweight of wall is $= \frac{4{\cdot}25}{67{\cdot}49} = \frac{1}{15{\cdot}9}$ only. Therefore, I fail to understand how the shed-roof and brackets can overthrow the wall. But, as "J. R. G." says it is "easy" to see it, I suppose in some way I am mistaken (?)—FRANK CAWS, Sunderland.



[65092.]—**Electric Bell Work.**—Question not very clear. You must take one wire along a passage and connect branches to this to each push; then drop down to next floor but one and work the same way. You miss out each alternate floor because you run the wire from the top rooms' pushes down to the floor, and from the rooms on the next floor you run up to the ceiling, and so through the same runs as the other floor; this saves a lot of time and work. Of course the other lines go direct from pushes to indicator through the same runs as other wire, and cannot be coupled together in any way. I prefer to take zinc to the pushes direct.—ALBAN.

[65093.]—**Engine.**—I thank "T. C., Bristol," very much for replying to my query; but he must have made a mistake in horse-power of engine, even if steam average pressure was 50lb. per inch, as the diameter of cylinder is 48in., and area would, of course, be much above 150in. I will state again, perhaps he will look at the query again. What would be horse-power of engine, with cylinder 48in. diameter, 9ft. stroke, at 16 strokes per minute, engine double acting; absolute steam pressure 50lb. per inch; steam cut off at half-stroke; back pressure 2½lb. per inch? How many boilers 30ft. long, 8ft. diameter, with two flues each 2·75ft. diameter, would be required to work the engine? The rule I used for boiler-power $\frac{8 + (2{\cdot}75 \times 2) \times 30}{5{\cdot}73}$ = 70·68 power of boiler, is from Armstrong's "Construction and Management of Steam Boilers." The rule, I think, gives horizontal surface of tubes and boiler, 5·73ft. of such surface being reckoned for one horse-power. The power seems to be very near "T. C., Bristol's." Would my calculation of the boiler power be about right? I forgot last query to give cut off for engine, but have given it this time.—NOVICE.

[65093.]—**Engine.**—Taking the effective heating surface of the given boiler at three-quarters of one-half of the shell and half of flues and back end surface, the total effective heating surface is 563·5sq.ft. Every square foot of such surface should be capable with a good draught of evaporating in this size and kind of boiler 5·5lb. of water per hour from 60°, or $\frac{563{\cdot}5 \times 5{\cdot}5}{62{\cdot}37}$ = 49·7, or, say, 50c.ft., which is, therefore, its nominal H.P. It should, consequently, be fully sufficient to supply a non-expansive, non-condensing engine, taking steam for ⅞ths of stroke, having a piston area of 500 circular inches, and a piston speed of 220ft. With the speed at which your engine works (288ft. per minute) it would supply 382 circular inches, and as your piston has 2,304 circular inches, it would require 2,304 ÷ 382 = six such boilers under these conditions. But yours is a condensing engine, and the cut-off is probably at one-third of stroke, and assuming steam of 50lb. absolute (quite enough for so large a boiler shell), the average pressure throughout the stroke would be 108 ÷ 36 = 3 = number of expansions, and 50 ÷ 3 = 16·66 = terminal pressure. Then 1 + 1·09816123 × 16·66 = 34·96 mean force of steam. If the vacuum is fairly good, the back-pressure from condenser will be 1½lb., and the net mean pressure on piston 34·96 − 1·5 = 33·46lb. per square inch of piston. Thus the indicated power of your engine will be $\frac{(48^2 \times {\cdot}7854) \times 33{\cdot}46 \times (9 \times 2 \times 16)}{33000}$ = 527·45H.P. Assuming 25lb. of water (as feed) per hour as equivalent to 1H.P. under these conditions, the requirement would be 527·45 × 25 = 13186·25lb. or 211·4c.ft. of water evaporated per hour. Your boiler evaporates, as shown, 5·5lb. per square foot, or in toto 563 × 5·5 = 3099·2lb. per hour, and 13186·25 ÷ 3099·2 = 4·25, or, in other words, four such boilers at least would be required. The engine uses per stroke (4² × ·7854) × 3 = 37·71c.ft. of steam, or per hour 37·71 × 2 × 16 × 60 = 72,403c.ft., to which 50 per cent. for loss, &c., may be added, bringing it up to 108,605c.ft. per hour. At 0·1227lb. per c.ft., this equals 13,326lb., or about the same as above. Some boilers do more than I have shown, and I have read of an experiment with a Lancashire type of boiler having flue tubes divided in short lengths or sections of varying diameters (thus causing a greater admixture and whirling of the gases), doing as much as 6¾lb. per square foot of heating surface; but, on the other hand, it is known that with the ordinary single-flue boiler only 1·3 to 1·5lb. is evaporated per square foot of *total* heating surface, resulting, however, in a higher evaporative efficiency per pound of coal consumed. 10lb. of water evaporated per 1lb. of coal from feed of 92° is not unusual in Cornwall, whilst at the higher rate of evaporation per square foot of heating surface as consumed above, it would probably not exceed 8lb. from feed at 60°. Thus the coal consumed per hour would be 13186·25 ÷ 8 = 1648·3lb., or 1648·3 ÷ 527·45 = 3·13lb. per indicated H.P. per hour. Assuming 4 × 27·5 = 110sq.ft. of grate surface, the coal burnt per square foot per hour would be 1648·3 ÷ 110 = 15lb., and the grate area per I.H.P. 110 ÷ 527·45 = 0·209sq.ft. or for each cubic foot of water evaporated per hour, 211·4 ÷ 110 = 1·92c.ft. per square foot of grate surface. To raise 200lb. of water from 60° to 212°—being an increase of 152°—requires 152 × 200 = 30,400 units, and as 1lb. of coal gives off in useful effect 7,700 units, 30,400 ÷ 7,700 = 3·95lb. To evaporate from 212° requires the constant addition of 966·6 units to every pound, and thus to keep 200lb. of water boiling (evaporating) 200 × 966·6 = 193,320 units ÷ 7,700 = 25·1lb. of coal.—MARIENBERG.

[65094.]—**Electric Lighting.**—I should advise lamps of 16c.p. in the rooms and 8c.p. in passages, and 100 volts, 0·6 ampère = 60 watts per lamp; this is perfectly safe current and economical horse-power for twenty lamps. 2. You can fix lamps to underside of gas fittings, and they look very well. A lamp will light a floor surface of an area equal to the square of its height.—ALBAN.

[65094.]—**Electric Lighting.**—Use 20c.p. lamps of Hamilton's (of Herne Bay) make, or the Anglo-American Brush Company, 45 volts; 2H.P. required for 20 lamps. Lamps look very nice suspended from ceiling in a cluster of three or five, and would amply light a moderate-sized room. On no account have your lamps sent by parcel post; they are sure to be broken. Pay a trifle more for carriage by a responsible company. I speak from experience, having had four lamps out of six broken in transit through post.—KENT.

[65099.]—**Deflection of Girders.**—Any good textbook (Molesworth, for example) will supply "J. R. G." with the information needed. I could add a good deal of detail, but "E. M." space is limited.—FRANK CAWS.

[65102.]—**Noises in the Head and Ears.**—I hope "Shon y Gof" has not been frightened very much by some of the replies to his query. It may be some "consolation" to him to know that this form of disease is curable in the majority of cases. One great cause of this complaint seems to arise from overtaxing the stomach with right and wrong foods. I should diagnose "Shon y Gof's" ailment of this description, especially as the symptoms modify. But perhaps he may have an idea of the first and original cause, which he has not given. What he wants is, I suppose, to get relief as quickly as possible. He had better read the Medical Column of the *Weekly Times and Echo.* Get a reply from Dr. Allinson, London; or advertise his address in the "E.M.," and I will reply further. —HYGIENIST.

[65112.]—**Watch Repairs.** — Clean the hole and also ruby pin from all oil, then heat the edge of roller (where pin-hole is) by means of a piece of heated brass rod, sufficiently to melt shellac, which is applied by drawing out a piece of shellac in gas-flame to a fine point, and the interior of hole touched all round with the point of shellac; then insert the ruby ring in required position while shellac is soft. The brass rod will probably require heating again to fuse the shellac after the pin is in, and make a solid bed round ruby pin. When the roller is cold, clear off all superfluous shellac.—J. W. M.

[65114.]—**Screw Cutting.**—If you must use four wheels with 30 on mandrel, put it in the form of a fraction $\frac{30}{30}$, then the other pair of wheels will be in the ratio of leading screw to the screw to be cut. Say you want screw 8 threads to the inch, your train will then be $\frac{30 \times 20 \text{ drivers}}{80 \times 30 \text{ driven}}$. If you have not two thirties, multiply a driver and a driven by any convenient number. Another way: Take a certain length of leading screw, say 3in.; there will be 6 threads. In the same length of screw required there will be 24. Split the figures $\frac{6}{24} = \frac{2 \times 3}{6 \times 4}$. Add ciphers, and there you are. —W. W. C.

[65120.]—**Metal Disc.**—Draw section of half the diameter; you have then a blunt wedge $\frac{3}{8}$in. at thick end, $\frac{1}{8}$in. at the other, and 3ft. 6in. long. Make this into a parallelogram by cutting off a slice $\frac{3}{16}$in. from the thick end and nothing at the thin end, then reverse this piece, and draw it with the $\frac{3}{16}$in. put on to the $\frac{1}{8}$in. end, and the nothing point on to what was the $\frac{3}{8}$in., and this gives you an average thickness of $\frac{3}{16}$in. all over.—ALBAN.

[65126.]—**Harmony.**—In copy from Vol. XIII., p. 76, three omissions are in C minor column. It should be: "Excepting acidentals where marked, E A and B are flats, C E G, min.; D F A., min.; E G E, maj.; F A C, min.; G B nat. D, maj.; A C E, maj.; B nat. D F (dim.)." The normal position of a common chord or triad is when the 1st, 3rd, and 5th are in their closest combination. It may be described as two thirds, one above the other, one minor third (three semitones), the other major (four semitones), or both minor if the chord is on the leading note; but never two major thirds combined. The third from the root decides whether the chord is major or minor. When the third is major the chord is major, as chords on C F and G (key C). When the third is minor, the chord is minor, as chords on D E A (key C); but the chord on the leading note is less than minor—i.e., diminished, as chords on B (key C). In following example (key C)—

+ joins notes forming major thirds.
— " " minor "
1. C + E − G
2. D − F + A
3. E − G + B
4. F + A − C
5. G + B − D
6. A − C + E
7. B − D − F

Or it may be graphically shown by dashes for semitones; the + and − to the left hand showing major and minor chords respectively; thus:—

1. (+)C− − − −E− −G(−)4 and 3 = 7 semitones.
2. (−)D− −F− − − −A(+)3 and 4 = 7 "
3. (−)E− −G− − − −B(+)3 and 4 = 7 "
4. (+)F− − − −A− −C(−)4 and 3 = 7 "
5. (+)G− − − −B− −D(−)4 and 3 = 7 "
6. (−)A− −C− − − −E(+)3 and 4 = 7 "
7 Dim. (−)B− −D− −F . (−)3 and 3 = 6 "

The other keys are similarly constructed.— W. H. S.

[65128.]—**Strength of Soda Lye made with Caustic Lime and Soda Crystals or Soda Ash.**—56 per cent. soda ash runs at present about £4 16s. per ton; soda crystal about £2 per ton. Soda crystal has a constant composition, and contains about 37 per cent. sodium carbonate; 56 per cent. ash contains about 94 per cent. Na_2CO_3. Hence for £4 16s. we can get 1 ton ash = 19cwt. Na_2CO_3. For the same money we can get 2½ tons of crystals = 20cwt. Na_2CO_3. Hence it is rather cheaper to use crystals. This seems a peculiar result, and is certainly not what I should expect, considering that crystals are manufactured from soda ash. Of course, my calculations are rough. I have based my calculation on 56 per cent. ash, but, of course, any other strength might be taken, the price, while I write, being 1d. per unit of 1cwt.—CHEMIST.

[65130.]—**Acoustic Telegraphy.**—The "dot" is the lower sound, and the "dash" the higher. —X.

[65131.]—**Regulator.**— TO MR. BOTTONE.— In the electrical engineering laboratories of Finsbury Technical College variable resistances are used, constructed in a slightly different way to that you mention. A long, narrow trough box is filled with squares of carbon, 3in. by 3in. or so, which are compressed more or less tightly by a hand-screw at the end. This answers admirably. I have heard of the use of a powdered carbon regulator in conjunction with glow-lamps some years ago, introduced, I believe, by Edison or Swan.—W. PERREN-MAYCOCK.

[65136.]—**To "Chemist."**— You can easily make a decinormal solution of HCl or Na_2CO_3, by diluting 100cc. of your normal solution to 1 litre. I have never heard of a decinormal solution of these substances being used for purposes you say you require them for.—CHEMIST.

[65139.]—**To Mr. Wimshurst.** — "G. H. D." is probably driving both his discs in the same direction: he should have the front driving-band running straight, and the back driving-band crossed. The rods holding the brushes should form 90° angle with each other, and the brushes be so situated that the right-hand brush on the front plate is some distance beneath the comb. The brushes and the rods holding them are, of course, absolutely necessary to the working of the machine; but the combs and terminals are not necessary.—J. W.

[65143.]—**Storage Cells.**—The leaden plates must be in some way roughened; they may be scored, like pork, in all directions with a bradawl, or punched full of little holes, and then the paste of red lead and sulphuric acid plastered over with a leaden spoon. The plates should then be reared up on edge in a current of air, to allow the mixture to set and harden somewhat. They are then charged by placing them in their cells with dilute sulphuric acid, and sending a current of electricity through the cells, until the fluid begins to bubble. The terminals are then coupled, and the cells allowed to discharge. A charge is then sent in the opposite direction; again the cell is discharged, and the same round of operations repeated until the cell holds a sufficient charge. After that, the charges are sent in one direction only. See also my book, "Electrical Instruments for Amateurs," for further details.—S. BOTTONE.

[65144.]—**Engine Query.**—Area of 8in. piston is 25⅛sq.in., and average pressure at 30lb. cut off at ½ = say 20lb. in cylinder; so that power = $25\frac{1}{8} \times 20 \times 140 \times 2 \div 33{,}000 = 4\frac{1}{4}$I.H.P. The flywheel has nothing to do with the power.—T.C., Bristol.

[65144.]—**Engine Query.**—

Diam. Area. Aver. pressure. Revs. ft.

$$\frac{8\text{in.}^2 \times \cdot7854 = 50\cdot26 \times 24\text{lb. (about)} \times 140 \times 2}{33{,}000}$$

= 10·2H.P. The flywheel does not give power, but it acts more or less as a store or reservoir, and gives it out when not getting it, as in the above case, where the steam is cut off half-way.—W. M. J., Dublin.

[65147.]—**Direct Transformer, Induction Coil, or quasi Galvanic Machine.**—I trust "An Amateur Constructor" will pardon my pointing out to him that the term "galvanic machine" is vague, in that it may mean anything, from a dynamo to a Daniell cell. He is about to construct a transformer after the old fossilised style, the use of which I am doing my best to discourage, *vide* pages 125, 170, and 191, and comment by "Engineer, Govan," page 148, &c. — W. PERREN-MAYCOCK.

[65148.]—**Soda.**—The reason that hypo. must be kept from photographs is because, in the case of negatives, it causes them to become yellow, and an efflorescence of the salt occurs on the film; in the case of silver prints it causes them to become yellow and fade away. Washing soda would not do this, except the efflorescence or "flowering" of the film, which will take place with any salt, as it is merely mechanical, while the yellow colour is due to chemical causes. The best way is to keep everything thoroughly clean, and separate all your chemicals from each other—that is, wash out every glass and dish after using, and don't pour a solution into a dirty glass under the impression that a little of the other solution left in the glass won't hurt.— PRINCIPIA.

[65149.]—**Link Belting.**—If "Link" will refer to No. 1,169 he will find all the information he needs—or ought to need—to enable him to make link belting.—NUN. DOR.

[65151.]—**Boot-Cleaning Machine.**—Several illustrations given in back numbers. It consists simply of a spindle with four to six brushes on it, and driven by means of a treadle.—T. C., Bristo

[65151.]—**Boot-Cleaning Machine.**—I have one driven like a lathe by a treadle, with two circular brushes, and shall be happy to part with it if Mr. Thomas Bainbridge will write to me.—C. E. LANCE, Stoke Court, Taunton.

[65154.]—**Beam Blowing Engine.** — The diagrams appear to be half-size. Without a sketch of the actual arrangement of tappet motion, I cannot advise; but think you will find the cause to be wear in the joints. The fault is that valves are a little late, and not open wide enough until engine is making the stroke.—T. C., Bristol.

[65154.]—**Beam Blowing Engine.**—This is a case of disarrangement of the "arms" or "tappets" on the air-pump rods. If there is a "cataract" on the steam valves, it should be regulated to close much earlier; if not, the duration of contact between the "lifters" should be shortened, for the steam is rushing into the condenser at the end of the stroke and spoiling the vacuum. The exhaust is probably all right. The sudden rise on the steam line is caused by the increase of pressure (or the resistance) in the blowing cylinder, and is common to such cases of air compressors. The water and coal are probably not far to fetch in this case.—W. M. J., Dublin.

[65154.]—**Beam Blowing Engine.** — These diagrams show an extraordinary state of affairs and one wonders how any person having charge of this important engine could let it go on to such an extent. The waste and bad working must cry aloud. The steam valves obviously either do not open sufficiently, as they show a loss of 50 per cent. in pressure, or the passage is obstructed. They also open too late, and carry the cut-off to the end of the stroke; consequently, the steam rushes through the exhaust valve before the stroke is complete; expansion is lost, steam is wasted and swept to the condenser by the piston on its return stroke, to the detriment of the vacuum. By adjusting the tappets for the steam valves on the pump rods to give a moderate lead, so that the valve commences to open before the piston has completed its return stroke, say by 1in., the working will be bettered. The exhaust valves are not so much astray; the vacuum is fair, but the engine should be turned round without steam, and the valves properly set. These remarks only indicate the direction the cure should take—perfection can only be attained by actual inspection and consideration.—W. S.

[65156.]—**Gravity Leclanche.**—This title, I believe, was introduced first for this battery by Mr. Roberts in the *Journal* of the Soc. Tel. Engs., Vol. VI. p. 266. The first I ever saw of it was in Vol. XXVIII. of the "E. M.," where Mr. W. J. Lancaster gives a description and drawing. Mr. Preece, in his Cantor Lectures, "Recent Advances in Telegraphy," Vol. XXX. "E. M.," p. 160, gives it this name; so does Mr. Lynd in his "Practical Telegraphist," second edtion, p. 22, where an excellent arrangement of the carbon and zinc is clearly shown, permitting the ordinary carbon to be used vertically (see letter and sketch, same heading).—ASSOC.INST.ELEC.ENGS.

[65157.]—**Direct Transformer or Induction Coil.**—May I direct "Steam's" attention to "Letter" column (April 20th)? I should be pleased to send him working drawings and full instructions. He will get much better results with this form. The condenser is used to "absorb" the "extra current spark," and consequently renders the sparking more intense. Water regulator best.—W. PERREN-MAYCOCK.

[65157.]—**Induction Coil.**—Put two layers of No. 20 silk-covered copper wire on the core for the primary wire. Separate each layer by a sheet of paraffined paper. The two layers may weigh 4oz. or thereabouts. The secondary, if for shocks only, may consist in five or six layers of No. 36 silk-covered copper wire. If the coil is to be used for other experiments, from ½lb. to ¾lb. of the said wire may be used, which will give from 15 to 20 layers. Each layer must be most carefully wound on for evenness, freedom from kinks, and perfect continuity; and great care must be used to separate and insulate the successive layers. The flanges may be 3in. in diameter. The condenser greatly increases the length of the spark, and the efficiency of the coil generally, by storing up the "extra current" in the primary, and sending it along at the right moment. The water regulator is simply a tube full of water, corked at both ends with sliding wires pushed through the corks which can be approached or distanced at will.— S. BOTTONE.

[65158.]—**Model Gas-Engine.**—I am just engaged upon a little gas-engine, the same size as yours, but of different design. I see other correspondents are also trying to get model gas-engines to go, without success, which makes me fear mine will prove disappointing. I think if we were to help one another, by exchanging the little experience we may acquire, we should very likely overcome the difficulty. Some say a gas-engine of that size cannot be got to go; but I am told that the to a height of 5ft., it must issue with a velocity of $\sqrt{64 \times 5} = 18$ft. per second at least. If you want to know exactly, collect the quantity that flows for half a minute, and measure. You can easily calculate velocity from this, as you know area of pipe.—T. C., Bristol.

[65183.]—**Hydraulics.**—8·025 $\sqrt{205}$ft. = 115ft. per second, velocity of discharge. This 205ft. head is net, after making its own allowance for friction, which, by the way, is extremely small in a smooth and perfectly vertical pipe of 5in. diameter; for a jet whose diam. (5in.) is no less than 1-12th of its height (5ft.), loses no appreciable head whatever. —FRANK CAWS, Sunderland.

[65186.]—**Reflecting Galvanometer.**—For ordinary rough work wind the bobbin with No. 36 silk-covered copper, and get on enough to give about 300 ohms resistance. (Good No. 36 copper wire averages about 5ft. to the ohm.) This means about 5oz. One small piece of watch-spring is better than a number of small pieces.—S. BOTTONE.

[65192.]—**Potassium.**—Perhaps the following particulars of the estimation of potassium as described in the *Trans.* Brit. Pharm. Conf. for 1878 will suit:—"New Test for Potassium. A Carnot. The te[illegible]tion is made by dissolving 1 part subn[illegible]muth with the aid of the smallest required quantity of hydrochloric acid; add to this a strong aqueous solution of 2 parts of hyposulphite of sodium, and then a large excess of alcohol. This reagent forms a yellow precipitate with solutions of all potassium salts, and does not affect sodium combinations. Barium and strontium give the same reaction; but as they belong to a different analytical group, they can be easily separated before the test is applied." "Volumetric Estimation of Potassium. A. Carnot. The author has described a test for potassium which depends on the precipitation from an alcoholic solution of a double hyposulphite of potassium and bismuth. (See the preceding article.) On this he now bases a volumetric process, which consists in the determination of the hyposulphurous acid in an aqueous solution of this double hyposulphite by means of a titrated solution of iodine. On adding the iodine solution to a cold neutral solution of the double hyposulphite, a red precipitate of bismuth oxy-iodide is formed, which can be prevented by acidifying with hydrochloric acid, which, in the short time required for the reaction, does not act on the hyposulphite. When the iodine is added, the greenish solution changes to a light golden yellow; towards the end of the operation, however, each drop produces a brownish tinge, which disappears on agitation. The end of the operation is shown by a single drop producing a permanent change from light yellow to dark brown. This change can be clearly perceived either in natural or artificial light. Two equivalents of hyposulphurous acid correspond to one equivalent of potash or iodine. Details of the preparation of the standard solutions are given, and also the precautions necessary to be observed in conducting the analytical operations. (*Comptes Rendus*, lxxxvi., 478-481.)"—PRINCIPIA.

[65193.] — **Indicator Diagram of Gas-Engine.**—Like steam-engines, you calculate the area of diagram. The mean pressure of compression must be deducted from mean pressure of explosion; so formula would stand, $\frac{a\,b\,d\,(e-f)}{33{,}000}$.

—T. C., Bristol.

[65194.]—**White Positive Photographs.**—These may be obtained on Eastman's permanent bromide paper.—G. G. B.

[65194.]—**White Positive Photographs.**—Depends on what process you employ. If collodion, expose fully and under-develop with a strong iron developer, to each ounce of which has been added one minim of nitric acid. If the gelatino-bromide process be used, expose fairly, but avoid over-exposure; develop with ferrous oxalate. Stop the development directly the image is fully out. Wash and fix as usual: again wash carefully, and soak in solution of bichloride of mercury in water, until the deposit is as white as milk. Again wash and dry.—S. BOTTONE.

UNANSWERED QUERIES.

The numbers and titles of [illegible] which remain unanswered for five weeks are inse[illegible] list, and if still unanswered are repeated four [illegible] wards. We trust our readers will look over the l[illegible] what information they can for the benefit of their [illegible] butors.

Since our last, "Principi[illegible] ed to 64529.

64556. Rustic Pipes, p. 61(
64572. Refraction, 611.
64591. Dynamo, 611.
64615. Abyssinian Pump
64620. Fehling's Sugar T.

64851. Coil. p. 91.
64861. Rock Boring, 91
64879. Valve Gearing,

QUERIES.

[65195.]—**Corns on Horse's Feet.**—Would any fellow-reader inform me if there is any perfect cure for corns on horse's feet?—B. R.

[65196.]—**Myopia.**—Can short sight by any means be corrected so as to enable anyone to do without spectacles (otherwise than a natural weakening of the eyesight by age)?—J. W. M.

[65197.] — **Gelatine Moulds.** — Will any reader kindly give the recipe for making gelatine moulds for plaster casting? Also the recipe for making impression wax.—WAX.

[65198.]—**Cost of Engines per Horse-Power.**—Would "T. C., Bristol," or others tell me the difference—per horse-power—in cost of working 6H.P. beam-engine, single cylinder, compared with modern horizontal?—BATES.

[65199.]—**Golf Balls.**—Will you or any of your readers kindly suggest a really good paint for guttapercha golf balls?—DORINI.

[65200.]—**Blasting Gravel.**—What would be the best way of blasting a gravelly rock to use for roads? The stone is not very hard, but picking it is a very slow process, and should like to try blasting.—A. B.

[65201.]—**Bursting Pressure on Tanks.**—Will "T. C., Bristol" or others inform me how to calculate the bursting strain of water on the sides of tanks having the following shapes? 1. A circular tank having a frustum of a cone rising from the bottom, as in Fig. 1. 2. An annular tank, as in Fig. 2.—R. M.

FIG. 1

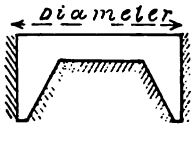
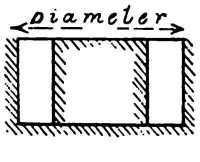


FIG. 2



[65202.]—**Keeping Iron Tube at Red Heat.**—I want to keep an iron tube, 1in. diam., 2in. long, at a low red heat. From its small size a furnace is impossible and gas is not to be had. Can I accomplish this by a blowpipe and spirit lamp, and could the heat be intensified by a coil of wire inside tube?—ONE IN A FIX.

[65203.]—**Looking-Glass.**—Is there any process by which tin—or other white metal—can be deposited from a solution on the surface of glass?—the process being similar to the mode of silvering glass by the reduction of nitrate of silver as per any of the well known methods.—J. W. M.

[65204.]—**To Mr. F. C. Allsop.**—I want to make a relay to close an electric bell-circuit to work by one No. 2 Leclanché cell for relay and one for bell. Contact made 200yds. away from bell, using ordinary telegraph wire for line and using earth plates instead of return. What quantity and size of wire should I want for magnets?—ANXIOUS.

[65205.]—**Bottle Washer.**—TO MR. BOTTONE.—We have a bottle-washing machine driven by foot power—one man working six hours a day on and off. Could I store up electricity from a dynamo driven by this machine—fly-wheel about 13in. diam.? If so, kindly say what kind of dynamo and storage cells required, and size of same. I want to rig up all myself.—BOTTLE WASHER.

[65206.]—**Enamelling.**—Could some kind reader give me particulars about enamelling photos.? Even after the most careful cleaning of the plate, the prints do not get loose. Some books recommend to mix the collodion with a few drops oleum ricini. I have done that, but can too much (10 drops, for instance, to 100gr. collodion) be the reason of my failure?—ARTIST.

[65207.]—**Compressed Oxygen.**—Will any reader please inform me how I may compress oxygen into steel cylinders as supplied by the Brins Company? Is it condensed in or pumped in? I have in use a steam-engine, so could bring this to use if needful for pumping, if it is done by the aid of steam or power. Can make my own cylinders, but don't know how to fill them. Should like to charge them to about 20 atmospheres and cylinders to hold 80ft.—H. BOARDMAN.

[65208.]—**Electroplating.**—I have a cast-iron hoop, 6in. diam., 2in. broad., upon which I wish to deposit a thin coat of copper of uniform thickness. Would some of your correspondents be good enough to say how this can be done—if by a single-cell battery? Also how I should treat the solution of sulphate of copper to give the deposit a gun metal or brass colour.—G.

[65209.]—**Moulder's Wages.**—A sand moulder on day work at 6s. a day, not standing his own losses, makes of a pattern three per day. The same pattern is given to a man that works on piece standing his own losses. Will he have to make the castings at 2s. each, or is he allowed anything extra for standing his own losses?—A SAND RAT.

[65210.]—**Dynamo.**—Will Mr. Bottone kindly give size and sketch of dynamo to receive 6in. armature? Output 60 volts, 10 ampères. Prefer compound-wound if I could light arc and incandescent. Please state quantity of wire required. Would a Pacinotti ring armature be suitable with about 12 teeth? Please state c.p. I may expect. Also will 1H.P. engine drive it?—RESISTANCE.

[65211.] — **Logarithms.** — In calculating angular positions of lines on a horizontal sundial my directions are: Add log. sin. lat. to log. tan. hour angle, subtract 10 from index and remainder is log. tan. of angle required. My difficulty is this? I find log. tan. 90° = infinity. How am I to add this (infinity) to log. sin. lat.?—ESNE CARALITA.

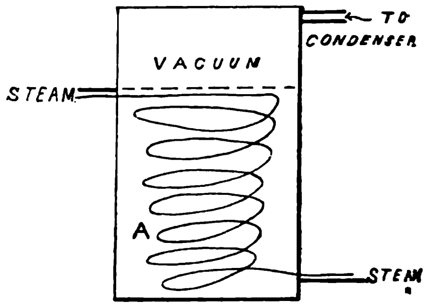
[65212.]—**Glaze for Porcelain.**—TO "POTTER."—Will you kindly assist me in the following? For some battery experiments I wish to cut down some large porous pots and then reglaze tops again. Please give me recipe for glaze. Also mode of applying same. Can they be fired in one of Fletcher's muffle furnaces? Where can I obtain Cornish stone?—X. WYSEHEAD.

[65213.]—**To "Chemist" or Mr. Gray.**—I have seen some small bags made of tissue paper, and when placed mouth downwards upon the crown of a silk hat and set fire to at the top corners they gradually burn down to within 1in. or so of the hat and then rise in the air leaving the hat uninjured. Will you kindly tell me how the paper is prepared to prevent its crumbling as it burns?—STAR.

[65214.]—**Theodolite and Compass Surveying.**—Will any practical surveyor, or one accustomed to instruments, explain why the position of the cardinal points are reversed on theodolite compass? Also in stating the magnetic north as compared with true north on plans, what allowance should be made for the eccentricity of variation which appears to vary daily as well as yearly? —J.

[65215.] — **Concrete.** — Having to lay some lead covered telegraph wire part of which has to pass through concrete composed of brick, clinker, and Portland cement, I should be glad to know if, while the concrete is wet, any chlorine or other chemical is given off likely to attack the lead.—J. E. S.

[65216.]—**Condenser.**—Would any kind reader oblige with a reply to the following? A cylindrical vessel A, 9in. diam., by 30in. high, is filled up 24in. with sea water at, say, 55° Fahr. Immersed in this water is a coil of pipe ¾in. external diam., and 35ft. long, filled with steam at a temperature of 320° Fahr. There is a vacuum of, say, 25in. mercury over top of water, and it must be remembered that as the water is evaporated the coil becomes partially uncovered. How much of above water may be evaporated before deposit will commence, and how long would it take?—TARA.



[65217.]—**Bells.**—Will some correspondent suggest the simplest connections to effect the following? I have signal bells between A and C working with the ordinary Morse keys. I want to make an arrangement midway at B, so that when at B I can, by the aid of switch and ordinary press button, ring to A, using the battery at A. The bell at C to be cut out when ringing from B to A, and when done by turning switch at B, I connect A and C to again work direct on the reply system by the Morse keys. Will some one show the easiest plan of arranging the connections and switches at A to enable me to work this plan?—SOLITARY.

[65218.]—**Jumelle's Marine Glass.**—Will "Nun Dor" or some other practical reader kindly inform me how to solder the brass parts immediately under the eye-glass together? The joint is similar to that in a brass door knob, and the eye glass turns round in the same fashion. I find that rough handling with ordinary solder makes it far worse instead of better—the brass being so thin. Also how to imitate the black enamel with which the brass parts are covered, part of which is by friction rubbed off the projecting parts.—E. ISHERWOOD.

[65219.]—**Motor Dynamo.**—TO MR. BOTTONE.—I intend making a motor as described in the "E. M." April 6th, 1888, but larger. I also want to be able to use it as a dynamo. For the armature I shall use your 4¾in. punchings with 10 teeth, and the F.M., &c., in proportion. Would it be better to have two armatures wound with different sized wires. If shunt-wound, would it work as a motor? What size wire and how much must I use to get the greatest efficiency out of each? Would the dynamo described in your book "The Dynamo" be sufficient to drive this motor? If not, how much E.M.F. would it take. What would be the H.P. of same? What H.P. would it take to drive it as a dynamo, and what would be the E.M.F. and c.p.?—E. J. P.

[65220.]—**Battery.**—TO MR. HAMILTON.—Do you think still that the battery you mentioned in the "E. M." Nov. 18th, 1887, p. 278—i.e. the zinc carbon one at end of letter—is as useful and as cheap as any? Must the outer cell be round or square? What size zinc and carbon, and if a stick or two of arc light carbons would do? Also could the zincs be left in solution when not in use? Would you also explain how to make resistance to suit small lamps, and the ampère of the lamps spoken of in the table of lamps in the "E. M.," of March last? Would above battery fill accumulators if connected in parallel to them? If so, how should the accumulators be connected?—A. E.

[65221.]—**Photographic Lens.**—I have a ½-plate lens, by Lerebours, of Paris. The diam. of glasses is 2⅛in., length from outside of one glass to outside of the other 3⅛in., front piece on which cap fits 1½in., distance from inside glass to focussing screen, when image at about 20yd. distance is focussed sharply, 6¾in. Will some brother-reader give his opinion of Lerebours lenses, and, if possible, from the above data, tell me what work mine is most suitable for? I wish to fit some stops to it. Where should the slit be cut? I should also like to know the usual number of stops and the diam. of their apertures.—W. A. ABINGDON.

[65222.]—**Reservoir.**—I shall be obliged if some of your correspondents will give me their opinion and advice in the following matter? Along the boundary of my property I have a stream that has always a steady flow (except during heavy rains) of about 405ft. per minute. Width of bed 4ft. 6in.; average depth of flow at lowest water 6in. The fall is sufficient to enable me, by diverting the stream, to obtain a head of water of 6ft. at a point 300ft. from the point of diversion. I propose to construct a reservoir, 150ft. by 20ft. by 6ft., to work a Poncelet's undershot water wheel, 10ft. diam., 12in. wide. The sluice to supply same to be 12sq.in. in area with a fall of one in ten. I have worked the question out, and calculate I shall be able to get from such a wheel from 6H.P. to 7H.P., which is what I want, and I shall be glad if some one of your numerous correspondents would tell me if I am wrong and where.—P. R.

[65223.]—**Rounding the Edges of Punched Brass Blanks.**—What is the most easy and expeditious way of taking off the sharp top edges of a large quantity of blanks punched out from 1-16in. rolled brass? Any process of filing would be out of the question as being in the end too costly. It is required that each blank should have a round and smooth edge. I am told by a friend that he has seen similar blanks placed in a peculiarly formed revolving band with some sort of abrading powder, but he does not remember detail of construction of barrel now used, nor the kind of abrading substance. Will some practical friend kindly advise me in this, and also state the proportion of acid with water for dipping these blanks into?—MUTUAL.

[65224.]—**Designing Machine.**—I tried to make one of these, as described in "H. T.'s" reply to "Alphard," No. 64650, p. 107. It worked well; but did not produce much variety of pattern. After raising, lowering, and otherwise altering the weights, it only produced three different diagrams, which I will forward to "H. T." if he will advertise his address. Perhaps he will kindly say how variety can be produced by the same continuous motion?—KENELM COLLINGS.

[65225.]—**Launch.**—Will any reader kindly say if I can extract the grease from the feed water in a compound surface condensing launch engine? If not, what oil does the least harm to boiler? The boiler is all steel and iron with the exception of the firebox side stays, which are of copper, so do I require to hang zinc plates in the boiler? If so, in what part, and could I insert thin strips through wash-out plug holes, as I don't want to break dome joint?—TARA.

[65226.]—**Lathe Query.**—I have a small lathe. The heads are mounted on wood and are 4in. centre. Now the lathe worked a single speed, the driving wheel being 16in. diam., the driven wheel 3in., which is as big a diameter as the lathe head will take. It is worked by 1¼in. strap. Now I want to know if it will be possible to put a cone to take a small round strap, so that I may have two speeds, or even three. The space on the shaft occupied by the present pulley being 3in., and there is ¾in. to spare. If you think it practicable, please say what the diameter of driving and driven cones shall be.—J. A. DIXON.

[65227.]—**To Mr. Bottone.**—I am making a Gramme dynamo, Manchester type, Paccinotti ring, 12 cogs, 6in. diam., 3in. wide, wound with 5lb. 14 c.c. wire. F.M. cores 6½ by 2, wrought iron, which I propose winding with 18lb. No. 19 c.c. to run at, say, 2,000. Will the wire be correct, and what may I expect from the machine? I should say the pole pieces are cast-iron, very soft. Also the ring is laminated.—S. LEANER.

[65228.]—**Pneumatic.**—In a pneumatic release for a photo. shutter there is a little cylinder with a piston in it. How is the joint between the piston and cylinder kept tight? In one—the Phœnix—so long as you keep pressing the ball the piston keeps in the same position, although there is a spring tending to draw it back. It seems to me that if it were only brass to brass, so much air would escape that it would lose its hold in a few seconds. I should like to make one, and any instructions would oblige.—STIRLING ROAD.

[65229.]—**Bunsen Batteries.**—Will Mr. Bottone kindly say if two 1-pint Bunsen batteries ought not to heat about ¼in. of thin platinum wire? I have got strong nitric acid in the inner cell, and 1-10 sulphuric acid in the outer. The mixture is just the same in both, but one seems to have no current at all. The two together will not work a very small motor. Are my quantities right? If so, please say what I must do.—FELIX HOLT.

[65230.]—**Kainite.**—Said to be employed for manure on account of its 13 per cent. of potash. It is said to be found on a bed of rock-salt. The matters found with the kainite are sulphate of magnesium and water, chloride of sodium and magnesium. Are these matters harmful to the soil? Is there any simple plan by which the potash can be got free from the other salts? The books speak of kainite as containing 13 per cent. of potash, as I have given it; but do not know what is meant by potash; but I suppose it is KO of Fownes. Is this so? Where does it come from—price per ½, 1, and 20cwt.? Any suggestions and remarks and hints for use as manure will oblige.—THE BRAE.

[65231.]—**Bones for Manure.**—Suppose bones, as obtained from the butcher and before boiling, are treated with sulphuric acid, either strong or dilute. Then the posphate of calcium is disintegrated and rendered more soluble. But what becomes of those parts of the bone which are usually got out by steaming—viz., the gelatine, &c.? Also what becomes of the nitrogen which bones are said to contain, or, when the books speak of the nitrogen in bones, do they refer to it as the gelatine from which nitrogen will come?—THE BRAE.

[65232.]—**Intensity Coil.**—I have purchased for making the above 1lb. No. 18 dbl. c.c., for primary, and 2lb. No. 26 dbl. s.c. for secondary; but find since, according to "Dyer," that for secondary I should have 6oz. No. 38 s.c. Will some reader kindly tell me if I shall get as much power from 2lb. 26 as from 6oz. 38? Also is paraffin wax the best insulator? Have cut 56 sheets tinfoil, 6in. by 4in., for condenser.—WM. MILNES.

[65233.]—**Ventilation of Churches.**—Relative to the correspondence on this subject, would some of your readers point to churches where heating and ventilating have been carried out combined, and for a sufficient length of time to prove its success? In some churches heated by hot air a very small fire induces currents of fresh air in summer.—ANTI-VITIATION.

[65234.]—**To "Eos."**—About 12 months ago, sitting in the verandah reading, I saw a spider running along the floor, when all at once a kind of fly alighted on the back of the spider and started stinging it as a bee would do. I watched the fight for about 5 minutes, but the fly killed the spider and was very much exhausted. I caught the fly, thinking to look at it through the microscope. He being a lively sort of a fellow, and thinking he might serve me something after the spider, I was not very careful in holding him, so he escaped; but I took this much notice of him. He was the size of a flying ant with a yellow abdomen, with two feathers protruding from his head similar to a gnat. Have you seen or what is the name of the above fellow?—DUTCH PAUL, Jeypore, April, 11.

[65235.]—**A Tribe of Indians with Tails.**—Can any reader furnish me with information respecting a discovery in Paraguay of a tribe of wild Indians who are said to be possessed with tails? The information, which was extracted from the *Ensayo Medico*, of Caracas, and published in a London periodical, runs as follows:—"There has just been an interesting discovery in Paraguay of a tribe of Indians furnished with tails. One day a number of workmen, belonging to Tacura Tuyu, were engaged in cutting grass, when their mules were attacked by Guayacuyan Indians and some of them killed. The workmen pursued them and succeeded in capturing a little boy of eight years old. He was taken to Senor Frencisco Poleochoa, at Posedas, and it was then discovered that he had a tail 10in. long. The boy says that he has a brother who has a tail as long as his own, and that all the tribe have tails."—GEORGE MACBETH.

[65236.]—**Medico-Electrical Apparatus.**—Would some of your electrical correspondents explain how to make a galvanometer or ammeter to measure from 250 mille-ampéres to zero, the needle being at right angles to the coil?—the total capacity of the instrument being 1 ampére, such as are supplied with medico-electrical apparatus. Also how are the connections made between the cells of a battery and a double dial collector, used to secure the whole range of cells in the apparatus getting an equal share of work, and not the bulk of the work falling upon the first few numbers, while the higher (from 27-48) get little or no work.—GEO. K.

[65237.]—**Varnishing Wimshurst Plates.**—Will some of our readers give me a hint on the best way to varnish the plates of a Wimshurst machine? Should the varnish be thick? How can I get it on smooth? Is shellac, dissolved in spirits of wine, the best mixture to use? I understand that the object to be obtained is a surface on which moisture will not gather. The plates that I have varnished (not very successfully) do not seem to have a drier feeling surface than plain glass.—G. H. D.

[65238.]—**Electric Bells.**—To "F. C. A."—May I ask you before finally closing your most able papers on the above to give us sizes of E. magnets and bobbins with amount of wire on each, with size? I am sure there are hundreds of readers of the "E. M." who would welcome the above, and if a drawing of the other parts separate, and sizes of each were also given, I am sure the articles would be complete. I do hope I am not asking too much; but it is what I have been looking for for some time.—NEW SUBSCRIBER.

[65239.]—**Voltmeter.**—Thanks to Mr. Perren-Maycook and Mr. Bottone. Let me alter my question. How can I measure the difference of potential at the lamp terminals? Siemens alternating machine, 85 glow lamps, 45 volts. If I can get at the E.M.F. at the lamp terminals I should get lamps of a lower E.M.F. for the last few on the circuit, so as to get them all burning equally bright.—CLOUDY.

[65240.]—**Dynamical Problem.**—A monkey is hanging on to the end of a weightless inextensible rope, which passes over a pulley, and to the end of which is attached a weight of the same mass as the monkey. If the monkey tries to climb up will he reach the top, and what will happen to the weight? A rigorous investigation will be gratefully accepted.—P. E. BATEMAN.

[65241.]—**Carbon Tracings.**—I should be obliged if some correspondent would kindly say how the carbon impressions of rail and fish-plate sections, &c., are done. I thought they were made with the template and common carbon paper under a press, but it does not show any trace of pressure having been applied.—ILIAD.

[65242.]—**Formula for Gradually Decreasing Scale.**—I want a mathematical formula for gradually decreasing scale. I know algebra fairly up to binomial thorem, but this does not help me. I think there must be a formula like that for arithmetical or geometrical progression. Given the first and the last of the series and the number of steps between, is there some formula by which I could find out the gradually decreasing scale?—STEPNEY.

[65243.]—**Lead Pipes.**—Do lead pipes, through which hot water flows, give off any deleterious fumes? We have some pipes fixed in connection with a hot-water cylinder placed against a white wall and new wood. The wall above the pipe is covered with what appears to be smoke or carbon. What is the reason of it, and is there any remedy?—PERPLEXED.

[65244.]—**Toy.**—Can any of your readers tell me how the following toy works? It consists of a small glass tube with a bulb at one end, the other end closed by a cork. Inside the tube is a small glass man and some kind of chemicals. When held in the warm hand the man dances up and down, or if put in the mouth works much quicker.—J. HY. WILSON.

[65245.]—**Canvas Belting.**—Will some of our readers be kind enough to suggest an adhesive but pliable cement for holding together the different plies composing the belt, so as to form it into a solid body, but free to work without breaking? If this can be done it will be a great advantage to those who use them.—W. H.

[65246.]—**N. Carolina.**—I have been offered a good and cheap farm in North Carolina, in the western, or Piedmont, section of that state. Can any correspondent tell me what the climate, society, and prospects are there? Is it better than going West? Perhaps some correspondent who has been there will kindly give me a reply. There are gold and other mines there owned by English gentlemen, so I hear.—O. B.

[65247.]—**Lifting old Steam Boiler.**—I have an old steam boiler, weighing, about 5 tons, to lift about 11ft. to be used as a water tank. Will any of your engineering friends tell me the size of sling chain and size of tackle fall, and say, two double blocks and winch which I can use with safety in lifting it. I mean thickness of link and thickness of rope.—H. G.

[65248.]—**Gas-Bags.**—Can any reader kindly say whether a gas-bag suitable for the oxycalcium limelight could be make of ordinary American cloth, sewn by means of a sewing machine, and treated with indiarubber solution or some equivalent solution?—VIR SAPIENTIÆ.

[65249.]—**Gypsum for Garden.**—The books speak of this as used in stables and on manure heaps "to prevent the volatilisation of ammonium carbonate." So "Crude potassium salts act in the same manner owing to the magnesium salts which they contain." What are the reactions in each case?—THE BRAE.

[65250.]—**Colouring Leather.**—Living in a small country town, I find it difficult to obtain coloured skins for bookbinding. Will some one kindly give non-injurious recipes for any or all of the following colours:—Dark-green, dark and light-blue, and dark-red?—BINDER.

[65251.]—**Looms Strap Forks.**—Will some kind reader tell me how to piece the strap forks of the Lancashire power looms? Only having a few running, it is rather expensive to take to smithy a few miles distant. Also a few hints on the tempering of drills for wrought-iron.—POOR OWNER.

[65252.]—**Model Injector.**—Have any of your readers constructed a working injector suitable for a model locomotive 2ft. long? If so, a description giving sizes of cores and general arrangement would be useful to—N. G. H.

[65253.]—**Halation.**—Can anyone give me a scientific explanation of the causes of halation in negatives on glass? Can it be avoided by placing the plate with film away from the lens, the back being carefully cleaned and making slight allowance in focussing?—P. E. BATEMAN.

[65254.]—**Power.**—I have a horizontal slide-valve engine, 1in. bore, 1¼in. stroke, port holes are ⅛ wide by ¼, and the steam pressure is 100lb. to square inch? Will any reader tell me what power I get?—IGNORANT.

[65255].—**Staining Vulcanised Indiarubber.**—Will anyone inform me how to colour the above black, which would stand rubbing and wear fairly well?—WM. HARPER.

[65256.]—**Colouring Canvas.**—What shall I use and how to make the ordinary white canvas appear like the brown nail canvas used for bags, valises, &c., by trunk makers and others?—WM. HARPER.

[65257.]—**Brazing Solder.**—Will some one kindly help me? I have been trying to braze some thin brass articles with the blowpipe, using the ordinary granulated spelter, but can't get it to run into joints till brass melts. What solder is best to use keeping off silver? Please give proportions of easiest melted and best running solders.—DAVID.

[65258.]—**Surface Condensing.**—Will "T. C., Bristol," or any other give me a sketch of an air pump for the above, 1¼in. and 2in. bore, 1½ stroke, and the simplest pump to pump water into the condenser? They are compound engines.—SEDGLEY.

[65259.]—**Oyster Spat.**—Will some one inform me where to procure, and the best way to preserve, on the passage with me to South Africa, about the middle of next month, a quantity of oyster spat?—B.

[65260.]—**Fan for Blower.**—Can anyone of our readers kindly give me sketch and dimensions of the above for cooling liquor (beer) when in the cooler?—AN OLD SUBSCRIBER.

[65261.]—**Taper Rolling.**—Can any fellow-reader tell me if it is possible to roll steel rods, tapered for a length of 5ft., the size, say, 5-16in. at top to ⅛in. at point?—NUKA.

[65262.]—**Inflammable Liquid.**—Can anyone give me the constituents of a liquid which, when a piece of wood is inserted and then exposed to the atmosphere, takes fire?—KENT.

[65263.]—**Diatom Mounting, Dry.**—Will anybody tell me how to prevent balsam or other sealing varnish from capillarising between the glasses in dry mounts?—W. J. S. STROUD.

[65264.]—**Borax Toning Bath.**—Will any reader give their experience with the above and the best proportions? Also what colour does it tone?—PRINCIPIA.

[65265.]—**Springs for Safety Valves.**—Compression $= \frac{W\,d^3}{S^4\,C} \times N$, where $W =$ weight, $d =$ mean diam. of coil, $S =$ thickness of steel in sixteenths of an inch, $C =$ constant $= 30$ for square and 22·8 for round steel, $N =$ number of coils. This formula is used by the Board of Trade. Can anyone show me how to make up the formula—in other words, to prove it?—ENGINEER.

Ether Drinking.—In some places in the north of Ireland ether is largely used as a substitute for whisky, one reason being its cheapness, inasmuch as a person can obtain for a penny sufficient ether to make him drunk. The subject of ether drinking in certain districts in Ireland has for some years attracted attention, and recently a clergyman moved a resolution bearing on the subject before the General Synod of the Irish Church. He proposed that a petition be presented to Parliament praying for the suppression of the sale of ether as an intoxicant in certain districts; but, as it was pointed out that ether was sold for other purposes than as an intoxicant, he substituted the word "regulation" for "suppression," and the motion as amended was adopted. There is a special kind of ether prepared for drinking purposes, and, although the Excise authorities have been applied to, they have refused to control its sale.—*Lancet.*

ANSWERS TO CORRESPONDENTS.

⁂ *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

⁂ Attention is especially drawn to Hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

BACK NUMBERS.

WE receive so many queries asking for directions how to make many instruments and appliances which have been fully described in back volumes, that we have compiled a list, which we shall insert in this column at intervals, of those most frequently sent, and as the numbers are still in stock, new subscribers should consult the list before sending their questions.

Bookbinding : No. 613.
Electric machines : Nos. 1,009, 1,025.
Electro-magnets : Nos. 772.
Lacquers : No. 866.
Pattern Making : Nos. 938, 941, 943, 945, 948, 950, 952, 954, 955, 956, 958, 959, 962, 963, 969, 974, 978, 986, 989, 993, 995, 998, 1,000, 1,001, 1,003, 1,004, 1,008, 1,009, 1,010.
Silver-plating : Nos. 1,009, 1,010.
Varnishes : Nos. 478, 619, 675, 723, 775.

The following are the initials, &c., of letters to hand up to Wednesday evening, May 2, and unacknowledged elsewhere :—

T. PARKIN.—T. Clements.—Medical Battery Co.—Mosses and Mitchell.—L. E. H.—Condenser.—W. W.—C. W. Maw.—Gwalia.—F. Walker and Hyde.—A. W. G.—Tamrai.—A Jobber.—Arthur Bird.—M. Smith.—Philomath.—J. Bates.—F. J. W.—Alban.—J. Brooks.—Rev. F. Carre.—Aladdin.—Teacher C. D.—M.I.C.E., Bath.—W. A. S. B.—A. I. E. E.—S. R. Bottone.—G. G. B.

ST. MUNGO. (Just so. We quite understand what it is you wish; but how many of our readers do you suppose are interested in machinery for decorticating pepper? The process is described in the cyclopædias; the machinery can be obtained from any of the dealers in grocers' machines. Try Messrs. Savage, of Great Tower-street—we think.)—J. HARRISON. (We have illustrated several self-contained electric lamps, one so recently as March 30, p. 96. Why not look up your back numbers?)—H. HARRIS. (The book on the Wimshurst machine is published by Pewtress and Co., 28, Little Queen-street, W.C., price 6d.)—A. C. (Please see indices of back volumes, and recent numbers. The cell should be about two-thirds full of a half-saturated solution. Make a saturated solution, and then dilute with water.)—G. S. F. (There are several electro-motors for boats described in back volumes, which see, and then you will be able to put a definite query.)—ROCHDALE. (Nothing of the kind that is harmless. See Dr. Richardson's lectures on the preservation of food, published by the Society of Arts. 2. Try the Banting system. 3. Flowers of sulphur taken in treacle; or better, plenty of green food, such as dandelions, nettles, &c., used as salad or boiled.)—S. O. (Lacquer or paint, which you like. What is it you mean? Why not cover with Brunswick black?)—A SUFFERER. (Try vaseline.)—FRED. (Pedals to American organs illustrated in Nos. 1,077, 1,066, 1,014 1,012, 1,009.)—NEW SUBSCRIBER. (The sizes are the same; but some reeds have square edges to the blocks. Others are bevelled or ⊳-shaped.)—INCOGNITA. (Methods have been given; but the simplest remedy is to fasten a bit of bright tin-foil at the back.)—A. M. (Tunmer's "Electricity in the Treatment of Disease," is published by Allen, Ave Maria-lane, E.C. Any bookseller ought to be able to answer such a question—especially in a city like Glasgow.)—SEYEH. (See the catalogues of such publishers as Crosby Lockwood and Son, Macmillan, Longmans. How can any one answer so indefinite a question? Dr. Percy's works would be the best, and they are published by Murray; but are expensive because voluminous.)—A. I. S. (Do they differ from the tables? What tables?)—H. M. A. (You can resilver by the battery process, or by rubbing on a silvering powder. See indices. 2. You require only a sufficient quantity of string and the netting needles. For general directions for netting, see p 982.)—A. W. (Almost any of the textbooks. 2. No work that we know of devoted to such subjects; but the matter is dealt with in most of the textbooks. 3. See some articles now appearing in the *Building News*, and for a work dealing with the subject generally, Stanley's "Experimental Researches into the Properties and Motions of Fluids," published by E. and F. N. Spon.)—T. R. A. 1. (See indices under heading "Lantern Microscope"—p. 50, No. 1,147, for instance.)—ENQUIRER. (You will find it very troublesome if the pipes are at any part below the level of the boiler. If you can manage to keep them always above the level, it is easy enough.)—T. R. A. 2. (Dissolve the guttapercha in benzol, bisulphide of carbon, or mineral naphtha, whichever you please. The leather must be thoroughly cleaned and roughened.)—NOIR. (You will find it mentioned incidentally in many back volumes. It is produced by making the iron articles hot, dipping in linseed oil, and allowing it to burn off.)—DUPLEX. (If *you are going* to use a battery the cost will be considerable; but you can find full particulars in back numbers—probably in this.)—W. AMER. (You will find what you want illustrated in No. 1138, p. 435, and elsewhere in back volumes. Copper wire should be used for joining unless you like to go to the expense of silver.)—RANGER. (So far as we know there is no limit to its duration if taken care of; but it is possible to demagnetise. 2 No. a magnet acts through anything and everything.)—F. S. WHEELDON. (If you want the electric light and must use batteries, better try the chromic acid cell, or if you wish to study economy while securing efficiency—the Bunsen. Can you get nitric acid at Malta at a reasonable price—say 1s. per lb.? That would determine which to use, as the chromic acid can be had.)—A. PARSONS. (A method of cold soldering with amalgam was described in No. 8-8, p. 81. It is useful at times, but is not to be compared with proper soldering or brazing.)—S. H. (You do not say where you found the expression. It should be stated in query, as a guide to those who may answer. But really, how many people are interested in such a matter?)—YOUNG FITTER. (As we have frequently mentioned, applications for situations as "engine-room artificers" should be addressed to the Captain of the Steam Reserve, H.M.'s Dockyard, at —which you like. Unless you are an expert mechanic you need not waste time in applying.)—S. BAKER. (Best olive—not cotton-seed—oil; but very little should be used. 2. They must be stained to the colour, and then covered with oak or copal varnish.)—ARDENS-SED-VIRENS. (If received, it was no doubt answered. It will require considerable outlay for the plant. See the letters on the subject recently inserted. 2. Do not know of a work on the subject, but there are many articles in back volumes. 3. Dissolve shellac in spirits, and colour to suit with gamboge, dragon's blood, saffron, aloes, &c.)—TYPO. (We have described the process over and over again. They are either taken from drawings or photographs, and the zinc is etched with acid.)—BANKER. (Yes, mainly.)—G. SMYTH. (No one can explain without seeing it.)—W. TRAVIS. (Consult a medical man.)—TINNER. (Scour with sand, pickle in acid, wash, immerse in hot oil, and then in molten tin.)—J. R. K. L. (How would bisulphide of carbon do? We think that rather worse than the mineral naphtha; but you can try rectified sulphuric ether or chloroform, if expense is no object.)—H. MELTON. (Yes, he did describe it, and illustrated it in No. 1,185.)—SIGMA LAW, OR TAU. (You can probably find as much information as you want in "Kensington's Analyses" (J. and A. Churchill). 2. You want only a box lined with a sheepskin mat, or fleecy wool, and keep it in a tolerably warm place. The top should slant down so that the chicks can get right amongst the wool. 3. Do you mean hair-dye, or what. See indices.)—T. L. W. (Microscope slides are not fixed. 2. Canada balsam is soluble in turpentine. 3. Not much, but it is useful for examining crystals.)—ENGLISH AND IRISH. (Women who leave their husbands and are then anxious about the custody of their children had better consult a solicitor; such questions are quite out of our province. There is a legal column edited by a well-known lawyer in the *Weekly Times and Echo.*)

Every Man or Woman suffering from any form of nervous derangement, loss of power, debility, or functional disorder, should send at once for "Electropathy; or, Harness's Guide to Health" (copiously illustrated). It will cost you nothing, and if, after perusal of the astounding facts it will bring to your notice, you should be persuaded to stop physicking and try rational treatment, you will assuredly be numbered among the ever-increasing multitude who daily express their gratitude for the priceless benefits derived from mild, continuous currents of electricity generated by wearing Harness's Electropathic Belt. Don't hesitate a moment, but sit down at once, lest you forget it, and write for the treatise, which will be sent you free by post.—Address, Mr. C. B. Harness, Consulting Electrician, the Medical Battery Company, Limited, 52, Oxford-street, London, W. (corner of Rathbone-place).

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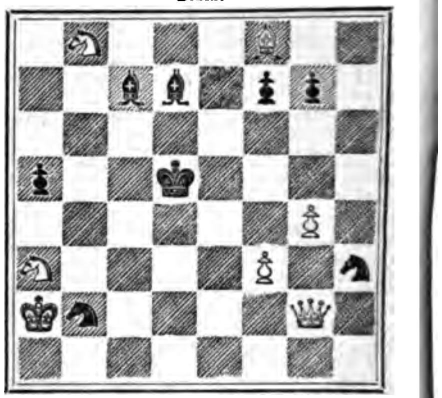
PROBLEM MXCV.

Black.



White. [7 + 8

White to play and mate in three moves.

SOLUTION TO 1,093.

White.	*Black.*
1. Q-R 5.	1. Anything.
2. Q, R, Kt, or P mates.	

(Seven variations.)

NOTICES TO CORRESPONDENTS.

CORRECT solutions to 1,093 by R. G. Briscoe, H. C. Haycraft, J. Methuen, A. Dean, J. Kilbee, Sorrel, J. Bryden, H. Fellows, A. Wheeler, C. Reader, Black Pawn, and W. Jay; to 1,092 by J. Bryden, A. J. Moulder (but 1. Q-K 2 is wrong, as K takes R), R. G. Briscoe, J. G. Hankin, Sorrel, and Hensing; to 1,089 by Meyer Crown, Texas (excellent problem).

SORREL.—The figures in brackets refer to the number of solutions sent when a problem has more than one. We have entered your name as competitor for W. Jay's prize.

W. H. WRIGHT, T. G. HANKIN, AND J. KISTRUCK.—How in 1,093 if 1. Kt (Kt 3) to Qu?

J. BRYDEN.—It should, we think, be the end.

J. KILBEE.—Your solution to 1,091 was correct. Acknowledgment accidentally omitted.

A. WHEELER.—No.

ON Saturday, April 14th, the Manchester Club defeated the Sheffield Association, at Manchester, by nine games to three.

THE *Bristol Times and Mirror* announces the death of Mr. J. Burt, a well-known player of the Bristol Club and author of a collection of games.

MR. ROBERT MILLER, joiner of Glasgow, has three inlaid tables in the Glasgow Exhibition, two of which are chess tables. In one table 12,200 pieces of wood are employed; 6,400 and 5,500 pieces having been taken for the chess boards, which are each 15in. square.

AGALITH is described as a new weighting material for paper manufacture. It is found in large quantities in the United States of America. It is a hydrated magnesium silicate containing small quantities of iron and alumina, resembling asbestos in its composition. In colour it is white, with a greenish tinge; it has a sp.gr. of 2·2—2·5, and can be readily ground up. Used for weighting paper, it produces an excellent result, whilst the mechanical loss of paper and of weighting material is extremely small.

A VERY good imitation of black walnut may, it is said, be manufactured from poor pine, the quality and appearance of the article being such as to escape detection, except upon very close examination. To accomplish this, one part of walnut peel extract is mixed with six parts of water, and with this solution the wood is coated. When the material is half-dry, a solution of bichromate of potash, with water, is rubbed on it, and the imitation walnut is ready for use.

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Advertisements must reach the office by 1 p.m. on Wednesday to insure insertion in the following Friday's number.

The English Mechanic

AND WORLD OF SCIENCE AND ART.

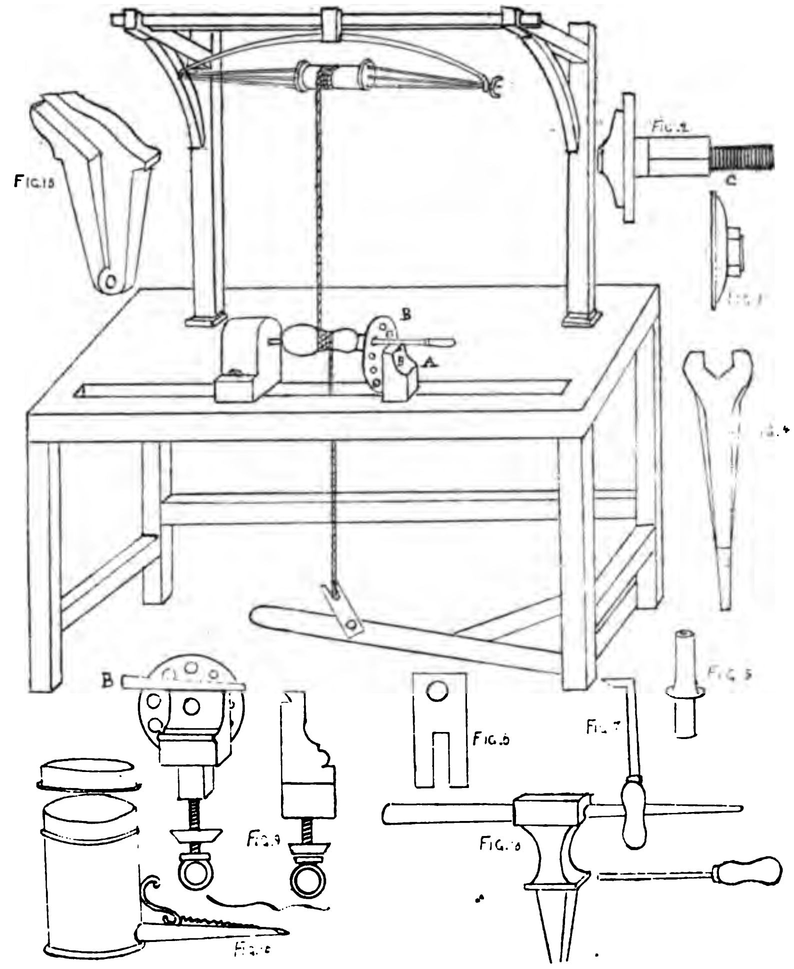
FRIDAY, MAY 11, 1888.

EXTRACTS FROM BERGERON.—V.

WHEN a chisel descends into a hollow it is often too large; but in that case it is skewed a little more, and by this device it becomes possible, even with a large chisel, to cut a line of quick curvature. This is, indeed, one of the proofs that may be given that the chisel is skilfully handled; and even to cause the two cuts to meet in the bottom of a hollow; that is the way in which it must be managed. Care must be taken not to cut the wood uphill; thus it will be cut from *c* to *d* in going towards the ferrule, then from *c* to *b*, then from *a* to *b*, and lastly from *a* to *e*. In this way the fibres will be neatly cut and the pores flattened down. If the wood is neatly cut, so that the strokes of the tool meet accurately, and the work has been turned perfectly cylindrical, the less hard the wood may be, like apple or beam-tree, it ought to be almost polished; a handful of shavings made by the chisel should be taken from off the lathe-bed, and grasping the handle in the fist it must be made to revolve while surrounded by the shavings, which will complete the polishing. It may be in regard to Fig. 10, the profile of the handle, that it is supposed to be finished; but there is also seen that the pulley, or bobbin *f*, remains. As there is still a certain operation to be performed on this handle, we shall not at present speak of the way to cut off this bobbin. We have yet certain considerations to lay before the reader, and it will suffice to say that this bobbin ought to hold to the handle by a connection five or six lines in diameter. If this handle were of any costly wood, such as rose-wood, violet-wood, purple-wood, ebony, or other, we could cut the wood very nearly the length of the required handle. In place of that part of the bobbin which will be wasted, we could reserve the part *e a* cylindrical, so as to place the cord there while finishing all that portion of the handle between *a* and *c*. Then, putting the cord in the hollow *b*, we could finish the end to its pear shape, bordering almost to the centre-point, of which the hole must be left as shallow as possible. But the mark of this centre will always be left, which is not desirable, and which will have no existence by the method we have already described.

In any other case it is an expense too slight to be regarded. When we speak of the lathe with mandrel, we shall give an easy way of turning this handle and many others without their having any mark of the centre point. The following is the method of completing the handle in the dead-centre lathe:—The hole which has to receive the tang of the tool (this is the name of the tail portion of every tool, even that of a sheath knife) ought to be in the centre of the handle; every other way of boring it in the lathe is uncertain. We are, therefore, led to speak of the lathe with boring collar. What is called a boring collar is a plate of iron, brass, or wood, in which are worked a series of conical holes to hold the end of a cylinder or of any other piece, and by means of which is obtained a power of working on the end of it without being hindered by the poppet centre.

A (Fig. 1, Plate II.) is a boring collar poppet; B is the cone plate. It is generally a circular plate of brass pierced in the centre with a round hole, into which enters an iron bolt with a head, turned accurately cylindrical and true to the hole, of a length a little less than the thickness of the cone plate. At the termination of the cylindrical part is a square a little shorter than the thickness of the poppet. Lastly, the remaining part is cut with a screw to a length of twelve to fifteen lines, and receives a nut which, bearing against the poppet and screwed up to it, fastens the plate to the poppet. The shape of this bolt may be seen in Fig. 2; its nut separate at Fig. 3, and the wrench for screwing it up in Fig. 4.



It can be seen that this disc turns on the neck *a* of the bolt, Fig. 2, and as, on the same circular line there are a dozen conical holes of different diameters, that which agrees the best with the bit of wood already turned cylindrical at one end is brought to the line of centres. Excellent cone plates can also be made of iron. The cost is infinitely greater; but the pieces turned by it revolve much more smoothly, and in addition, since in both cases one is obliged to use a drop of oil if one is turning ivory or wood of a light colour, this oil forms, on the brass in which the piece turns, a brown deposit which gets incorporated with it and deeply traces a brown circle which nothing will remove except cutting away half a line of the material. Lastly, there is one alternative way of making these cone plates. They are constructed of wood by putting in the lathe small plates with parallel sides and six to seven lines thick, 6in. or 7in. long, and 4in. wide. A mortise (Fig. 6) is worked in the lower part, by means of which it is passed over the neck of the bolt, and is there fixed at a convenient height. To bore the holes in these cone plates the following is the method adopted when a chuck lathe is not possessed. The operation is much more difficult; but as we are engaged in detailing all operations, this one must find a place here. A chuck (Fig. 5) is to be turned between centres on which must be reserved a pulley or bobbin. It must have the form of a very long cone, and, by the aid of a carpenter's brace, a cylindrical hole must be made in that part of the plate where the conical hole is desired.

This hole must be smaller than the piece which is to be worked with the boring collar, and it is to be made to fit on the chuck rather tightly, so that the plate may hold securely in the lathe. The chuck is to be put between centres, and it must be seen that the plate runs truly in one plane—i.e., that it does not sway from side to side, which very often happens. It must be corrected with the mallet until it revolves very truly; then, with a bevel tool bent at right angles the hole in the plate is to be widened out and made conical. When the wood has been entirely cut away, the plate will loosen its own hold; but it will be necessary, with the in-and-out calipers to try whether the conical hole will be large enough for the piece of work for which it was intended.

For this kind of boring collar a wood must be chosen fairly hard and close-grained—such as service, hawthorn, or sauvageon (?), and when turning with the cone-plate it should be first of all rubbed with soap, for, it may be mentioned in passing, that woods which work in frictional contact should only be lubricated with soap, and never with oil, which, penetrating the pores, makes them swell, tightens tenons, and renders friction hard and excessive.

Whatever kind of boring collar is used, and the last is beyond dispute the worst, the poppet fitted with the one which is nearest to the size of the cylinder which is to be placed in it is to be advanced, and when the hole is perfectly concentric with the centre point, the nut is to be screwed up sufficiently to prevent the cone plate shifting. The handle is to be placed against the left-hand point, and is then to be supported by its ferrule in the cone plate, and trial is to be made by working the treadle, whether the friction is too great or too slight. In one or the other case the cone-plate poppet is to be advanced or set back—it being as yet not firmly clamped upon the lathe-bed—until it is decided that the work revolves with sufficient freedom. The wedge-shaped rest is to be placed in the dovetail seen in the head of the poppet, and as the wedge is wider at one end than at the other, it is to be advanced until its upper edge is almost level with the centre of the piece which is being turned; but slightly below it, by the thickness of the tool which is to be used. A rather sharp-angled point tool is to be taken, and placed at the centre of the piece, to open out the hole to the width of the drill that is to be made use of. Then with the drill, Fig. 8, the hole is deepened, withdrawing it from time to time to clear out the borings, and plunging it into grease, or drawing it through a candle; and when it is thought that the hole is sufficiently deep the boring is stopped. Then a somewhat larger drill is taken: this is to be presented very steadily, exactly opposite to the hole, and then grasping the poppet, the left thumb is to be applied against the tool, so as to direct it, and insure the centrality of the hole. As soon as it is ascertained to be correct, the drill is to be advanced little by little, clearing out the borings frequently, until the bottom is reached.

As an assortment of drills of all sizes should be provided, the hole can be enlarged to the size required, so that the tang of the tool which it is desired to fit with a handle may enter it exactly, or even with some degree of force; but as all the tangs of tools diminish towards their extremities, and as, if the hole is of equal size throughout its depth, the tool, although it may at the orifice fit tightly, would be too loose at the bottom of the hole, and would shake about in use, attention must be given not to run in each drill further than may be necessary to render each hole slightly conical. In this way the tang will be equally gripped along its entire length, and the tool very firmly handled. The simplest way to arrive at such result is, in finishing the hole, to use a taper-broach.

It is very difficult at first to drill the hole straight throughout its entire length. The rule we may give respecting this is to hold the right hand at one height, so that the tool may be a continuation of the axis of the piece which is revolving; but while giving attention to this, the second drill should carry away all irregularities which the first has left, especially if it cuts well, particularly at the end. In another place we have spoken of the method of giving to drills that keenness of edge which they require. When the handle is drilled, it can be proved whether the hole is central by placing it again in the lathe between the two centres. If it revolves as truly as when it was finished, that is a proof that the work has been well done. But absolute truth is not needed in the case of which we are speaking—provided the hole is fairly central, that is always sufficiently satisfactory. We have but kept in view the perfection of the art and the instruction of beginners. It only remains to finish off the handle at the end opposite to the ferrule. It is supposed to have been again returned to between centres. With the chisel the separation of the bobbin or pulley is deepened, and the wood is so cut away as to give to the end an agreeable pear-shaped form, avoiding giving to it any flat places or inequalities; and when we are near cutting away entirely the wood which attaches the bobbin to the handle, it becomes necessary to give but gentle movements to the treadle; because this part, becoming exceedingly weak, could not withstand a severe strain. The wood would break at this point, the handle would fly against the window or the person of the turner, the end would be disfigured by the roughness left by the fracture, and it would only be possible to repair the injury by altering the form which it was intended to give to the handle.

When, then, in leaving a connection between the bobbin and handle all the finish desired has been given to the latter, it is to be polished with a few shavings, as we have taught already, and is to be withdrawn from the lathe. Then, gripping it in a vice, it is to be entirely separated with the saw, not at the exact spot prepared by the chisel, but encroaching a little upon the bobbin. The end is to be dressed first with a rasp, then with a bastard file, until the profile is finished as it ought to be. This detail of the operations required to turn a tool-handle has less for its object the handle itself than the giving the method of turning all other work. Thus the details into which we have entered will enable us to dispense with their repetition.

Bergeron in the next chapter describes the making ferrules in iron and brass, and goes on to treat of various special works to be done with the pole lathe. What has been already written will, however, suffice to enable the reader to understand the mode of working with the above primitive machine, and I shall therefore at once go on to the Tour-en-l'air, or lathe with mandrel and flywheel.

O. J. L.

MICROSCOPICAL ADVANCES.—XXXVI.

By Dr. ROYSTON-PIGOTT, M.A. Cantab., F.R.S., F.R.A.S., Memb. Roy. Coll. Physicians; Fell. Cambridge Phil. Society; formerly Fellow of St. Peter's College, Cambridge.

Researches in High-Power Definition—Attenuated Lines, Circles, and Dots.

THE *Micrometer Gauge*, which I had the honour of describing to the Royal Society, is a most searching instrumentation for estimating the size of minute objects. Alluded to in the last article, it consists of selecting a series of straight fibres accurately measured in thickness and placed in the focus of the eye-lens, with the object by comparison to estimate size by degrees of fibres thickness in the field of view. Some of these gauges are—

1. Spun glass in a micrometer eyepiece.
2. Spider lines in movable pairs.
3. Sets of these lines of various sizes accurately measured.

There were some minute black specks on a flattened globule of mercury vertically illuminated. A particular spider line was selected as slightly larger than the black speck: power 1,000. The image in focus of eyepiece was magnified 100 times. The size of the speck was therefore, as that of the spider line is 1-10,000th—One millionth.[*]

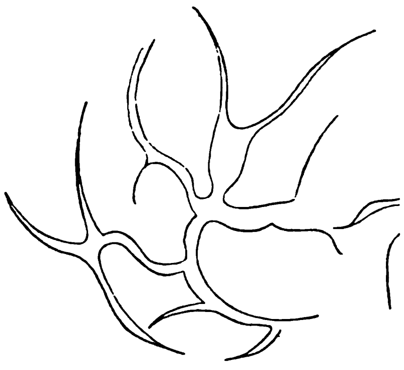
This micrometer gauging has now been employed for many years. There are two other methods (which I now refrain from describing) adapted for close verifications. We will now pass on to other lines transcendently minute.

The marginal lines of glass threads, spider-webs, and minute cylindrical bodies give studies of high delicacy.

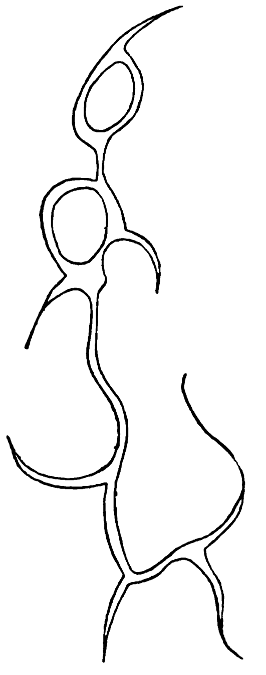
The long stems of tall villi in scales, under the best glasses, develop two very black margins (quite invisible in ordinary microscopes) astonishingly clear. A power of 2,500 then displays these margins perfectly.[†] They are very easily flattened down, and then their stems, lying parallel to the cover and adherent, can be most exquisitely seen as transparent objects.

It is evident that the variable thickness of the spider lines must introduce some error, which can be entirely eliminated, however, by proper precautions and by algebraical treatment.

If parallel spider lines be applied measure a minute body, I recommend micrometer readings to be taken twice—by external, and then by internal, con The mean of these will be the exact si the body, observed as if measured fron precise centres of each spider line.[*]



I have had an opportunity of prese to the Royal Society an account of th traordinary lines, both black and silvery coverable in silica cleavage, which I introduce here, as surpassing in del Nobert's celebrated lines, and devel black lines of surprising attenuation, ba some of the best glasses now produced, provided with adjustment by screw coll



I have noticed three different p mena :—

1. Black lines vary from 1-100,000 1-800,000th of an inch, depending o slighter or greater obliquity of illumin Some of them are quite as fine as a s line 1-10,000th of an inch diminishe times.
2. A thin, silvery line of light right the points between the black cracks, of wonderful attenuation, diminishing in ness as the definition is more pure.
3. Achromatism.

Of these three effects, the easiest to c is the silver line, more difficult the inte black interference lines, more difficult

---

[*] One hundred times smaller than the spider-line—i e, 1-10,000th diminished 100 times, or 1-1,000,000, or a millionth.

[†] Mr. Hinton, Vorley-road, Holloway, has sent me some most beautifully clear mounts, dry, of the following scales, showing large villi:—Zygæna: filipendulæ, athamanthæ, coronillæ, lavendulæ, transalpinæ, meliloti, trigonillæ, medusa.

[*] The readings of my micrometer, with 2,000 are true to the half-millionth of an inch. See *Proc* Royal Society, No. 208, 1880.

[†] Mr. Henry J. Slack says these films are made ing silica fluoride through a solution consisting 4 parts and glycerine 1 part. A drop of this flui closed by a cover-glass upon a slide and allowed to rate, when it deposits the various grotesque alluded to. (Forest-row, Sussex, is his address.)

hibition of both kinds, silver and
t once.
fine, sharp edges of the silica cracks
brilliant reflectors when the central
the condenser are stopped off, and
silver lines become severe tests of
for they become clear or confused
y according to the high or lower
of the objectives. The very best
are, regular, smooth, equal, tortuous
lines resembling the uncouth writings
rocks of Sinai. Yet these same lines
finely mixed with intensely delicate
ck interference lines the instant the
approach more perfect corrections.
Zeiss oil glass failed to show these
ıena, I concluded that a slight dif-
in the correction would have de-
l them, by the addition of a screw

Powell and Wray glasses (1-10ths)
of this adjustment, and succeed ad-
in displaying the double set-silver
ick lines, and are the only glasses in
session of use. By slight obliquity of
ation the *black shadows* (which are
istinct from these fine lines) may be
o appear broader on one side and
on the other side of the silica fault
k.
ination is an important factor: with
bė condenser at full aperture the black
lines appear much thinner; by P.
condenser of 120° thicker; under 70°
), until, with parallel rays, they get
aximum thickness. The same thing
ards margins happens to fibres,
rs, and spherules. My very best glass
attenuates these black outlines
0 diam.). Evening daylight.

chromatism. The very first time I
se cracks exhibited by Mr. Slack, who
ne what they were, I replied "Vege-
bres." The Ross glass showed them
l cylindrical. By changing the length
body, or re-correcting the objective
in a first-rate glass, the cracks became
as black-edged, the middle spaces
vide. It was a long time before the
ena now described were discovered.
worked a great deal at Nobert's cele-
bands, I do not hesitate to believe in a
superiority of these silica lines to
's in truth, delicacy, and minuteness.
ion should be given here. Those filmy
hich are formed on the cover-glass and
dispute, present the very finest lines
estigation. Those lower down formed
slide in consequence of the film of
ntroduce a very untractable spherical
ion. If an ordinary condenser be
ed—say, ¼ o.g., with an aperture of
ne lines appear jetty black, sharp,
decisive, and strongly pronounced,
ith daylight.

e objective be good enough at a cor-
rection, a brilliant crimson line can
on the centre of each silica fault. It
to appear when the ¼ condenser is
depressed. Irregular-shaped plates
ble with only one black outline, form-
fault or crack at all. Streets and
f cities arise, forming very interesting
les, and when the central light is
l off these streets become illuminated
ines.* It is truly surprising with how
mplification these beautiful *bright
lines* can be distinguished along the
of these exquisitely minute chasms.
eat advantage is this: we know ex-
hat we are gazing at—viz., cracks,
or chasms in the silica plate formed
ery perfect parallel walls, separated
er large or most minute interstices.

This fact is so different to the unknown shapes of the grooves cut in glass as Nobert's lines as to provide invaluable data for distinct definition of the highest order of differentials.

My apparatus for measuring focal distances or depth shows a very constant thickness of the silica film of one thousandth of an inch; but the chasms are situated on both the upper and lower surfaces, and in depth vary from the 1-20,000th to the 1-10,000th of an inch. 1-50,000th change of focus develops instantaneous transformations in the lines. Under 2,000 diameters, a focal change of 1-100,000th rapidly broadens or narrows the silica streets, and with great care even 1-200,000th of an inch focal change produces a manifest alteration.* Often detached plates or flakes can be seen 1-10,000th above its fellow crack. Power employed, about 2,000 Swift's 1-12th oil (cod-liver oil). Many of these plates or flakes are tilted during crystallisation.

The silica film and cover-glass together violently under-correct the objective; but as the screw collar cannot work further, it was now over-corrected by lengthening the body 6in., which now presents splendid definition under about 2,500 diameters. In almost every case the lines are perfectly smooth; in a very few cases they appear chipped. Abbé's widest angular aperture in illumination is employed; nearly 180° in air (daylight dull).

If very thick shadows are desired, 1½in. Ross of the finest quality is used, screwed into P. and L. stopped condenser. Brightish diffraction lines now appear accompanying all the broad shadows of a blueish colour, the median space being pink, bordered by two black shadows within the blue, which now looks like a rose-colour vegetable fibre (× 1,200). These can all be just glinted nicely with 500. The blue line depends on the screw collar in a magnificent 1-8th of P. and L. Employing the condenser's angle of 30°, a most splendid jet-black interference line arises, just 1-5,000th of an inch above the black side shadow, and appears to be shadowed by two smooth equal French - grey bands. In rising foci first appears a very thin brilliant white central line, grey bordered; in a higher focus the intense interference jetty-black line reappears. If the crack be too broad there is no interference and no black interference lines, several orders of which optically exist in higher focal planes. In many instances a double black line may be defined, ornamented with an intensely white central streak following exactly the meanderings of the crevasses.

Measures of black interference lines by spider gauge: Thick, 1-75,000th of an inch; thin, 1-150,000th of an inch; thinnest, 1-1,000,000th of an inch.†

(By a misprint in the last article, 1-40,000th should have read 1-140,000th.)

COLOURED PHOTOGRAPHS.

ALTHOUGH the absurdity of the phrase has been pointed out, patentees, for some reason, still entitle their inventions photographs in colours, and Mr. W. Trenemen is not an exception, for his patent, recently published, is called "Improvements in the production of photographs in colours." A photographic print is produced (from a negative taken in the usual way) in any of the several manners recommended by Swan, Lambert, the Autotype Company, and others who practise printing with gelatine sensitised so that the action of light is shown upon development. Such print should be produced upon a collodionised glass or such other surface as will admit of its ultimate transfer to paper, glass, china, or other permanent support. A coloured print may be made as follows:—A glass transparency is produced by any of the various wet or dry plate processes, and varnished with a hard waterproof varnish, such as that made by mixing commercial white hard varnish and methylated spirit of wine in proper proportions. Another and better method for the process consists in printing a carbon print from the original negative, and developing this print upon a temporary flexible support, and then transferring it to glass, which has been prepared in the usual way, either by a substratum of albumen or gelatine mixed with chrome alum or other similar substance, which renders the image (after development) undetachable from the glass. This carbon transparency should also, when dry, be varnished with a similar varnish to that previously recommended. After the varnish is quite dry, a piece of thin paper of strong texture, such as that known as "rice," is damped and stretched over the film side of the transparency. By transmitted light the proper colours are washed evenly over the paper, and may, if thought proper, be shaded to any extent, so long as such shading coincided with the lights and shadows in the photograph, the outline for the colouring being supplied by the light passing through the transparency. Water colours are best for the paper painting, but in cases where some of the fine lines are concerned, or where in the final process the fitting would be difficult, oil colours should be used for painting those portions on the carbon film itself, which is to be superimposed upon the coloured paper. A little experience will show where it is better to use oil colours upon the carbon film, and where water colours are to be solely relied upon with the paper backing. As little oil work should be put upon the carbon film as possible, as the paper backing will not adhere so firmly to the carbon film where oil colours are used; the carbon film having a great and uncontrollable tendency to split away from the paper backing when oil colours are used on any large amount of surface. However, when used for small surfaces, this tendency is annulled, probably from the entire contact insured by the surrounding surfaces where water colours are employed. The oil colours should be mixed with mastic or other similar varnish as possible, in order to facilitate their drying, and, what is of more importance, their final adherence to the paper holding the remaining colour.

When the colouring upon the paper is completed, it is quite dry, it is immersed or floated in a warm solution of gelatine or other transparent mountant of a proper strength, say, 20 per cent. of gelatine solution; the carbon print also which is to form the face of the finished print should receive a coating of the gelatine or whatever mountant is used for the coloured paper print. When both are thus prepared, the coloured paper print is laid face upwards, and the carbon print is superimposed upon it, care being taken that the colours are in their proper places under the carbon print. If the colours on the paper fit the carbon film, the two are squeezed together and left until the gelatine is set, and then immersed in a 15 per cent. solution of alum for five minutes, or the prints may be left to dry upon the glass, and after being cut round and stripped from the glass, may be immersed in the alum solution for the same period before mounting. Should the coloured paper and carbon print not fit exactly the first time of trying them together, they can easily be separated, and if the coloured paper is too short for the carbon print, by having it longer or immersing it in the hot gelatine solution, it will be found to lengthen, or if the coloured paper print is too long, by allowing it to dry slightly and immersing it or floating on a solution of a lower temperature, or simply brushing it over (after drying) with the gelatine solution or whatever mountant is used, it will be found to have contracted to the proper size. The squeezing will then complete the print. After the carbon print, which is to supply the outline for painting, has been developed upon the temporary support, it can be transferred to paper instead of glass; but this does not make the ultimate finished print fit so well, on account of the expanding and shrinking of the paper.

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d P. and L. ⅛ immersion shows chasms just like
, being under-corrected. A double concave hard
inserted 5in. above the objective, the tube fur-
thened to produce greater over-correction. I
hted to find this achromatised the objective made
and converted into an immersion about 1870.
sen line turned black.

* The changes should be made downwards, as the oils for immersion adhere to the objective and spoil the reading.

† Mr. Hinton will be instructed in the method of preparing these objects.

FIG. 1.

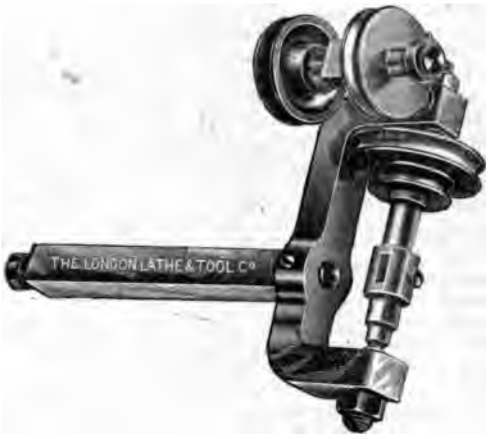
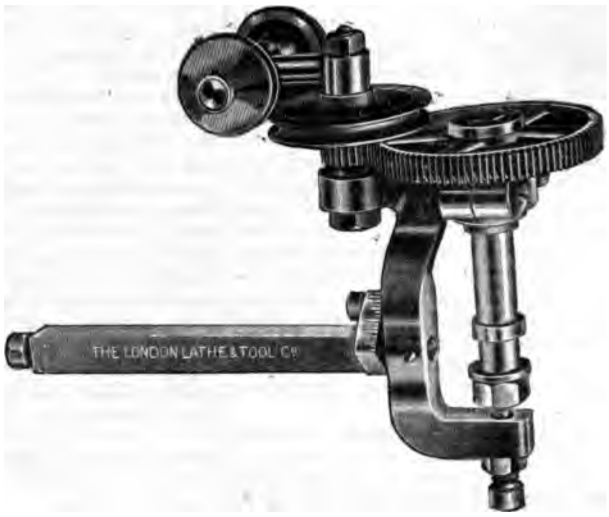


FIG. 2.



UNIVERSAL CUTTING MACHINES, BY THE LONDON LATHE AND TOOL COMPANY.

THE two instruments shown in the accompanying illustrations are made by the London Lathe and Tool Company, Pomeroy-street, New Cross-road, S.E., for use in their geometric lathe, of which we gave a full description in No. 1,181 (see also No. 1,184). They can, however, of course, be used in any other lathe fitted with an overhead motion.

The first (Fig. 1) is designed more particularly for ornamental work. The square shank is hollow, and the spindle carrying the whole front part passes through it, so that by means of the nut at the back the spindle carrying the cutter can be set either vertical, horizontal, or at any intermediate angle without removing the instrument from the tool-box. The two small guide pulleys can be removed altogether, or, if required, fixed on the side opposite to that on which they are shown in the illustration. The cutter can be adjusted, as regards height, by means of the screws carrying the spindle.

The other instrument (Fig. 2) is similar to the first; but is geared and adapted for the use of circular cutters. It can be set at any angle required, and the guide pulleys can be adjusted to suit. It would appear to be an instrument admirably suited for wheel-cutting, key-grooving, and light milling work generally, as the gearing enables substantial cuts to be taken with but little strain on the driving band.

LANGFIELD'S METHOD OF HEATING TRAINS.

A METHOD of heating railway coaches and steam-propelled tramcars by warmed air has been patented by Mr. J. Langfield, of Tyldesley, and has been tried with satisfactory results on the Bradford and Shelf tramway. The patentee places a horse-shoe shaped or circular chamber in the smoke-box, and a pipe, with a bell-mouth, is laid from that through the front of smoke-box. Another pipe is fixed to the chamber, and goes through the side of the smoke-box, is carried along the side of the engine, and is coupled up to the carriages with a flexible pipe, with a similar joint to that used with the vacuum brake.

The pipe is carried along underneath the carriages, with an opening or perforated grid in every compartment.

The cold air going through the bell-mouth into the chamber becomes heated by the waste heat in the smoke-box, and is driven forward by the velocity through the pipes and into the carriages.

Hot air, being lighter than cold, passes along and heats a train as well standing as running. The pipes are of copper, as light as possible, and covered with asbestos.

The hot air can be carried along any length of train that is running. The cost is small, *and there is* no danger, as there would be with *steam, water, or gas.*

SUNTER'S IMPROVED SCREWS.

THE object of the improvements in the manufacture of wood screws, recently patented by Mr. L. E. Sunter, of Carlisle-street, Lambeth, is to so form the thread that the screw may be readily inserted into wood without the aid of a gimlet, bradawl, or other tool such as is usually employed to bore holes for the reception of screws. The improved screw is made with one or more longitudinal grooves or flutes which extend from end to end of the screw-threaded portion or shank, as shown in Fig 1, which is an elevation; while Fig. 2 is a section on the line *x*, *x*, drawn to an enlarged scale. The shank or body *a* is formed with a screw thread *b* of the ordinary or any suitable description. Grooves or flutes *c* are cut in the said shank in a direction parallel with its axis, so that the screw-thread *b* will be intersected and divided by each of the grooves or flutes. One or more grooves or flutes *c* may be employed according to circumstances. The edges c^1 of the grooves are perferably slightly undercut, thus providing cutting edges, which enable the screw *a* to enter the wood readily, and cut a thread therein without the necessity for making a hole beforehand with a gimlet or other instrument. Moreover, as the particles of wood so cut and separated lie in the grooves or flutes *c*, outward compression and splitting of wood, which often result from the use of ordinary screws, are avoided.

Fig. 1.

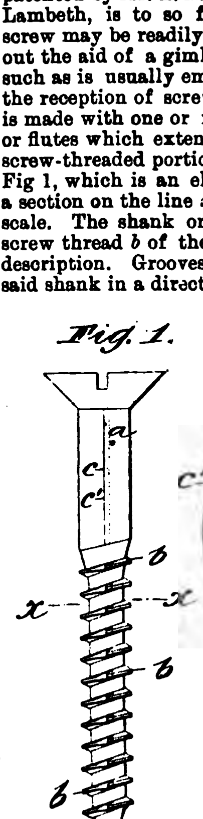
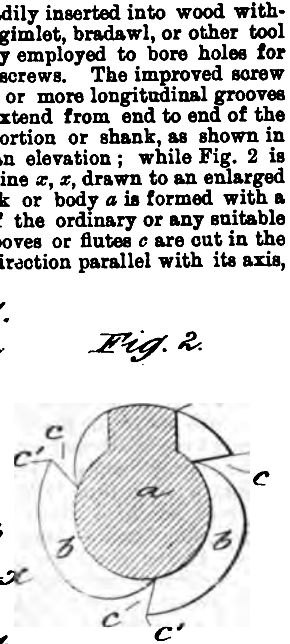


Fig. 2.



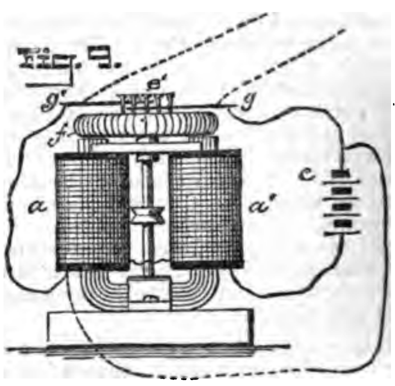
Although the grooves or flutes *c* are described as extending from end to end of the screw-threaded portion the patentee wishes it to be understood that he does not confine himself to the extent of the grooves or flutes, as the latter can be recessed in any other desired manner, so long as the required cutting-edges are formed. For instance, the grooves or flutes *c*, instead of being cut in a direction exactly parallel to the axis of the screw *a*, can be cut in a direction inclined thereto.

EXPERIMENTS ILLUSTRATING THE PRINCIPLE OF THE DYNAMO.*—II.

AFTER noticing the effect of plunging a magnet into a coil of wire, it is not very difficult, in the present light of electrical knowledge, to understand how the process of induction is carried on in a continuous way in the armature of a dynamo.

The simplest form of armature for illustrating this point is undoubtedly that known as the Gramme ring armature. In the action of this armature the prime factor is magnetic induction. It is perhaps unnecessary to go into the details of the construction of the Gramme ring, as commonly used in dynamos. A very crude ring answers the present purpose. Its core is formed of a compact circular coil of soft iron wire, which, in cross section, may be circular or of any other form. The core is wrapped with tape and varnished to insure insulation.

FIG. 9.



Around this iron ring or core is wound an insulated copper wire, arranged in a spiral coil *f*, like the winding of an ordinary electro-magnet. The ends of the copper winding are joined by soldering, thus forming a closed coil. The ring is mounted upon a circular wooden support attached to a spindle, so that the armature may be revolved in front of the poles of a magnet, *a a'*, as shown in Fig. 9. In the wooden support, in a circle concentric with and near the spindle, are inserted six or eight wire nails, *e'*, arranged at equidistant points. The copper winding of the ring is spaced off into as many sections as there are nails in the circular row, and at the end of each section the insulation of the copper wire is removed a short distance, and a wire, *i*, is attached by soldering. These attached wires are each connected with one of the wire nails. Now, all that remains to complete the Gramme dynamo or motor is the application of two conductors, *g g'*, to the circular row of wire nails, as shown in Fig. 10 and 11.

The dynamo has all of the essential features of the regular machine—the field-magnet, the iron armature core, the conductor wound upon the core, the commutator cylinder formed of the wire nails, and the brushes consisting of wires held on opposite side of the commutator cylinder.

This dynamo is constructed for illustration only, and not for practical use. It will generate a current, and may be driven as a motor by a current, but of course not with the same advantage as a more complete machine.

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* By GEO. M. HOPKINS, in the *Scientific American.*

vestigating the phenomena of the armature, ll to begin with the simplest case of mag- duction. When a bar of soft iron is held :he poles of a magnet, as shown in Fig. 12, mes itself a magnet. The magnetism ed in the bar by the action of the magnet is

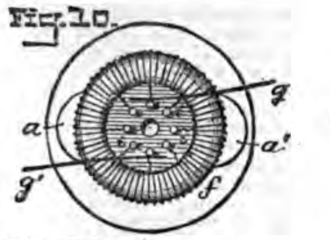


Fig. 10.

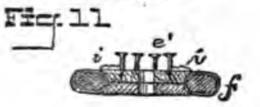


Fig. 11

that of the magnet. That is, the mag- developed in the end of the bar opposite ole of the magnet is S., and, similarly, the sm developed in the end of the bar oppo- S. pole is N. The centre of the iron bar is

bstituting an iron ring for the straight bar, n in Fig. 13, the effect will be the same.

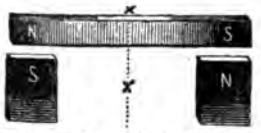
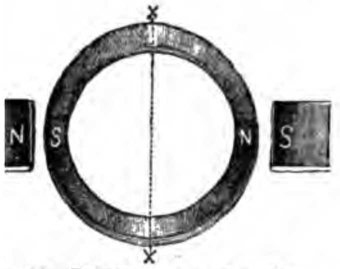


Fig. 12.—Magnetic Induction.

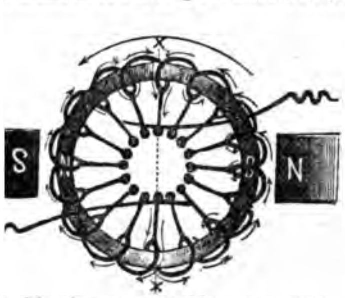


. 13.—Induction in an Iron Ring

ions of the ring opposite the poles of the acquire polarity by induction, as in the ance, and the magnetism extends in the m the vicinity of the poles towards the ine X X, which forms a right angle with a ing the poles of the magnet. In the figure ing the location of the magnetism in the idicated by the shading.

rning the ring upon its axis, the mass of moves, but the polarity of the ring main- xed position relative to the poles of the

the ring carries a coil, as shown in Fig. 14, etic poles of the ring remaining stationary, e material of the ring and coil are revolved,



. 14.—Armature in Magnetic Field.

continual passing of the sections of the ugh the magnetic field surrounding the portions of the armature core and the the magnet, which is the same in effect as ng of a magnetic bar through the coil of ture.

s the inductive effect produced by the ation of the armature core, the passing of uctor through the magnetic field of the magnet augments the current.

Each half of the armature between the neutral points is practically a single coil of wire, terminating at two of the commutator bars—which in the present case are the two nails—at diametrically opposite sides of the commutator cylinder, all of the remaining commutator bars and their connections being idle.

In Fig. 9 two circuits are shown in connection with the machine—one in full lines, the other partly in dotted lines, both connected with the battery *c*. When the circuit represented in full lines only is employed, the machine runs as a motor. When the wires shown by full lines are disconnected from the brushes *g g'*, the rotation of the armature in the field of the magnet *a a'* produces a current in the manner already indicated, and this current is taken from the armature by the way of the wires *i*, the nails *e'*, and the brushes *g g'*.

This machine, when used as a generator, is strictly a magneto-electric machine, although an electro-magnet is employed as a field-magnet. A permanent magnet might be substituted for the electro-magnet.

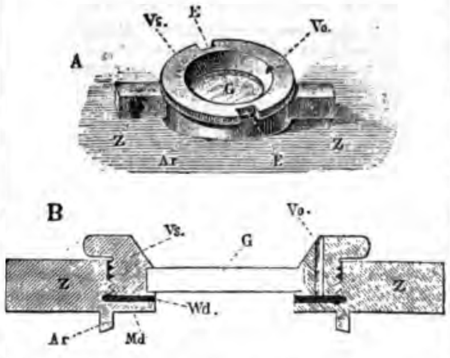
For the sake of securing the greatest possible simplicity, certain modifications of the action of the armature have been omitted.

GERLACH'S EMBRYOSCOPE.

THE embryoscope, devised by Dr. Gerlach, supplies a great and long-felt desideratum in experimental embryology. It is a mechanism for closing hermetically a circular opening, made with a trepan, in the shell of the hen's egg; and it serves the purpose of a window, through which the living embryo may be directly observed, and its development followed from day to day.

The instrument consists of two parts: 1. A *mounting-ring* (Aufsatzring) to be firmly cemented to the egg-shell. 2. A *key-piece* with glass front, which screws into the ring and closes it air-tight.

In the cut A represents the embryoscope in perspective, and B in section. The metallic mounting-ring is 1½mm. thick, and has a lumen 2cm. in diameter. The lower edge A*r* is bevelled and saddle-shaped so as to fit the equatorial surface of the egg, while the upper edge is flat. From the outer surface of the ring, two square-cornered bars, Z, project in opposite directions. On its inner surface, a little above the lower edge, is a diaphragm, M *d*, with an opening 13mm. in diameter. Resting upon this diaphragm, and corresponding with it in size and shape, is a second diaphragm of thin wax-cloth, W *d*, which serves as a packing-washer for the key-piece.



The key-piece of the embryoscope consists of a low, metallic cylinder, closed by a disc of glass, G, which represents the window that is to cover the artificial opening in the shell. The upper part of the cylinder expands peripherally to form a rim with a milled edge. This rim has two notches opposite each other, into which fit the arms of a small wrench, by the aid of which the key-piece can be tightly screwed down. There is also a short, narrow, vertical canal V*o*, or vent, the lower end of which must open in the middle of the key-piece ring.

The accessory apparatus required in the use of the embryoscope consists of (1) a *trepan*, (2) a *guide-ring* for the same, (3) a *metallic fork*, and (4) the *key or wrench* before mentioned.

The trepan is a thin, metallic cylinder 2 to 2½cm. long, the lower end of which is toothed, while the upper part is fluted and serves as the handle. The diameter of the trepan is a trifle smaller than that of the opening of the diaphragm. The object of this is to leave a very narrow zone of shell, covered with shellac, inside the inner edge of the diaphragm.

The guide-ring for the trepan has the same construction as the key-piece, except that it has no glass disc. It serves to steady as well as guide the trepan during the process of cutting.

The fork has two notches at the ends of its prongs, fitted to receive the two bars of the mounting-ring. When adjusted to the bars, the fork serves as a means of holding the embryoscope securely, while screwing or unscrewing the key-piece.

The wrench, the use of which has already been explained, is similar in construction to the wrench used for mathematical instruments.

The mounting-ring is fastened to the egg by means of a cement consisting of *two parts of wax and three parts of colophonium*. The cement is hard and brittle at the ordinary room-temperature, but becomes soft and kneadable when held in the hand for a few moments. After warming the mounting-ring over a gas or a spirit-lamp, a roll of the softened cement is pressed into the space which must be completely filled between the lower face of the diaphragm and the lower edge of the ring. As soon as the ring becomes sufficiently cool, it is pressed firmly to the equatorial surface of the egg, and the excess of the still soft cement, which is thus forced outward and inward beneath the ring, should be removed before it becomes brittle, by the aid of a small, sharp-pointed blade. In order to avoid injuring the blastoderm, which might occur if the hot ring were fastened to the shell directly over it, it is best to fix the ring to the *side* rather than the top of the egg.

After the ring has been securely fixed, and the superfluous cement removed, the exposed edges of the remaining cement seen beneath the lower edge of the ring and the inner edge of the diaphragm, must be covered with a coat of an alcoholic solution of yellow shellac. This may be applied with a small brush, care being taken to cover the cement completely, and as little of the egg-shell as possible.

After the shellac has dried, a process which is completed in twelve to fourteen hours in the open air, and in six hours in the incubator, the shell may be trepanned.

Antiseptic precautions are required in opening the egg. An oblong porcelain trough or glass dish is first filled with a 3 per cent. solution of carbolic acid, and in this are placed the instruments to be used in the operation; a *glass rod*, a medium-sized *brush*, small *shears*, *forceps*, the *trepan*, and the *guide-ring*. Before using, these instruments are dried with carbolised cotton, and after using returned to the dish of carbolic acid.

After washing the hands in dilute sublimate or carbolic acid, a perfectly fresh egg is painted with the 3 per cent. solution of carbolic acid, and then dried with carbolised cotton. The small end of the egg-shell is then cut out with the shears, and the thick white poured with the aid of the glass rod into a clean dish, leaving the yolk and the thinner white in the shell. The white is to be used in screwing in the key-piece, and must therefore always be prepared beforehand.

After these preparations, the egg to which the mounting-ring has been cemented is disinfected in the manner above described, and placed in an egg-carrier with the ring uppermost. The inside of the ring is then brushed with carbolic acid, which is shaken out after one or two minutes and replaced by a ½ per cent. solution of common salt, which is also allowed to remain from one to two minutes, and then completely removed by means of carbolised cotton. The guide-ring is now screwed in, and the egg trepanned *from the side*, in order to avoid injuring the blastoderm. The egg is next placed with its opening upward, and the guide-ring removed. When the trepan is withdrawn, the excised piece of shell often comes with it, and sometimes the underlying shell-membrane. If this is not the case, the two pieces must be removed separately by the aid of the pincers. Care must, of course, be taken not to injure the blastoderm and the *zona pellucida*.

The thin white, which was left with the yolk in the shell, is allowed to flow over the glass rod upon the exposed blastoderm until the ring is filled, care being taken to avoid air-bubbles. The wax-cloth diaphragm is next taken from the dish of carbolic acid, dried in blotting-paper, drawn through the thick white, and inserted in the ring in close contact with the metallic diaphragm; and then the keypiece, previously washed with carbolic acid and dried with carbolised cotton, is slowly screwed down. The superfluous white is thus slowly forced out through the vent (V *o*) until the key-piece reaches the diaphragm and closes the vent. Finally, when the strength of the hand is no longer sufficient, the egg with its embryoscope is placed in the metallic fork, and the wrench applied until with this means it is no longer possible to turn the key-piece farther.

The process of trepanning and inserting the key-piece is somewhat more complicated in the case of eggs that have already been incubated, as the egg and the fluids employed must be kept warm. A water-bath is required, consisting of a low tin box, filled with water, and provided with covered apartments for the reception of the egg, the thin white, the carbolic acid, and the salt solution, which are in this way maintained at a proper temperature. In other respects, the mode of procedure is exactly the same as given above.

The key-piece may be removed as often as desired, provided the above precautions are taken each time in inserting it. If the key-piece is unscrewed by means of the fork and wrench, it must, of course, be washed in the warm carbolic acid, and the vent cleared by the introduction of a wire.

The egg must be placed in the incubator with the embryoscope on one side. If it is placed upward, the respiration of the embryo is hindered. The embryoscope can be turned up at any moment, and kept upright for five minutes at a time without injury to the embryo.

With a little practice, the whole process of arming an egg with the embryoscope may be completed in from six to eight minutes.

The embryoscope is well adapted for purposes of class-demonstration, for investigating the growth of the various parts of the embryo, and the physiological process during the embryonic life, as the action of the heart, movements of the body, &c. It is indispensable to him who would study the effects of external agents upon the embryos of warm-blooded animals; and must be of great service where it is required to determine the precise stage of development before removing the embryo from the egg. It has been found useful in studying the formation of double embryos. Fenestrated eggs have been successfully incubated up to the thirteenth day, and it is probable that under favourable conditions the embryos of such eggs would reach maturity.

On the fifth day, it is still easy to bring the embryos under the window. On the sixth and seventh days it is more difficult. At this period the change in the position of the embryo, which requires from five to ten minutes, should take place in the incubator.

After the eighth day the embryo cannot be brought under the window. If it be necessary to determine whether such an egg or an older one still lives, we have only to leave the egg for several hours in the incubator with the window directed upwards a little, after which, by strong reflected light, one may readily see the blood circulating through the channels of the vascular area.—*American Naturalist.*

MACHINE DESIGNING.—II.

By Prof. JOHN E. SWEET.*

PERFECT as are the modern boring machines, both horizontal and vertical (and the reason they average so good is probably because the imitators find no poor ones to copy), there is one thing that might in many cases be found valuable, and that is a rotary spindle driven at various speeds and fixed in a head movable along the cross beam of the vertical machine. This would be complete for boring the crank-pin hole in engine cranks, and a complete plain radial drilling machine, useful in all shops where the machine only has legitimate work enough to keep it employed for a part of the time. Such a machine could hardly be called a compound, and certainly not a combined machine, although used for turning, boring, and drilling. Combined tools and machines are seldom successful. A common hammer, which may be said to have two business ends, a lathing hatchet, and Disston's nigger saw, as I believe we used to call it down South, cover nearly the whole ground in tools, and Scott Russell's idea, as expressed in his remark, after viewing a combined machine at the Paris Exposition, may be remembered to advantage. The machine referred to consisted of a central post with a drilling machine on one side and a slotting machine on the other. After staring at it with evident curiosity, the attendant, somewhat elated at the apparent interest of his distinguished visitor, asked what he thought of it, to which he replied: "I was thinking if I had that machine which part I would cut off, the drill or the slotter?" What I know about a slotting machine is fairly comparable to Burton's knowledge of the French language. He said he knew the French language by sight, and that's about the extent of my knowledge of a slotter, and possibly this is the reason I could never persuade myself into the belief that they look well or as well as it is possible to make them. The slotting machine, like others of the overhanging class—that is, drilling and punching machines, is subject to strains that they have to resist to a disadvantage, and where springing to a certain extent cannot be avoided. Might it not be set down as a principle that the framing should be devised so as to have the springing do the least possible harm? A slotting machine might be so designed that all the spring there was in the machine would have a direct tendency to throw the cut out of square with the table; whereas, if the sliding bar was worked with a walking-beam there would be no detrimental spring whatever. Evil resulting in a punching machine from springing is of another character altogether; much springing adds immensely to the power required to do the punching, and unless specially designed to avoid such a result, the springing throws the punch out of adjustment with the die, and bad work and dull tools are the result.

If the upper and lower parts of a punching machine are just equally rigid or equally elastic, and the punch and die central between the two, then the springing, however much, would not throw the tools out of register, and would do no harm except the waste of power. The loss of power in springing a machine is sometimes returned when the spring returns, but in a punching machine all power expended in springing the frame is a dead loss. The springing of machine framing, the springing of tools, and the springing, all add to the cost of doing work, not only on account of loss of power, but in the dulling of the cutters, and in this none more so than the milling machine. The tools or cutters themselves are costly, and the act of cutting, as performed by an ordinary slabbing cutter, differs from nearly all other cutting action. Each separate chip removed is a wedge-shape piece, and the cutting edge of the cutter starts in at the point of the wedge. The appearance of a milled surface, as ordinarily left on soft metal, is usually more uneven than any feed or imperfection in the cutter accounts for, and it is safe to assume that the teeth of the cutters slip over more or less and then bite and gouge in deeper than if each one took its allotted amount. Both actions tend to dull the cutters, and not only the spring of the machine and cutters tend to produce this result, but an elastic feed motion also contributes to this same result, so that a rigid feed is likely more essential in a milling machine than in any other.

Many have thought that as a remedy for the difficulties arising from the cause above described, that it would be an improvement to feed the work to the milling machine in the opposite direction—that is, so the cutting edges of the milling cutter would start in at the large end of the wedge; but whether this would be an advantage (except, perhaps, in cutting shapes) is doubtful. In the roughing out the cutting edge would be starting in on the scale, and in finishing flat work the cut is so slight that there could be but little gain.

Milling machines were for years thought to be well adapted for small work, but not for large, and this idea is likely entertained by many yet, while others believe that the reason it has not proven successful in large work was because there were no large machines, while the truth probably is that the kind of work has more to do with the question of adaptability than the size, and that certain classes of work of whatever size can best be done by rotary cutters, while other kinds will always be best done by the planing, shaping, and slotting machines.

What cutting action shall be adopted to perform a certain operation is as much a question in machine designing as any other. The most perfect of all machine work is done by an emery or corundum wheel, and the next of all I have seen is done with what is usually understood, though perhaps not properly, an end mill. Cutting tools, traversing in curved paths across a flat surface, have an advantage in never following over twice in exactly the same path, as is the case in a planer tool, which probably accounts for the absence of chatter; but, on the other hand, the cutting blade traverses over 11in. of distance to finish a 7in. cut. The planer wastes time in stopping, running back and starting, while the traversing blades are always at it.

After a half century of study over the lathe and planer, improvement still goes on, and in this view what may we not expect a quarter of a century hence of the milling and traversing cutters and emery-cutting devices?

In all our planning and all our study there is one vital principle that is hardly ever thought of and never mentioned. We all look for the best new machine, but who to see which is to be the best old one? The mathematicians tell us which is the most perfect gear, but all their calculations are based on a new one, and no thought given to the one-half or three-fourths worn out. An engine cylinder needs no counter-bore when new, but experience has shown the necessity for it when old; and short cross heads, working on long slides without overlapping at the ends, soon wear the slides concave and themselves rounding, with the result, two curved surfaces of unequal radius always growing worse. The slides I will speak of later on. The gear tooth needs an undercut at the root as much as the cylinder needs a counter-bore. The epicycloidal may be the best form for a new gear, and the single arc odontograph for an old one.

With the exception of the J. Morton Poole grinding machine, nearly every machine tool depends for the accuracy of its work upon the accuracy of sliding surfaces. In the best work special methods are adopted to make them true, after which they are left to fate to keep them so. Who has ever deliberately undertaken to plan and build a planing machine that should maintain perfect truth during its entire existence? The planing machine has a short table working on a long bed, the milling machine a long table working on a short bed—the lathe a short rest on long slides, and the shaper a long slide in a short guide.

The tool builder would laugh at the engine builder who should run a cross head on guides not cut away so the cross head would overrun at the ends; and yet he makes the sliding block on the cross feed of his lathe 6in. long working on a dovetail 2ft. long, sometimes running off at one end and never at the other. The sum of the two fitted surfaces is 30in. If divided equally—that is, a 15in. sliding on a 15in. dovetail, the two would remain true and be a good job as long as the lathe lasted. This is one of the places where for lathes of moderate size there is no excuse for anything but wearing surfaces of equal length. The designer who finds any difficulties in this that he cannot overcome has too little genius for the job. Equal length sliding surfaces can usually be employed in all the slides on milling machines, punching machines, and many others, and wherever possible the use of any other arrangement is simply poor designing, to give it the mildest criticism possible. A short sliding block on a long guide invariably gets bad sooner or later, and refitting becomes necessary.

The sliding head of a shaper invariably made longer than its guide is an ever-present nuisance, and one that can be abated. The requirements call for a slide to work at all sorts of stroke, from 1in. to a foot, and at positions varying as much as a foot. As now made, much of the back end of the sliding arm does not get a 100th part of the wear that the front end does, and often none at all. As a result, in many establishments the thing may be worked for a year at short stroke and in one place; then when the attempt is made to use it in a different position, it is so loose in one position and so tight in another as to be worse than useless. The remedy is easy. Make the two sliding surfaces of a length, and attach the connecting rod to an immovable pin, then both ends of the slide will always overrun, whether the stroke is 1in. or a foot. To provide for the varying position of cut, the plan shown in Fig. 3 is presented.

This slide is guided in the usual way and driven by a connecting rod rigidly attached to the side or bottom, as most convenient. Instead of the slides carrying a head and tool post, it is bored out, split, and provided with two binding bolts, so as to grasp the tubular arm, which, when loose, may be slid or turned in any position, and then firmly bound in that position.

The diameter of the hollow projecting arm need not be much larger than the width of the tool-holder—5 or 6in.—in an ordinary 10in. or 12in. machine. The sliding arm being provided with a featherway and surrounded by a graduated worm-gear or ring feathered to it, the bar may be rotated to any angle and adjusted endwise without disturbing or losing the angle at which it is set. A second advantage of this arrangement would be the removal of the ordidary side projections which so frequently come in the way when using the present machines.

I have not presented this so much to represent an improvement in shapers as to show how it is possible in machines of this class to use slides of equal length, maintain their proper position, and get adjustment of tool. But you will say it is not so simple. True. Neither is a watch as simple as an hour-glass, nor a Corliss engine as simple as a Hero. Good things cost more than poor. All improvements have to be paid for. Sliding surfaces, such as those of the planing machine and slide-rest of a lathe, cannot be of equal length; then the question arises, Are they made to maintain their truth as well as possible?

The table or platen of a planing machine cannot be used successfully for its entire length unless the bed upon which it runs is longer than itself—usually about one-half longer—and when so arranged and used to any considerable extent on short work, it wears the bed concave and itself convex to fit. This would occur even were both absolutely rigid, but is much aggravated by an elastic table, which may be sprung one way or another every time a new piece is secured to it. A rigid table with wearing surfaces so generous as to always float on the oil, however heavy the load, would keep true a long time, or if the wearing surfaces were cut away towards the end of the bed, as shown by this model (see Fig. 4, p. 210), the result would be practically perfect. If the slide-rest of a lathe be long enough, strong enough, has wearing surface enough of the right sort, and any man has courage enough to cut away the ways on the plan just shown, one would remain true for a time far beyond anything yet produced. And so with all slides; in fact, the principle can be applied to all wearing surfaces where from necessity a short piece must work on a long guide, or a short nut on a long screw.

Journals with end play should have bearings and box of the same length; collars, or the bosses, on wheels that resist end thrust on shafts, should rest upon or run against bosses of exactly their own diameter. The guides or slides of steam-engines are as often too long as the cross heads are too short, for one is as fatal to enduring truth as the other.

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* *The substance of a lecture delivered before the Franklin Institute.*

I have used the best-known tools to illustrate principles that are employed in all machines; the assembling or combining the sliding, the rotary, angular, and screw motions, is invention or design in proportion to the extent of originality. The construction of the framing calls for the exercise of many faculties; it must be suitable, strong enough, rigid enough (entirely a different quality), of such form that the patterns can be readily made, if to be of cast metal, so as to be easily forged, if of forging, so it can be machined; and last, but not least, so it will look right—in fact, lacking nothing but the poetry to be artistic. This looks, this artistic, this good or bad, this one thing that is past reason, this thing that we can't argue about, but feel, is that part that much more can be thought about than said; that part which we may never be able to tell what to do to be right, and at most, but few things that may be depended upon as positively wrong.

Whatever nature does she does right; whatever the designer does different from what nature would do if she had the same work in hand, cannot be right. Nature at her best roots her trees to the ground, tapers their trunks, and stretches out their far-reaching branches, but the branches all combined would not exceed the trunk in size; and the branches all grow out from the trunk on one and the same plan—never two or three growing up and then one down, as we find them in some late drilling machines, but all follow the same grand plan. If there is ever an exception to this in nature it is by distortion, a deformity, an abortion. There has not yet been so many good machines designed to call for an abortion for the sake of variety, for, in fact, there has been so many abortions that the good ones make the variety.

The causes that have been instrumental in producing such a large percentage of poor designs were these: our early draughtsmen were architectural draughtsmen; and when the aspiring mechanic required a drawing for his new machine he employed the architect, who brought with him his ornaments and forgot the principles. His posts were columns without cornice or pediment, and when his frame, which he did not understand, did not look right, he attempted to ornament it into shape. This state of affairs was made worse by another set of draughtsmen who neither understood architecture nor mechanics, and lacked genius. Machines made from such designs have been scattered throughout the country, imitated and counterfeited, with their worst features made most prominent; cuts published in all the technical journals without a comment as to their merits or demerits in design; and now, to add to this, our colleges are going on from bad to worse by placing before their students models of motions and machines, constructed as machines never are constructed, or would not work if they were, and placing the students under a professor of drawing who teaches them how to make drawings rather than how to represent a properly designed machine, or teach them to know what constitutes good and bad designing.

The columns of all the best buildings in the world are straight—that is, their axial line. When their own weight is a considerable fraction of the whole weight, they have a considerable taper; when their own weight is but a small fraction, there is only taper enough to make them appear straight. I do not believe a computation was ever made to determine that this was right, but the designers were led to it by their own instinct. When the sides of a tapering column are perfectly straight, they will appear concave. This fact, known to the architects in Baalbec days, was remedied by making the lines curved just enough so the columns looked straight. Their imitators, discovering the fact without being able to appreciate it, did as imitators usually do—magnified their discovery and multilated a design they could not appreciate.

Take the columns of the different orders and styles of architecture—Doric, Tuscan, Ionic, Corinthian, Norman, and Gothic. No man at the present day will attempt to add to or take from in the hope of betterment, and yet the axis of every one is a straight line. No one of sense will ever attempt to improve them by making them crooked, because the straight line is right; and so with all the successful single-post machine designs—they are straight. It is true that George Richards, of Manchester, gives the sides of the post a noble sweep, but the axial line of the post remains straight.

It is true the supports of a machine are subject to oblique as well as vertical strains, while the columns of a building are not; but why do we fancy that a crooked member will resist those strains better than a straight one? The reverse curve is a line of beauty—yes, in an ornament, but in a thing not, unless there is a constructive demand for such a curve. The outline of a Porter-Allen engine bed is a reverse curve. True; and it's also true there was no room for a straight one. The noblest architecture is grand because it is consistent. Our machine designs are noble in proportion to their consistency. Every feature of every noble style of architecture is conceived in the same spirit. Every feature of a Grecian building, its columns, its openings, its mouldings, itself, were in one style, and so of the Roman, the Gothic, and the Norman, and every feature of a machine design should possess the same general characteristic. The Grecian and Roman columns were round, and for the service they had to perform round was the best possible form they could be. The Gothic columns are not round usually, because for carrying the arched ribs of the vaulted ceilings, clustered columns conform to the arches, and best serve the purpose. In machinery, a square or rectangular form is best, because, usually, there are things to be added, and brackets or slides are most easily attached to a flat surface. The shape is consistent, and will never be improved upon. It is one of the things no Queen Anne fashion the overthrow. Fashion follows in machinery as well as in other things, and when it follows because it is the fashion, it is more likely to follow the bad than the good. All our older mechanics can remember when the posts of an iron planing machine were formed to fit various ogee curves—that so-called line of beauty. Does that form look well to anyone to-day? It has given way to the bold sweep of a single curve, which has come to stay, not simply because it looks better, but when rightly drawn it is right and looks right.

The true form is not a perfect parabola, however, because the case is not one parallel to the fixed beam loaded at one end. The planer post never gets its strain at the extreme end. We cannot trust to the mass of our mechanics to produce tasty designs, because the spirit of our people is not artistic.

The old form of framing and that used yet by the builders of cheap machinery is H or U section—a style supposed to be strong because the mathematicians say an H section is a strong one; but it is no stronger in any direction than the box, and infinitely weaker when subject to torsion. The patterns are costly to make and easily broken in the foundry; there are no cores to make, but lots of mending up to do. Your city is not only blessed with good designers, but with good pattern-makers and founders besides. I think if a Philadelphia designer should go elsewhere the first man he would send home for would be his old pattern-maker, and the next the boss foundryman. One who has never tried it can hardly realise how little is the difference between a graceful curve and an ugly one. The man who fails to discover this difference is the one who just fails, whether as a designer or pattern-maker.

If an Englishman were set to improve the German design he would put in more iron: if the Frenchman, he would make the form more graceful; if the native Yankee, he would paint it green and stripe it with red; and to change this spirit, the example set by Philadelphia has done more than any other one thing, and it has not been so much by substituting steel-coloured paint for green as the substitution of consistent things and forms for inconsistent ones, and doing the thing that was to be done in the simple, right way. This consistency comes, I believe, more from inherent common sense than education, and doing the thing right is more the result of good judgment than mathematical calculation.

It may not be possible to separate in our minds very completely machine designing from mechanical engineering, but in the sense I am endeavouring to devise rules for the one, I feel sure our colleges are entirely over-estimating the importance of the higher mathematics. When one has to use his judgment whether to give a factor of safety of four or ten, his judgment will tell him about how large to make the thing any way; and in another sense, where what Oberlin Smith calls the "anvil principle" becomes an element, the figures are entirely misleading. Or, take the case of the flywheel of an engine. It is impossible to begin to figure at all until you have guessed upon the first factor—that is, what per cent. of variation in speed will you accept? For absolutely uniform speed is an impossibility in an ordinary engine, and the extent of variation admissible is entirely guesswork. If you guess twice too much your wheel will be four times too small, and so you will be twice as likely to get it what you want if you guess at the wheel and leave out the figures entirely. It is true that here and there mathematics are useful. In certain cases the higher mathematics are necessary; but usually arithmetic covers the ground, or a few marks on the drawing board and the slide rule is a much quicker way. When a class of forty students spend a good part of four years in learning the higher mathematics, with the certainty that at least thirty-eight of them will never have any use for them, and that the other two will forget a large part before the time for them to put them to use arrives, is it not worth questioning the real value of so much application? "Discipline the mind" may be all very well when the mind is the thing that is to do the work, but where something is to be made the mind should never, in the sketch, the drawing, or in the mathematics, lose sight of the *thing*, to worship the methods.

For the designing of buildings, the designers, architects, receive special training; for the designing of machines, with some stingy exceptions at our colleges, no training is had, and every man does it himself.

If anyone is to build a house he employs an architect to make a plan; if we are to build a machine, none of us think of employing a machine designer. I have known one exception to this. A manufacturer bought a patented invention, with nothing to show what the machine was to be but a wood model—crude in every element. He employed a man to get up some drawings of it, and with the instructions to "put it in shape." For the drawings and the putting it in shape he paid 25 dollars, and the result has been quite a fair fortune. If manufacturers would employ designers when they have machines to design as they would architects—I mean real designers, not simply draughtsmen—I believe they would find it an equally profitable investment. This would in many cases cost considerable, because competent designers are scarce, and the reason they are scarce is because, aside from the special gift, the necessary requirements are so varied.

Besides being every inch a mechanic, saturated with the courage to do things new and right, one needs the genius of an inventor, the training of an engineer, a knowledge of architecture, the experience of a manufacturer, the skill of a master mechanic, the handicraft of many tradesmen, and the spirit of an artist.

USEFUL AND SCIENTIFIC NOTES.

Victoria.—The digest of the latest statistics of the Colony of Victoria by the Government Statist contains some interesting figures in regard to the Australasian Colonies generally. Mr. Hayter says that if the Australian continent were divided into 100 parts, Victoria would embrace three such parts, New South Wales 10, Queensland 23, South Australia 30, and Western Australia 34. The area of Australia, New Zealand, and Tasmania is 3,075,030 square miles, being 680,972 square miles less than that of all Europe, but 47,439 square miles more than that of the United States. The Australasian Colonies occupy three-eighths of the whole British dominions in area, but only an 80th of the whole population; but the area of Canada is slightly larger than that of Australasia. The population of the latter in 1886 was 3,427,877, and Mr. Hayter calculates that if the population goes on increasing as it has done in the last decade, the population in round numbers in the successive decades will be 1891, 3; 1901, 5; 1911, 8; 1921, 11; 1931, 16; 1941, 23; 1951, 32; 1961, 46; 1971, 66; 1981, 93 millions, while in 2001 at the same rate it would be 189,269,663. The aggregate revenue of Australasia in 1885 was 23¾ millions, with an expenditure of 25¼ millions sterling. In twelve years the revenue has increased from 12¼ to 23¾ millions, or 94 per cent., while the population in the same period increased 54 per cent. The total debt is about 70¼ millions, or £3 3s. 9d. per head of the population. Of this total 6½ millions have been spent in railways. The value of the gold obtained in the different Colonies between 1851 and 1886 was about 324 millions sterling, of which the share of Victoria was 217 millions. The total assets of the Australasian banks amounted in 1887 to £135,134,300, and the liabilities to £98,115,160. The average amount left by each person dying in Victoria (which is taken as the average amount possessed by each person living) in the years 1872-76 was £185; in 1878-81, £223; in 1882-86, £305. At this rate the national wealth of the Colony of Victoria alone in 1886 would be £285,527,885.

A New Source for Citric Acid.—A Russian chemist, Gn. P. Kossovich, has recently proposed to use the cranberry, or Oxycoccus palustris, as a source of citric acid. The amount of the acid contained in the cranberry appear from his investigations to be about 2½ per cent. of the total weight, so that a large quantity of the plant must be utilised for a very small yield of the acid. However, the cranberry grows wild in vast quantities in some parts of Russia, so that it is quite possible that the proposed plan may be commercially practicable. In addition to the medicinal uses of citric acid, it is largely employed by dyers, for whose purposes it is suggested that the juice of the cranberries might be utilised in its fresh condition, instead of the concentrated lemon juice, which now has to be obtained from Italy.

TRAINS are now run on the Brooklyn Bridge, with the headway between them shortened from 90 to 80 seconds, so as to increase the present capacity of 12,000 passengers, or 120 cars per hour, to 16,000 passengers per hour.

SCIENTIFIC SOCIETIES.

MANCHESTER MICROSCOPICAL SOCIETY.

AT the last meeting of the systematic demonstration class in connection with the mounting section of this society, under the direction of the chairman, Mr. E. P. Quinn, the examination of blood corpuscles was continued, the blood of the bird first claiming attention, the corpuscles being oval, nucleated discs, much smaller than those of the frog or newt. Upon the same slide a drop of frog's blood was placed for purposes of comparison, and as these corpuscles measure in their greater length about 1-1,000th of an inch, they were found exceeding useful in determining the size of the other corpuscles. The presence of the nuclei was demonstrated both by treatment with acetic acid and magenta. The white corpuscles presented no features of special importance beyond those already observed in the blood of the newt.

The examination of human blood was next undertaken, no little amusement being caused amongst the members taking part in it when directions were given for each to prick his finger with a sharp needle for purposes of supply. This, however, can be done without any appeciable pain by tightly wrapping a piece of string round the end of the finger. Both the red and white corpuscles were examined, the red ones being circular bi-concave discs, a little less than one-third the diameter of the blood of the frog—that is about 1-3200th of an inch—the thickness, when seen on edge, not being more than one quarter of this. A marked difference between this blood and the bloods previously examined was the tendency of the red corpuscles to run together into rouleaux like rolls of coin. Between these a few white corpuscles were visible, of irregular outline, and about 1-2500th of an inch in diameter. The absence of nuclei in the red corpuscles, and their presence in white corpuscles, was demonstrated by treating with magenta and with acetic acid. The action of water in causing those corpuscles to swell, and of syrup in causing them to shrink, was very marked, the explanation of this being that a lighter liquid diffuses more rapidly into a heavier one than a heavier into a lighter. This action is known as osmosis. The action of a solution of common salt caused the corpuscles to assume a peculiar crenated or spinose appearance, a form often assumed by red corpuscles after leaving the body in certain conditions of the blood, when they may be mistaken for white ones. A drop of human blood placed upon the slide for some little time and then examined, showed radiating structure of fibres which really forms from the blood plasma, and is known as fibrin. This network held the corpuscles in its meshes, and thus the cause of the formation of a blood clot was to some extent observed. Another drop, to which a little common salt had been added, remained liquid, and no such network of fibrin was formed, explaining the use of certain salts in preventing the coagulation or clotting of the blood, which, under normal conditions, always takes place when it leaves a healthy blood-vessel.

At a special meeting of the section the chairman, Mr. E. P. Quinn, gave a *résumé* of the work done in the systematic demonstration course up to the present. He demonstrated the difference between protoplasm and cellulose by means of combustion experiments, showing that protoplasm contains approximately 53 per cent. of carbon, 21 per cent. of oxygen, 7 per cent. of hydrogen, and 16 per cent. of nitrogen, and usually sulphur and phosphorus, while cellulose consists of 6 atoms of carbon combined with 10 of hydrogen and 5 of oxygen, there being an utter absence of nitrogen. Attention was drawn to the fact that in the chemistry of animals and plants the mere chemical composition may not sufficiently indicate the nature of the compound, as substances of very diverse appearance and properties may have an identical composition. This was illustrated by experiments with cellulose prepared from bran, starch, and dextrine, which all agree in chemical composition. Cellulose is scarcely affected by boiling water or by iodine; starch forms a thick paste when treated with boiling water, and becomes a deep blue when treated with iodine, and dextrine is soluble, and with iodine is stained a brownish red. The value of stains in distinguishing the different chemical substances was shown by projecting upon the screen, with a lantern, tubes containing white of egg as typical of protoplasm, starch as starch paste, and solution of dextrose, to each of which iodine was added with an immediate change of colour: the first brown, the second blue, the third a brownish red. The same was shown by soaking pieces of white calico and white flannel in a solution of picric acid. The first, which is made up almost entirely of cellulose, was scarcely affected by the stain, whilst the second was stained a deep brown. The methods of distinguishing protoplasm by the use of chemical reagents, without the trouble of making exact chemical analyses, were illustrated;—the most striking experiments being the heating of white of egg as typical of a nitrogenous substance with a solution of caustic soda and one or two drops of copper sulphate, a beautiful violet colouration being produced, whilst a solution of grape sugar typical of a non-nitrogenous substance when similarly treated gave a red precipitate. Slides specially prepared for the purpose were then projected upon the screen showing the various cells that had been examined and the results as already reported in the "E. M."

In speaking of chlorophyll corpuscles, it was pointed out that the chlorophyll is simply the colouring matter, and not the corpuscle, and that this green colouring matter can be dissolved out by alcohol, leaving the corpuscle intact. A glass trough containing such an alcoholic solution of chlorophyll was projected upon the screen and its spectrum illustrated, which differs according to the concentration of the solution, the dark absorption bands varying from 2 to 7, and so typical that by the spectrum chlorophyll can be distinguished from any other form of green colouring matter.

Speaking of the contents of the red blood corpuscles, they were described as consisting of 90 per cent. of the peculiar form of protoplasm known as hæmoglobin diffused through the rest of the corpuscle, the stroma. It was shown that this hæmoglobin could be extracted from blood corpuscles, and even crystallised, a preparation of such crystals being projected upon the screen by the oxy-hydrogen microscope. It was also shown that these hæmoglobin crystals could be dissolved in water and in blood serum, so that it may be inferred that the non-solution of the hæmoglobin of the corpuscles in the blood itself must be prevented by some peculiar property of the stroma through which it is diffused. The rapidity with which a solution of hæmoglobin could absorb oxygen and lose it again was exhibited by projecting upon the screen the spectrum of a hæmoglobin solution that had been shaken up with air, when two dark absorption bands were visible in the green separated by a bright green line. Upon the addition of a drop of a reducing agent the character of the spectrum was immediately changed—the two absorption bands became merged into one broad one; but upon shaking up the solution again with air, the former spectrum and bands immediately reappeared. This experiment tended to show that the taking up of the oxygen was the result of chemical combination, and not of mere absorption—or, in other words, that in scarlet arterial blood the hæmoglobin exists in the form of oxy-hæmoglobin, and in the dark-brown venous blood it is the presence of reduced hæmoglobin that gives the characteristic colour.

At the next meeting of the section the study of the vegetable cell will be resumed, with especial reference to its chemistry.

Technical Education Bill.—The Bill to provide for technical education in England and Wales, prepared and brought in by Sir H. Roscoe, Sir U. Kay-Shuttleworth, Sir B. Samuelson, Mr. G. Dixon, and Mr. A. Acland, has been printed. It provides (1) that any School Board may make provision for giving technical education in any school under their management, and either by day or evening classes, or both, as may seem fit, having regard to the daily occupations of the persons to be benefited thereby; (2) that if no such provision is made, or if it is insufficient, and if the local authority by special resolution determine that provision or further provision ought to be made, they may themselves make such provision. The Bill also provides for the rendering of aid by School Boards or local authorities to voluntary schools in which technical instruction may be given; and two sections define the conditions under which Parliamentary grants shall be made for the encouragement of such instruction both in voluntary schools and in Board schools. It is proposed that any School Board or local authority, should they think fit, may institute an entrance examination in reading, writing, and arithmetic for persons desirous of attending technical schools or classes under their management, or to which they contribute.

Arrow Poison.—At a recent meeting of the Academy of Sciences, M. Chevreul, the venerable Academician, communicated, in the name of M. Arnaud, Curator at the Museum of Natural History, a very interesting note on the toxic substance which the Somalis employ to poison their arrows. This substance is the "Ouabaio" wood, and from this wood M. Arnaud has extracted a crystalline matter, a glucoside endowed with terribly venomous properties. In subcutaneous and in extravenous injections two milligrammes suffice to kill a dog weighing twelve kilogrammes. Death rapidly occurs by an arrest of the heart's action.

AT the Institution of Civil Engineers, Mr Tomlinson stated that the lighting of the Metropolitan Railway carriages with gas on the Pintsch system paid for itself in three years.

SCIENTIFIC NEWS.

BY the death of Sir Charles Tilston Bright, applied science loses one more of its most distinguished students. Born in 1832, the youngest son of Mr. Brailsford Bright, he was educated at Merchant Taylors' School, and while there devoted much of his leisure to the study of electricity and chemistry. At the early age of fifteen we find him engaged in the service of the Electric Telegraph Company, and much of his success in after life was no doubt due to his early experiences in the practical work of telegraphy in various parts of the United Kingdom. He was the engineer of the first cable between England and Ireland, and in 1858 he successfully laid the first Atlantic cable, which gained him the honour of knighthood. Since then Sir Charles Bright had been engaged in completing the communication between the telegraphs of India and Europe, in the laying of cables in various parts of North and South America, and the West Indies. His numerous inventions in connection with the practical work of telegraphy—most of them made in collaboration with his brother Edward—are well known to electricians.

Prof. Leone Levi died on Monday night. He was born at Ancona, Italy, in 1821, but settling at Liverpool, he became a naturalised British subject. Engaged in commercial pursuits he became Secretary of the Liverpool Chamber of Commerce, and devoted himself to the study of commercial law. So long ago as 1852 he was appointed professor of the practice and principles of commerce at King's College, London, and he subsequently became well known as an able statistician.

Samuel Poliakoff, the Russian railway king, whose death has been recently announced, was in many respects a remarkable man, for although born of poor Jewish parents in Lithuania, he died proprietor of five great railway lines, which together formed about a quarter of the railway system of Russia. He founded the first school of railway engineering and the Russian school of mines, the Alexander II. residential college for students at the University of St. Petersburg, a great hospital at Moscow, schools of handicraft for women, and many other institutions.

Dr. Gerhard vom Rath, geheim Bergrath, and hon. professor in the University of Bonn, died suddenly while passing through Coblenz on a scientific expedition. He was the most distinguished mineralogist in Germany, and being very wealthy was also well known as a philanthropist. Prof. vom Rath was in his 58th year.

Dr. J. Palisa, of Vienna, discovered another small planet (No. 276) on the 17th ult., making the number discovered by him no fewer than sixty-four.

Another instance of the generous manner in which citizens of the United States promote science without appealing to the national funds has to be recorded. Prof. W. R. Brooks, formerly of the Red House Observatory, which he founded at Phelps, New York State, is now located at Geneva, N.Y., where, thanks to the liberality of Mr. William Smith of that town, he will be able to pursue his astronomical work under much more favourable conditions. The Smith Observatory is of the first class and is equipped with instruments of the highest quality, and its director, Mr. Brooks, is also provided with what he describes as a "fine residence." He promises to give a full description of the observatory shortly.

The public lecturers for the Bath meeting of the British Association have been appointed. On Friday, Sept. 7, Prof. W. E. Ayrton will lecture on the "Electrical Transmission of Power"; on Monday, Sept. 10, Prof. T. G. Bonney will lecture on the "Foundation Stones of the Earth's Crust"; and the lecture to the operative classes, on Saturday, Sept. 8, will be by Sir John Lubbock, who has chosen as his subject, "The Habits of Ants." Prof. Flower has been nominated as president of the meeting to be held at Newcastle next year.

The lecture at the Royal Institution for this evening will be delivered by Mr. Chandler Roberts-Austen, Mr. W. H. Barlow, who was to have discoursed on the Building of the New Tay Bridge, being too ill to undertake the task.

At a recent meeting of the Anthropological Institute, Mr. Francis Galton, the president, communicated a note in which he stated that during the Health Exhibition at South Kensington over 9,000 persons were measured in his laboratory; and a comparison of these measurements with those of Cambridge University men gives a result strongly in favour of the latter, as the following table shows:—

	Height.	Weight	Breathing Capacity.	Pull.	Squeeze.
Cambridge	68·9	153·6	254	83	87·5
S. Kensington..	67·9	143·0	219	74	85·0

These figures point to the high physical condition of the upper educated classes; and a comparison with those derived from the statistics collected by the anthropometric committee of the British Association show that the average Cambridge student is distinctly above, and the average visitor to the exhibition about as much below, the mean of the general population in these particulars. The comparative brain capacity was calculated by multiplying together the maximum length, maximum breadth, and height above a plane passing through the *meatus auditorius* and immediately beneath the superciliary ridge. The men were divided into three classes: (A) first-class honour men; (B) all other honour men; (C) "poll" men and failures. It was shown that the heads in class A were distinctly larger than those in class B; and that, while both gradually increased in size from the age of nineteen to twenty-five, the superiority was steadily maintained. In the case of class C, which started with a smaller head than either A or B, the size increased with much greater rapidity than in either of the other classes up to the age of twenty-two and a half, when the curve was found to cross that of class B; and at the age of twenty-five the size of the head of the average "poll" man, although considerably less than that of the "first-class" man, was slightly larger than that of the ordinary honour man.

The Italian Electrical Society offers a prize of 600 francs for the best work on electro-magnets, with especial reference to their application to dynamos.

The late Emperor of Germany shortly before his death conferred a pension of 1,000 marks (£50) per annum on the widow of Philip Reis, one of the inventors of the telephone.

The following paragraph is "going the rounds," and is another instance of the need for real technical education:—"For use in bed rooms and libraries colza oil is the best, because, as it contains oxygen, it impoverishes the air less, and its waste products are also less destructive than those of gas, but it is about three times as costly." From experiments made years ago it was shown that with equal flames that of colza oil was extinguished by contamination of the air in 71 minutes, wax candles in 79 minutes, and cannel gas in 152 minutes. Colza oil, as an illuminant, is almost as bad as tallow candles from the point of view of vitiation of the atmosphere.

The current number of the *Journal* of the Royal Agricultural Society contains several papers of general interest. Mr. W. Proctor Baker contributes a useful article on "Modern Improvements in Corn-milling Machinery," in concluding which he says that "until some fresh development takes place, the demand from millers will be for dry, firm wheat with a clear, sharp fracture, and damp, soft wheats will be a drug in the market. It is, however, certain that finality in the art or practice of milling has not yet been attained, and that mechanical science will sooner or later provide a simplification of the somewhat complicated processes now in use, as well as means whereby wheats in the condition of average English crops may be reduced to flour without the drawbacks that now stand in their way and reduce their prices as compared with their foreign competitors." Perhaps it may come in the direction of a more general use of wheat-meal in preference to flour.

According to the *Times* Vienna correspondent, "an interesting surgical operation was recently performed at Vienna by Dr. Gersuny, assistant to Prof. Billroth. Dr. Fleischl, professor of physiology at the University, who for a long time past has been suffering from intense nervous pains, the result of poisoning, was completely cured by attaching the corresponding nerve of a rabbit to the diseased nerve. The case is creating considerable interest in medical circles here." It would create a great deal more if the "correspondent" would be explicit, and explain definitely what was really done.

"A few days ago," says the *Times*, "the 50th anniversary occurred of what must be regarded as one of the decisive events in the world's history. On April 21, 1838, the two steamships *Sirius* and *Great Western* arrived in New York Harbour from England, being the first steamers that crossed the Atlantic. The *Sirius* sailed from Queenstown on April 4, the *Great Western* from Bristol on April 8. Both arrived at New York on the same day, the latter vessel being behind the other by only a few hours." In Mr. I. Brunel's life of his father, I. K. Brunel, the great engineer, it is distinctly stated that the *Sirius* left Cork eight hours before the *Great Western* left Bristol, and both arrived at New York on April 23. Mr. Brunel is not likely to have made a mistake, because he goes on to argue that the *Great Western's* was the better performance, because Bristol then was a whole day's run further from New York, and the *Great Western* arrived in the afternoon of the same day as the *Sirius* arrived in the morning, and had "nearly 200 tons of coal left"—an important point in those times. The subject is worth a note, if only to show how "history" is written.

It is said that Volapük is making progress, but several competitive "languages" have been started in Germany, and two works on cognate matters are about to be published in this country, "World Speech," by Alexander Melville Bell, advocates English spelt as pronounced as by far the best medium for international communication, and as superior to any artificial language. "Lingua," by G. J. Henderson, while holding that the formation of an international association is absolutely necessary for the making and controlling of any really efficient medium, suggests as the most expedient basis a language the vocabulary of which is almost entirely classical Latin, while its grammar is modern—mainly English simplified.

More gold in Wales. Quartz has been discovered near Festiniog, samples of which yielded at the rate of five ounces of gold to the ton—at least, so it is said.

Another German Expedition to Kilimanjaro and Eastern Africa is being planned. Dr. Meyer, who achieved the highest point of Kilimanjaro yet recorded, and Dr. Baumann, who accompanied Dr. Lenz on the Congo, intend to thoroughly explore the country round the Meru region, where Dr. Baumann hopes to make a complete topographical survey.

Attar of Roses.—According to a paper in the *Board of Trade Journal* for April, the production of attar of roses constitutes one of the most important branches of native industry in Bulgaria. The valley of Kezanlyk, known as the Vale of Roses, is the centre of this production, which extends as far as Carlovo, and the villages which lie sheltered from the north wind by the vast chain of the Great Balkans. In 1885, and no later statistics have been published, the manufacture of attar of roses in the district indicated amounted to a value of 1,100,000 francs. The prosperous condition of the valley of Kezanlyk has led other districts of Bulgaria to develop the same industry, and particularly the inhabitants of Strema, and of Toundja, at the foot of Mount Rhodope. It is not yet certain that the attar from these new countries will equal in quality the famous product of Kezanlyk. The Government, however, is anxious to encourage this movement, and the Department of the Interior has lately authorised the purchase of a certain quantity of attar prepared at Strema and at Toundja. Specimens of each are to be sent for examination at the laboratory of the University of Moscow, and the result is to be published.

THE Bartholdi statue of Liberty at New York is lighted by twenty arc lamps, seven of which go to form the torch held in the hand of the statue. The eight lamps remaining are placed in the corners of the terrace, and illumine the base of the statue. A number of Bernstein incandescent lamps working with a potential difference of six volts are also employed.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

*** *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."—*Montaigne's Essays*

THE STARS IN THE TRAPEZIUM OF ORION.

[28716.]—I DID not, of course, accuse your able correspondent, "F.R.A.S.," of making any mistake as to the stars in the Trapezium of Orion. His statement that Huggins and Salter were agreed as to the position of six faint stars in and close to the Trapezium was understood as meaning six stars in addition to the well-known four. He did not state that the newly-discovered star was identical with any of these. As to Mr. Sadler, he referred to a letter of his which appeared in your columns so far back as the year 1882. This letter I did not see; but his statement that the star had been discovered with a small telescope half a century ago, and was numbered 6 on his diagram, led many of your readers, I fancy, to conclude that it was one of the known six—which the mention of that number by "F.R.A.S." was rather calculated to confirm. I have, moreover, seen the same assertion made broadly elsewhere. Mr. Sadler is no doubt right as to the discovery of this star by De Vico and Dumonchel; but the general belief is that all these faint stars were unknown before their supposed discovery by Huggins.

But what is more material is that their existence has, I believe, always been matter of controversy. "I have very little faith," wrote Mr. Burnham, "in the real existence of these suspected stars after the failure of this and other large refractors to show them." I am not aware that he ever saw them afterwards. Prof. Asaph Hall also searched for the stars in question carefully, but without success. On the other hand, Mr. Salter saw five of Huggins's six stars, and even suspected that he saw the sixth; but it is not surprising that American observers were disposed to place more reliance on Hall and Burnham. And if the great Lick telescope only shows one out of the four stars whose existence is in dispute, the result is not favourable to the English observers. The Lick star undoubtedly is pretty close to the position of one of Salter's stars (I have not Huggins's diagram at hand); but, considering the small dimensions of the Trapezium, this is not very surprising. On the whole, I think the question of a real discovery must be regarded as still in doubt.

W. H. S. Monck.

SATURN.

[28717.]—JE me suis bien mal exprimé dans ma lettre 28635, ou M. E. Holmes m'a bien mal compris, puis qu'il avance dans sa lettre 28698 que j'ai trouvé le contour de l'ombre de Saturne rectiligne (straight); il serait peut-être plus étonnant de trouver toujours ce contour absolument *droit* que de lui découvrir toutes sortes d'irrégularités. En réalité j'ai dit que "l'ombre semblait d'une forme assez régulière que son contour ne présentait d'apparence de concavité qu'en raison de l'existence d'une petite pointe, très courte, sur la division Cassinienne."

J'aurais dû dire que par *forme assez régulière* j'éntendais la forme régulière de l'ombre d'un globe, c'est à dire un contour convexe en général, mais se relevant un peu sur la division Cassinienne de manière à y projeter une saillie fort petite; cette ombre était d'ailleurs sensiblement plus large du côté du bord extérieur de l'anneau que du côté du bord intérieur.

Par cette description je n'ai nullement voula faire entendre que je considérais comme inexactes les descriptions que j'ai données antérieurement de cette ombre; le phénomène en question doit varier, en effet, suivant les époques.

Mes dernières lettres dans "l'E. M." prouvent assez que je suis de l'avis de M. Holmes quant à la circonspection avec laquelle il faut envisager certains détails de cette planète lointaine, mais je ne puis m'empêcher de protester, au nom de tous les *bons observateurs* contre l'explication qu'il donne en général de certaines apparences figurées dans les dessins: d'après lui nous avons observé un objet hors du centre du champ d'un mauvais oculaire qui défigure l'image, à l'aide d'un grossissement trop faible avec le désir anxieux de voir, non pas la vérité, mais *quelque chose ;* nous n'avons pas tenu compte des moments de mauvaise définition de l'image, nous avons une anomalie quelconque dans l'organe visuel, si, après un temps trop long, nos observations ont été confirmées par d'autres observateurs le fait est comparable à l'observation d'étoiles imaginaires et conforme à une loi de la nature humaine en vertu de laquelle on finit toujours par voir ce que l'on désire découvrir, ce que l'on se figure devoir exister. Si M. Holmes avait ajouté que les *mauvais observateurs* procédent ainsi, je dirais que je suis de son avis, mais il s'exprime d'une façon trop générale, et je crois inutile, de réfuter ces suppositions tout-à-fait imaginaires dans le cas qui nous occupe.

M. Holmes ne peut contester que la connaissance *prealable* d'un fait par un observateur consciencieux est parfois indispensable a celui-ci pour confirmer une observation antérieure difficile. Prenons un exemple d'une grande actualité en ce moment ; la plus sérieuse confirmation jusqu'ici des merveilleuses observations de M. Schiaparelli sur la planète Mars est venue de Nice et si M. Perrotin est parvenu à distinguer quelques canaux et leur gémination, à la dernière opposition, à l'aide de son équatorial de 15 pouces, c'est après les avoir longtemps *cherchés* sans le moindre succès ; sans aucun doute, si M. Perrotin n'avait pas été prévenu et n'avait pas eu la persévérance, je dirai même l'obstination nécessaires, tout cela lui aurait échappé comme à presque tous les astronomes jusqu'ici. Et je puis étayer mon opinion de mon expérience personnelle depuis que j'observe Mars toutes les fois que le temps le permet, pendant l'opposition actuelle, avec mon réfracteur de Grubb. Après avoir eu bien des insuccès, j'eu suis arrivé à voir chaque jour davantage et, actuellement, le peu de faits que le temps si mauvais m'a permis d'observer me suffit pour proclamer, d'une façon plus directe que je ne l'ai fait jusqu'ici, l'exactitude absolue des cartes publiées par le savant et habile astronome de Milan. D'autre part la difficulté extreme de ces observations explique parfaitement les insuccès de nombreux astronomes, et restera le grand titre de gloire de celui qui, le *premier*, s'est arrêté à des détails aussi délicats. Parmi les résultats bien incomplets que j'ai obtenus, par un temps toujours défavorable, *l'image n'ayant pas encore été parfaite une seule fois*, je citerai la visibilité dans mon huit pouces, avec son grossissement de 280 fois, des canaux Phison, Orontes, et Astusapes, et, pour mentionner des objets relativement faciles, je citerai le Nepenthes, la Nilosyrtis, la Boreosyrtis, Protonilus, Deuteronilus, Tanaïs, Ismenius lacus, Tithonius lacus, &c. Je n'hésite pas à dire que si l'existence du Phison, de l'Orontes, et l'Astusapes ne m'était pas connue, si je ne les recherchais pas avec obstination, ils m'échapperaient probablement, mais mon habitude des observations est assez grande pour que je puisse affirmer leur réalité incontestable.

Louvain, mai 4. **Dr. F. Terby.**

R. CORONÆ—EARTH'S MOTION.

[28718.]—WITH reference to letter 28694, containing the observations of Mr. Gemmill on R. Coronæ, I beg to forward some notes on the same star, which will supplement the first list. They were made with a small binocular magnifying five times. I take π as 6·0m., so as to make the observations comparable, and where the dates approximate, it will be seen that there is a very good agreement with Mr. Gemmill's list.

1886.	May	2	6·3	about = H.P. 2,602.
	„	4	6·0	just visible to naked eye.
	June	1	6·0	$= \pi$.
	„	29	6·3	decidedly fainter than π.
	Sep.	26	6·5	$\frac{1}{2}$mag. $< \pi$.
1887.	Mar.	24	7	about
	June	15	7·5	faint, say 7·5.
	July	19	7·5	estimated.
	„	28	7·5	
	Aug.	8	7·6	
	„	14	7·6	
	„	22	7·6	
	„	24	7·6	
	„	31		barely visible in bright moonlight.
	Sept.	6	7·8	clear.
	„	7	7·5	perhaps.
	„	18	7·5	
	Oct.	9	7·3	estimated.
	„	13	7·5	faint, in clear sky.
1888.	Mar.	5	7·0	about
		30	7·0	„
	April	4	7·0	„
		6	6·7	getting brighter
		9	6·8	estimated
		15	6·3	est. ruddy.
	May	1	6·3	3 steps $< \pi$
		4	6·3	„

Referring to the second paragraph of letter 28691, *in which the fact of the earth's rotating* motion is noted as visible to the spectator, I find I once observed the same thing. Why it was I do not know. I had ascended a hill near Pretoria in the Transvaal, and, with a perfectly clear horizon and a cloudless sky, was watching the sun set. I recorded at the time that the rapid apparent motion of the sun seemed to impress me strongly with a plain proof of the earth's rotation on its axis.

E. E. M.

THE SOUTHERN HEAVENS AND EARTHLY GRADIENTS.

[28719.]—MR. HAMPDEN (letter 28668, p. 190) is somewhat mistaken. I had no intention of arguing with him—we all know that is useless. I simply ask him to show us how his theory can be made to fit the absolutely known facts of the earth and the heavens. He says, "We (meaning himself) do not make maps to order: we plan them according to *facts*, not theory." All right; let us have that map which will accord with the facts. Here are the facts I invite him to agree with. He says the lines of longitude must diverge from the central north to the southern circumference. Of course; but, unfortunately, they do not do so south of the Equator: instead of diverging, they draw together again going south exactly as they do going north. He very properly says: "It is most unfair to force anyone into a debate on subjects which he candidly admits he is perfectly ignorant of." Quite so; but what if he himself insists upon explaining them, and ignores what those who do know about them tell him are the facts? I tell him facts which everyone who has stood on the Equator knows to be the natural facts, and he, who has not seen them, says "the assertion is not worthy of an honest disputant." He tells me he is sure that I "will not venture to assert that any practical measurement of the meridians of longitude south of the Equator has ever been made." Why, such a measurement is made by every ship which travels on the sea south of the line. Every navigator knows that sailing east and west 1,000 miles makes exactly the same difference of time at the same latitude north and south, and this is the point at issue — not the arc of the meridian. Mr. Hampden will find it very hard to convince a sailor that the distance between two points corresponding in longitude — say to London and New York—is several times as great in miles, if taken between the Capes of Good Hope and Cape Horn. I have passed those capes several times, and know what I am talking about, and the southern heavens have been as familiar to me as the northern; so the difference between Mr. Hampden and myself is that I know the facts to be accounted for, and he refuses to accept any facts which do not suit him, and then coolly says he "disowns all theories; ignores all laws"—the last certainly including the laws of evidence. As to the first, one would think that starting with "on a circular plane, such as the earth is, the lines of longitude must diverge," is a curious way of disowning all theories. I can assure him I am not at all "startled at the discovery that our facts and his theories have no shadow of agreement." He coins his facts, and therefore, there is no more likelihood of agreement than there would be between a teller of the Bank of England and a forger of false notes.

In letter 28707, p. 216, Mr. Hampden reverts to his old fallacies about the curvature of the earth. As a matter of fact, which any surveyor will tell him, every act of levelling for railway lines takes into account and proves the curvature; but what Mr. H. ignores is that this curvature is so slight that no plan can show it. Just consider his special example of a railway 160 miles long, with a decline between the ends of, say, 6,400ft.—that is, a difference of about 1 in 150, which is a curve only barely visible on any reasonable scale of plan, if very carefully drawn, and the corresponding straight line drawn in careful contrast. But he can see that curvature for himself whenever he pleases. Of course, what he often talks about, but never tries—a few miles of perfectly level and non-running water with three or four stakes—would show it at once. But let him go out with a good level and two or three friends provided with stakes or marked rods, to any fairly level plain, and having fixed a stake, level from its top to others distant—say a mile each way; then let him go to each of these, and he will find that when he levels for all three, the most distant will have to be raised—it will not be a case of a fall beginning somewhere, as he so often says. From both ends the level will show the further stake to be lower than the middle one. If he used a number he would see their tops forming a regular curve. It could be very easily shown by a series of electric lamps carefully arranged at night.

Returning to the heavens, he says, "Neither 'Sigma' nor anyone else has referred to any proof at all bearing on the subject." Well, he tells us that the North Pole is a centre from which the lines of longitude radiate to a bounding circle which is the southern ice limit. Now circles enlarge as they progress from a centre: we see the circles of latitude on the earth so increase, because the miles corresponding to one hour of time do so increase. We see the circles of the stars in the heavens so increase—anyone can see that any evening. I say, as anyone else who knows the facts, that after we pass the Equator they both no longer increase, but decrease, going further south, as they do in returning north; that north and south the conditions are identical, and therefore all cannot be circles drawn from one centre—the North Pole—but from two centres, the North and South Poles. Mr. Hampden denies the fact, because he has not seen it. Well, I invite him to see it himself the first fine, starlight night. Looking south, he will see the circles of the stars (of course he must watch them for several hours), traverse the heavens larger and larger till he looks at those on the Equinoctial or Equatorial line; from that line he will see them get smaller and smaller, here in England, just as he would on the Equator. The only difference is that on the Equator all the circles would be vertical, and the two poles or centres on the horizon; while here, the single visible centre, the North Pole being raised to a degree corresponding to the latitude, the circles are all inclined, and we can see the complete circle formed by the more northerly stars, just as in the south we see the complete circles formed by the more southerly ones.

Sigma.

FLAT EARTH v. ROUND EARTH.

[28720.]—YOUR note to Mr. Hampden's letter (28668, p. 190) was not discourteous, although that gentleman (28707, p. 216) naturally cannot be expected to agree with your remarks. Plain-speaking is sometimes necessary. Mr. Hampden is hopeless, as all paradoxers are. I have had some experience in discussing with more than one—the late James Smith, the circle-squarer (who maintained that π was exactly $3\frac{1}{8}$), among them, and I have found a quality possessed alike by them all—an inability to sustain discussion without introducing, some time or other, a *petitio principii*—a quiet assumption of the truth of the very principle under examination. Therefore, for this reason, discussion with paradoxers is always hopeless, for no progress is made, and time and patience get at last used up in vain.

Mr. Hampden's letters recently show many instances of this mental peculiarity. In letter 28661, p. 188, he says there cannot be any obliquity of the sun's rays if the sun is millions of miles off, and asks anyone to imagine a triangle with two of the sides millions of miles long, whilst the third side is only three or four thousand miles long. Now, this is assuming that the earth is flat—the very point in dispute. Of course, *if* the earth were flat, and we were to connect at midsummer these three points—the sun, the spot in the Tropic of Cancer where it is noon, and that spot in the Arctic circle where it is likewise noon—we should obtain a right-angled triangle, the obliquity of whose hypotenuse would be extremely small. But Mr. Hampden does not seem to appreciate the fact that if the earth is *not* flat, the obliquity of the line connecting sun and point in Arctic circle may be very great.

One other illustration. In letter 28707, p. 216, Mr. Hampden gets on the subjects of gradients—a point which evidently is a chronic bugbear to him. In the first place, he appears to confuse a level surface with a flat surface.

When we say that water finds its own level, we do *not* mean that water spreads out into a geometrical plane; but that it conforms to the general outline of the earth's surface, *whatever that may be*. *If* the earth is flat, then level and flat are identical; but if the earth is (say) spherical, then level does *not* mean flat, but curved according to the earth's curvature.

The question of engineering is very simple, although Mr. Hampden thinks it a crucial point. How are levels obtained? By a "spirit-level." Now spirit "finds its own level," in the same way as water does; and *if* the earth is spherical, the spirit level simply enables us to obtain a level which has the curvature of the earth. To argue, as Mr. Hampden does, that because an engineer obtains a level, therefore it must be flat (i.e., a geometrical plane), is to assume that the earth is flat—the very thing in dispute.

To say that the "curvature must begin somewhere" seems puerile, if it is not a joke. Will Mr. Hampden say where the curvature of an orange "begins"?

Again, much is made by Mr. Hampden of the curvature in long distances; and he asks how is it such great depressions cannot be observed. For instance, he says that the decline in 160 miles is 6,400ft. Well, suppose it is, what of that? We don't fall over a precipice of 6,400ft. The 6,400ft. is not even spread out over the 160 miles, or it would be 40ft. at the end of the first mile, whereas it is, we know, only 8in. Mr. Hampden, in stating the curvature, always begins with one mile, thus "8in. in 1 mile; 32in. in 2 miles; 6ft. in 3 miles," and so on, until the square of the distance begins to produce telling results. Has it never occurred

Mr. Hampden to reverse the process? Thus, in. in 1 mile; 2in. in ½ mile; ½in. in ¼ mile; in. in ⅛ mile; $\frac{1}{32}$in. in $\frac{1}{16}$ mile, and so on. It should e remembered that the eye, and even delicate intruments, fail to detect very small curvatures.

Mr. Rous-Marten (28664, p. 189), refers to arious small gradients, the smallest of which is in 800. Now let us see how very much smaller the curvature of earth:—

istance. 5,000ft.	1 in 8,362	Decline
4,000ft.	1 in 10,450	
3,000ft.	1 in 13,970	
2,000ft.	1 in 20,905	
1,000ft.	1 in 41,810	
500ft.	1 in 83,620	

If a railway with decline of 1 in 800 may be garded as "practically level," how much more significant is 1 in 83,000, the decline of earth's rface along 500ft.? The total curvature in the me distance is less than 1-10 of an inch.

I don't think Mr. May (28708, p. 217) need have oted Isaiah. Indeed, so far as that verse goes, might be quoted by Mr. Hampden himself. To y that the earth is a "circle" is not to say it is sphere. I think Scripture had best be left out.

F. S. S.

FLAT EARTH.

[28721.]—TILL I read Mr. May's letter (28708), would not have believed that any correspondent the "E.M." would have been so grossly ignorant what he writes about as not to know a circle om a sphere. The inspired prophet could not ossibly have used a more strictly accurate phrase. he Almighty is represented as "sitting on the *ircle* of the earth." How delighted the astronoers would have been had the word globe or phere been used! But there is not a single innce throughout the whole Hebrew Bible of the rong word being used. So Mr. May is rather too te in the field. Any little schoolboy would have ld him that the two shapes were as distinct as oak tree and a haystack.

"E. L. G." is informed that neither "gutters," r ruts, nor drain-pipes have anything to do with e subject. My opponents are certainly in a fog present.

John Hampden.

THE GLACIAL PERIOD AND THE MOON'S WATER.

[28722.]—YOUR correspondent, "E. L. G." 641), page 169, criticising my letter (28612), nts your readers to believe that fine snow-mist me through the 50 to 200 miles of our atmosphere ithout getting dissipated as vapour, and, finally, ring the last few seconds of its fall, became elted, and so elevated in temperature as to reach e earth scalding hot, both at the Equator and at e Poles.

I believe, with "E. L. G.," that formerly our rth received an addition of water from somehere outside in space; but whether that water me from the lunar surface, a burst planet, a hyogen comet, a detached hydrogen prominence om the sun, or a hydrogen nebula, it could arcely come as "E. L. G." suggests. Those of ur readers who know about the culinary paradox d the hypsometer will know why.

Water in vacuo boils at about 72° Fahr., and ,000ft. high on the summit of Mount Blanc at 78° Fahr. At the summit of Mount Everest the rometer would stand at 10in., and a little below miles at 1in. Scalding hot water could not ist there, and mist or ice-mist would rapidly come vapour. That vapour would quickly read throughout the atmospheric ocean, and ould reach the ground as rain within the tropics d as snow in the higher latitudes, north and uth. A mass of ice on impact with our atmoere would develop heat enough to dissipate elf similarly in vapour. A mass of hydrogen ploding in the rare confines of the atmosphere uld not affect the surface except ultimately rough the taking away of oxygen; but e resulting water would reach the earth the same way as water from any other outside urce. A mass of water itself without the other fluences would be dissipated into the finest pour by friction long before it came within les of the earth. There are waterfalls amid the ps, amid the Rocky Mountains, and in other ces where the fall is so high that no water ever ches the ground. It fades into invisible vapour it falls.

rather imagine the addition of a quantity of ter to our air and earth would use up a certain portion of heat instead of giving it out, as L. G." wants to teach. Ice, by absorbing t, tends to preserve ice. One-third more heat ceived about the Poles than about the Equator ually. The whole of the heat poured by the upon a glacier is expended in melting it before aises it one degree higher in temperature. The efaction of ice, in other words, absorbs about F. On the other hand, nearly 1000° F. are required to convert water into steam. How, then, could the addition of water make our earth warmer?

When I spoke of mammoths (28612) I alluded to those special mammoths mentioned in my former letter ("E.M.," March 16th), and which were complete, perfectly fresh, and certainly found in ice—not mud. The Tungusian chief who discovered the first was so astonished to see it in the middle of the berg that he considered it an apparition, or an evil spirit, and it was some time before he returned to try to obtain its tusks. If the Deluge ended the Glacial period, as "E. L. G." holds, would he kindly explain the recession or shrinkage of the great Swiss and other glaciers which is going on at the present day, and has been going on more or less steadily for a long period—in fact, up to the Glacial epoch.

Many of your correspondents think the moon has absorbed her water. In what form, pray? Chemically, as the water of crystallisation, or in combination or oxidation? If so, did the chemical processes develop heat, and how did that heat affect water not yet used up? Mechanically, in fissures, crannies, pores, or caves? If so, did the water retain its dissolving power on the rocks, or how far down in the lunar surface does the influence of heat and cold extend, so that we may know whether it is water, ice, or steam we are dealing with when your correspondents talk of absorption into the moon's pores? Would the earth and the sun have any influence on water or steam beneath the moon's surface? A just scientific answer to these questions on physical, chemical, geological, and astronomical grounds will help the solution of the problem where the lunar seas have gone. These questions can be discussed quite apart from lugging in the Deluge and Darwinism.

There are several slight errors in my last letter (28612). One of grammar, where a plural is put instead of singular; and the bursting of iron *cameras* should be iron *cannons*.

Francis E. Cane.

R.M.S. *Scythia*, May 7.

SURVIVAL OF THE FITTEST.

[28723.]—THIS is a most inopportune time for maintaining, like "Sigma," p. 193, that Australia (save the mark!) has inherited naturally its "fittest" animals. In the midst of this outcry that rabbits, introduced yesterday, threaten to realise an extravagant idea of Darwin, to account for the extinction of the American horses, that "in some countries we may believe that a number of species subsequently introduced, by consuming the food of the antecedent races, may have caused their extermination." Surely, if the antecedent races were the fittest, or anything near the fittest, they ought to starve out the new comers, our coneys, who, according to Solomon, "are but a feeble folk." The rewards offered for Pasteur's chicken cholera or anything to keep these foreigners down, look extremely unlike the land having preserved its "fittest." It was the repeated world-wide fact, of which this is a single instance, the fact whereon Darwin insisted that "he who admits creation of each separate species" (just as and where it now exists) "will have to admit that a sufficient number of the best-adapted plants and animals have not been created on oceanic islands; for man has unintentionally stocked them from various sources" (i.e., originally from Asia) "far more fully and perfectly than has nature"—it was this world-wide fact that I meant by "the obvious non-survival of the fittest on any land disconnected from Asia." We are constantly hearing of fresh cases, similar to the present Australian rabbit-plague, that in whatever lands there have been non-Asiatic living creatures, those peculiar creatures either have disappeared or are now being starved out by the competition of artificially introduced Asiatics (i.e., of Noah's animals), though in most cases imported by mere accident. Even this little Britain, in the 50 centuries it has been insulated, seems to have had two species peculiar to itself—the grouse that our Game Laws have much ado to preserve, and the black rat that is believed extinct since the Hanoverian Accession, by the merely accidental importation of the Continental brown rat. And so, whatever "Sigma" says of no flood having exterminated from Australia its marsupials, might have been equally said of Britain with its grouse and rat. I admit these were not in Noah's ark; but neither are they "the fittest" for Britain, since we see some that *were* in his ark displace them. So, too, Noah's cattle (with a little of our assistance) displace the bison from North America; and his horse, once abundant in both Americas (as their fossils show), but unknown to either from Noah's time to that of Columbus, is now displacing the South American llama.

The enormous and sudden extinction of vertebrate species on every land of the globe about 50 centuries ago did not, I have always held, in Britain or perhaps any equally large island, reach every individual species. If all organisms were swept off the land, numerous animals, especially the smaller, would cling to drift-timber, and if there soon ensued, as geology shows there probably would ensue in very few days, upheavals of portions of the rocky crust near the coast lines, and as we positively see to have occurred near the Carnarvon coast, where Moel Tryfan bears on its top marine gravel and shells of the Glacial age, these new hills would be colonised by many of the drifting plants, and in some cases a few animals of which a few species (but not "the fittest," nor with any selection at all referring to fitness) survived to overspread the adjacent old lands. The catastrophe had not the least tendency to make the fauna of different lands more uniform than before, but rather the reverse. If special types were till then prevalent on particular continents, as the Edentates on South America, or Marsupials in Australia, the flood would tend to perpetuate or even strengthen that specialism. In Australia, according to "Sigma," none but marsupials (among the mammals) survived—i.e., none but the type already most prevalent there. If so, it would be eminently consistent with my notion of the Flood; but I find from other authorities, as the Duke of Argyll, that several Australian mice are non-marsupial. At any rate, the prevalence there of marsupials is much greater now than it was in Antediluvian times; because I find that enough was known of Australian fossils, even 40 or 50 years ago, to lead Darwin to insert in the 1845 edition of his *Journal of Researches* this sentence (p. 174): "It appears from the character of the fossils in Europe, Asia, Australia, and in North and South America, that those conditions which favour the life of the *larger* quadrupeds were lately co-extensive with the world." Now in p. 193 "Sigma" plainly implies the largest modern Australian native brute to be a kangaroo, which I presume Darwin did not include in his italicised "*larger* quadrupeds," favoured by conditions "co-extensive with the world." He went on to say that "What those conditions were [if differing at all from present conditions] no one has yet even conjectured." Nor has anyone to this day, including himself, suggested the least reason why any of those continents would not be as fitted to support the mammoth, mastodon, and all those formidable giants of the quaternary age, now found in their gravels, as they ever were. He had to close the subject, and avoid ever touching it again, by the despairing remark that, "Certainly no fact in the long history of the world is so startling as the wide and repeated exterminations of its inhabitants"; though this plural and this "repeated" were pure guess. He had no shadow of ground for any more "exterminations" than this recent post-glacial one. But, anyhow, I take him for a better authority than "Sigma," and he plainly held that something *has* occurred, no less in Australia than elsewhere, to destroy so largely its pliocene quadrupeds, as to have extirpated numerous whole species, indeed all the bulkiest, and left but a fragmentary accidental few of smaller species.

As for "a total destruction of the earth's inhabitants" (other than human), in the rigorous sense cavillers try to insist upon, it was never supposed but by ignorant Mediæval ranters. The only story I would defend is that of Genesis, both as recording divide oracles, and a common-sense popular account by eye-witnesses of what they saw. In the oracles, including the statement that "all flesh had corrupted its way upon the earth," it seems very questionable whether the frequent phrase "all flesh" means more than all humanity. But of the story, the very strongest destructive phrases are (vii. 21), "All flesh died *that moved upon the earth*," and (22), "All in whose nostrils was the breath of life, of all *that was in the dry land* died, and every living thing was destroyed *which was upon the face of the ground*." Thrice, in those few words, comes a limitation implying that some might be *off* "the face of the ground" and *not* be destroyed. The utmost really deducible is that whatever survived was afloat.

But we must distinguish between what Noah could know or suppose and what we may understand now. It was natural for him to say afterwards, and innumerable descendants of him to believe, that "Noah only was left, and they that were with him." To all possible human knowledge it then was so. By the way, I wish Mr. Hampden would explain to us the need of an ark on his view of the earth's form and structure. Whether it be an oblong rectangular plane as he used to teach, or a circular one as he makes it now (page 192), the waters had to be confined by barriers; and I want to know why Noah could not be directed with far greater ease to travel to and climb one of those barriers? On any flat world his ark seems to me a most gratuitous and clumsy contrivance.

If the catastrophe were due to what Genesis and the Assyrian tablet both make its sole physical cause—namely, "rain from heaven," but which no apologist now seems to assume as having anything to do with it—then it is true that creatures swept off the ground would have no practical chance of grounding again, unless the ground were upheaved to them. Neither would the ark itself have more chance. But modern geology has shown that such upheavals are precisely the likeliest events to follow very quickly, especially near coast lines. Why, then, may not Moel Tryfan, and fifty other similar upheavals near other lands' coasts not yet so well surveyed have risen a few days after the catastrophe and have afforded footing to some of the wreckage, including a few animals of each of such lands, long before the emergence of the chief new upheaval, the great Ararat and all Armenia that are related several months later to have saved our ancestors? Wherever the dove on the 164th day found an olive sapling it must have been growing for months. A week earlier, too, the raven had found itself a country. Doubtless all our present large lands, distant from Armenia, had in these months begun to be restocked.

But, anyhow, this is certain: they all, including Australia, have, since the Glacial age, been deluged (not "submerged"), and cleared of the majority of previous animals and all the largest kinds. This is a nut whereon let all beware of breaking their teeth, as poor Darwin and Lyell broke theirs.

After raising this question, "Sigma's" letter, 28686, page 193, straightway flies to a totally different subject, which fills all beyond the first line. If he thought there was, or is, any "land disconnected from Asia" whereon the fittest quadrupeds for such land were living at civilized man's advent, it was easy to name such land and such quadrupeds, whether knowing or ignoring what I meant by "the obvious non-survival of the fittest." I ought doubtless to have said "of the fittest *quadrupeds*." It may be doubtful whether the American continent may not have naturally as fit birds, on the whole, as the Old World, though the New Yorkers are complaining that some of our sparrows—Asiatic originally—carried there a few years ago, are dealing with the natives somewhat as Australia complains that Noah's rabbit is dealing with the marsupials.

But unless "Sigma's" letter had thus been mislabelled, I suppose that, if correctly headed with its utterly fallacious dogma, "Australia never deluged," it would have had no more chance of appearing than my answer to "F.R.A.S." to prove "Britain deluged in Noah's time." Yet either of these questions, I maintain, is a purely scientific one, and no more "theological" than an inquiry whether there were railways in Cæsar's time.

As to whether Australia, or any other land unconnected with Asia, has its fittest animals (of any class) "Sigma" has not said a word. It was, therefore, needless and not pertinent for me, in a letter sent last week, to discuss this. But as "Nun. Dor." complains of a certain query (64702) being an "unmitigated impertinence," I should like to be told of an impertinence anywhere in the world more unmitigated than some anonymous "Sigma" of yours enunciating *e cathedra* that "anyhow, one thing is certain," no Deluge destroyed the early animals of Australia, and this is a "nut that all teachers of a universal Deluge have to crack." There would be no nut if fifty "Sigmas" were spouting such rubbish in every periodical on earth, and no scientist anywhere contradicting them. But in this case it happens that the late Darwin (who is probably his model biologist) had stated the exact contrary, and, as far as I can find, everyone treating of Australian fossils, since any were known, has equally contradicted him. In Howorth's exhaustive "Mammoth" book, chap. xiii. gives a list of 80 extinct Australian quadrupeds (many not marsupial) of the "pleistocene" (i.e., the latest) gravels and bone-caves, and proves the impossibility of any other conceivable cause than a sky-deluge having extirpated them. In fact, the poor fragmentary fauna left in Australia, compared with what it had before its last gravelling, is plainly a far more reduced relic than survived in either of the Americas. They were cleared, by the Flood, of everything larger that the bison; but Australia, by "Sigma's" own showing, of everything larger than a large kangaroo. **E. L. G.**

CHEMICAL MANURE MAKING.

[28724.]—TO assist me in this as an amateur I want certain information.

Nitric acid commercial: What is its full formula? Is it only composed of nitrogen and oxygen, or is there not water as well? Again, what is the weight of nitrogen in a pound of nitric acid commercial?

May I put this question another way? If common washing-soda is saturated (or, say, the acid neutralised) by the addition of 1lb. of commercial nitric acid, shall I find all the nitrogen in the nitrate of soda, less only any small quantity which may pass away in the effervescence caused by the nitric acid? And again, if I evaporate the solution of nitrate of soda so made with the 1lb. of nitric acid, shall I be able to tell how much soda there is present, and which has been saturated?

Full answers to these questions will teach me *some chemistry,* besides giving information as to *manure-making.* **The Brae.**

ELECTRIC ALARUM CLOCKS.

[28725.]—FIG. 1 is an arrangement for contact in a Seth Thomas American alarum clock. When the alarum is set the piece A shoots forward, and engages with a pin on the axle of bell hammer of clock.

When the clock has worked round to the proper time, A is released by a cam (not shown in fig.), and springs back and makes electrical contact with B.

The arrangement can be fitted to the clock in a few minutes, all that is required being a strip of sheet brass ¾in. long and ⅛in. wide, and a small piece of wood to insulate B from clock-case A.

FIG. 1.

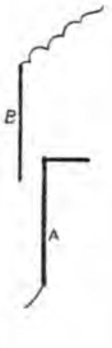
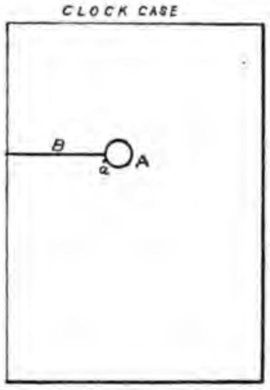


FIG. 2.

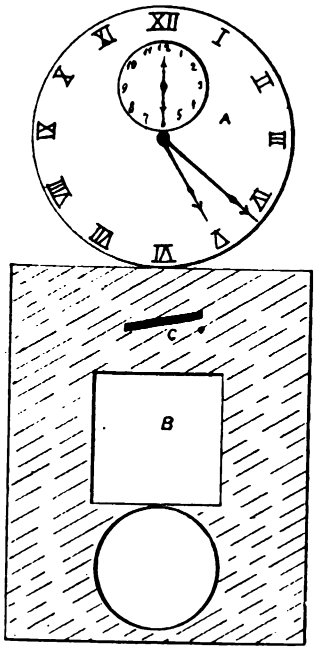


The piece A and the cam are part of the clock, so that all that is necessary is to mount B on the wood, screw same up to clock-case in such a position that B is just behind A, and does not make contact unless the clock alarum is ringing.

(2.) This arrangement can be fitted to any clock with the requisite space.

Take an ordinary wood case alarum as an example. These are set by means of a movable disc behind the hands. Take this off, and on the barrel behind it solder a short pin. To the side of the clock-case screw a brass spring, so that when the XII. on the disc is underneath the XII. on the face the pin on the barrel makes contact with the spring. Fig. 2 will explain the arrangement. Fig. 3 is No. 1 complete.

FIG. 3.



In each of these one wire is coupled to the works of the clock, and the other one to spring B.

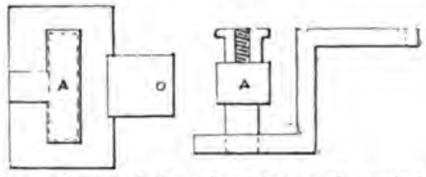
Both arrangements have given satisfaction, more especially the first one.

References to sketches: Fig 1. A, clock mounted on box containing Leclanché cells; B, bell; C, switch. Fig. 2. Clock-case; A, barrel of disc with pin, *a*; B, spring with which A*a* makes contact.

C. W. Maw.

GRAVITY LECLANCHE.

[28726.]—THANKS to "A. G. H." and Mr. J. J. Ryder for their suggestions. This battery was introduced, so say Preece and Sivewright, to utilise the troughs having broken porous partitions, and yet a good deal of experimenting seems to have been made, judging from what Mr. Martin F. Roberts says in the *Journal* Soc. Tel. Engs., Vol. VI. page 266. I may add he is an authority in such matters, having been on the electrical staff of the G.P.O., London, many years. Frequent experiments have been made with a view to dispense with the porous cell altogether. With this object the porous pot has been replaced with a bag of felt or canvas, and also by perforated earthenware cells; but my experience leads me to think neither of these modifications is desirable, as, in addition to the polarisation being more rapid, considerably more local action takes place, apparently caused by small particles of manganese or carbon reaching the zinc plate. A far better plan is the *gravity* arrangement, proposed, I think, by Mr. Fuller; but even in this form it is advisable to wash the crushed carbon and manganese to remove any traces of the powder produced when the materials are being broken for use. The polarisation in a gravity cell fitted up as above is, when short-circuited, slightly more rapid than when a porous cell is used; but then its recovery is equally quick, so that in actual working the results obtained compare very favourably with the original form of this battery, and the internal resistance is extremely low, not averaging more than 1½ unit."



Shape of zinc plate used. A is an ordinary lead-capped carbon plate passing through centre of zinc.

Assoc.Inst.Elec.Engs.

THE SAMUEL MORLEY MEMORIAL FUND.

[28727.]—WILL you allow me to add a few words to the letter on the above subject, which you kindly inserted a fortnight ago?

I wish to mention that the proposed memorial—viz., the purchase of the Victoria Hall, has the cordial approval of Mr. Samuel Morley's family. It is also desirable to urge that the present opportunity should be seized *without delay*. It will never recur. Should we fail to raise the necessary sum (£17,000) by August next, the formal arrangement which has been entered into with the landlord will fall through, and, at the expiry of the lease in a few years' time, the present admirable work of the "Vic." would cease.

If we fail in our present effort, there will be no lack of competitors anxious to secure the Hall, and work it on ordinary low music-hall lines.

The Charity Commissioners can only take over the "Vic." *after the freehold has been secured.* Friends and admirers of Mr. S. Morley, and sympathisers in a work so well tested and so widely useful, are appealed to for a prompt and liberal response.

An influential Memorial Fund Committee is being formed, and subscriptions will be received and duly acknowledged by the Duke of Westminster (hon. treasurer); Lady Frederick Cavendish, 4, Upper Brook-street, W.; by Miss Emma Conns, hon. sec. Royal Victoria Hall, Waterloo Bridge-road; and by the London and County Bank, Westminster Bridge-road, S.E.

Lucy C. F. Cavendish.

P.S.—Perhaps as some of your readers may not have seen the earlier letter, it will be well to recapitulate the objects of the memorial fund. They are to buy the freehold of the Victoria Hall, where work is carried on by means of concerts, entertainments, lectures, and classes, which Mr. Morley greatly valued, and which he longed to see placed on a permanent basis. If the freehold is bought this will be done, for the Charity Commissioners have agreed in that case to take the Hall as part of the People's Palace scheme for South London; thus the work which Mr. Morley did not live to finish will be effectually accomplished, and will be a blessing to the neighbourhood for generations to come.

DIRECT TRANSFORMERS AND INDUCTION COILS.

[28728.]—WOULD not Mr. Perren-Maycock's proposed renaming of the induction coil be liable to cause considerable confusion between that instrument and the continuous current transformer or motor generator? To the average electrical engineer the word "direct" transformer would, I think, suggest the continuous current transformers of Messrs. Paris and Scott, Jehl and Rupp, &c., which have of late attracted so much attention. Again, in an induction coil, though the current in the primary is an interrupted current of one direction only, the current in the secondary is necessarily of a rapidly alternating character. Would not, then, the appellation "direct transformer" be, to a certain extent, a misnomer?

I quite agree with Mr. Perren-Maycock and "Engineer, Govan," as to the unscientific form of the conventional induction coil, and have long thought that the great improvement in the alternating current transformer would bring about a radical change in the construction of induction coils. The advantages of a closed magnetic circuit are too great to be passed by, even though it means increased expense and difficulties of construction.

F. C. Allsop.

21B, St. James's-street, Brighton, May 5th.

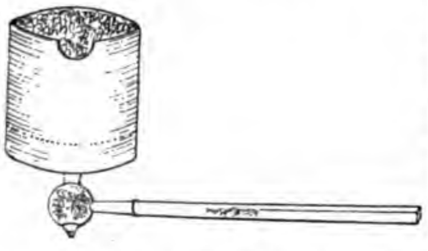
NEW INDUCTORIUM OR TRANSFORMER: TO MR. PERREN-MAYCOCK.

[28729.]—AS this subject is again attracting some notice, allow me to direct the attention of those interested to Vol. XLIII., page 171, and read the criticism which followed, especially in the light of subsequent events. One of the Brothers Varley patented a closed magnetic circuit induction coil in 1856. See Rankin Kennedy's articles on "Secondary Generators and Transformers" in the *Electrical Review* about twelve months ago, since published in book form, I believe.

Middleton, near Manchester. **F. L. Striffler.**

A GOOD BLOWPIPE.

[28730.]—TO brother plumbers, gasfitters, &c., who are in want of a blowpipe that will let both the hands be at liberty while making a joint in compo or lead pipe. I have often found it very inconvenient with the old method of blowpipe and rushes, and also disliked the disagreeable smell caused by the burning of rushes, so I thought I would try and construct a blowpipe that I could use with methylated spirit, and which could be used in any awkward corner without the necessity of employing both hands. I do not know if the idea is new. The pipe resembles an ordinary smoking pipe, the bowl being made of 1¼in. copper tube with a small air-chamber at the bottom, and a swivel joint, so that the flame can be turned in any direction. The mouthpiece and stem are made of the ordinary blowpipe. It is very light, and is about 7in. long, and can be held in the mouth quite easily. I have given a rough sketch, as it will be better understood.



J. R. Brooks.

TURRET CLOCKS.

[28731.]—I HAVE read with much interest Mr. A. Marson's letter on maintaining spring for small turret clock in to-day's "E. M." As I have hitherto asked in vain, in various directions, for some information on turret-clock making, perhaps Mr. Marson could help me. I have got every book I could learn the name of which treats of horology—Sir E. Beckett's "Clocks, Watches, and Bells," Britten's book, and also Glasgow's, but find in none of them the practical and technical instruction needed to enable one to venture on the construction of a small turret clock with any certainty of succeeding in the attempt. Except in Beckett's book, clocks are dismissed with a few words, while the whole importance is given to watches.

A turret clock seems to be quite within the power of an amateur with a good lathe and the skill to use it. Watch-making beyond most of us.

Would Mr. Marson say if Reid's book, which he mentions, gives practical details of *clock-making?* Or if he knows of any other or later published books treating on the subject? Perhaps, too, if he were willing to write them, Mr. Editor would find room for a set of articles from him on "Turret Clock-Making," such as those most valuable papers from "J. H." now appearing on "Gearing."

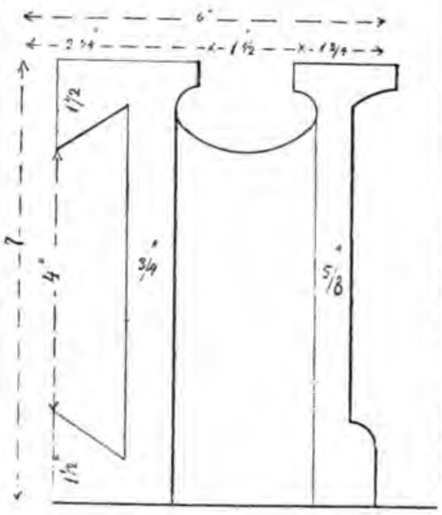
This I can say: to some country subscribers, where there are no public clocks, information how to make a small turret clock would be most acceptable.

Fredk. Carre.

THE FRONT-SLIDE LATHE-BED.

[28732.]—I SEND a section with dimensions marked on it of the form of bed I have proposed for front-slide lathe, in order that if any of those who took a part in the late correspondence on the subject, or who still take an interest in such an amateur's tool, desire it, they might communicate with me, as I am asking several manufacturers if they would give me estimates for a gap bed 5ft. long of this section.

If several were satisfied with this form, of course it would be better worth the manufacturer's while making the slight alterations which would be necessary on the ordinary patterns, and the beds could be supplied to us more cheaply.



I say now nothing as to the form of saddle, or how slide-rest is to be fitted to it, as there was nothing generally agreed on that point; therefore I leave it open for each one to choose his own form of saddle, bracket, and slide-rest, special patterns for which have to be made, varying chiefly according to the views held as to how milling work can best and most conveniently be done.

My vote will, for several reasons which I have before mentioned, be given in favour of the chief milling being done with a special head, such as was illustrated in a former letter of mine; milling between the lathe centres being attended with several drawbacks. Some things can be done with the cutters, but the range is limited in height as well as in length. The feed not automatic.

To be a success the bed must not cost much more than the ordinary bed.

As there is only the extra metal in the front slips, and the somewhat increased depth, besides the extra planing, to provide for, I do not see that the cost need be much increased. That it should cost more than for the extra metal and surface planed, I do not see; for the addition of the front slips to the ordinary pattern, with some increase in the depth, is all the alteration needing to be made.

If anyone agrees with me in the desirability of getting *something* done, and will write to me direct, or through the "E. M.," I think a beginning might safely be made on a bed and standards.

I know every day I work at my lathe I find the nuisance so great of having to *make six alterations* of apparatus before work can be resumed, if you have had to interrupt it in order to use a hand tool, that I am determined to end it.

Inver, Donegal, April 28. **Fredk. Carre.**

P.S.—I am pleased to see the Universal Lathe Company have appeared in the field since I wrote the above. Pending some full description and illustration of their new lathe, I am asking them for quotations for bed on my section.

May 7. **F. C.**

TO "O. J. L."—POLE-LATHE SPINNING.

[28733.]—THANK you. I have indeed complicated the tool-rest. I tried a bar across from standard to standard, as appeared to be shown in one of the woodcuts in Holtzapffel; but it was not convenient, and after one or two makeshifts, I constructed this parody of the usual T-rest (see Fig. 1). A piece of hard wood, with a long slot in it, lies across the lathe-bed, and is fixed in any position by a round-headed screw and washer at the top of a short square rod passing between the bearers, and held down by a wedge beneath them. The actual rest is an oblong bit of black walnut, a feather on which takes into a groove on a similar piece fixed square across the end of the slotted bearer, so that this rest can be set at any height, and held by a thumb-screw working in a short slot.

This works well enough—is the stiffest part of my apparatus, in fact—but I have since made one dispensing with the thumb-screw, and thus coming fairly within the conditions of simplicity I had laid down for myself. The round-headed screw-washer and slotted bearer are as before; but at the overhanging end of the bearer an inch centre-bit hole is bored, through which passes a turned post, having a slot cut through it for the greater part of its length, so that by driving wedges above and below the said bearer, the rest can be set at varying heights. I have been trying to fit the lathe with a mandrel, and spent much time in turning a collar on a sort of wooden face-plate, with a spindle through it, which, at all events, showed how amply the machine would suffice for making such things as small wheelbarrow or toy cart-wheels; but when complete I found I could do the job better with a centre-bit; and there it stands, for I have turned to other work after failing to provide the mandrel-nose with a screw in a legitimate manner. It is curious that no mention (so far as I can find) is made in Holtzapffel of the use of the pole-lathe by flute-makers, who employ it to turn up to the stops. There is at least one soft wood turner in London who still uses the pole-lathe, and one could not wish better work than he does; no doubt there are plenty about the country still. As to my pole, it now stands vertically to the right hand of the bed, and the cord works through a pulley on a sort of crane. That joists are not always available is the reason for deviations from the primitive plan, which no doubt is in itself the best.

Fig 1

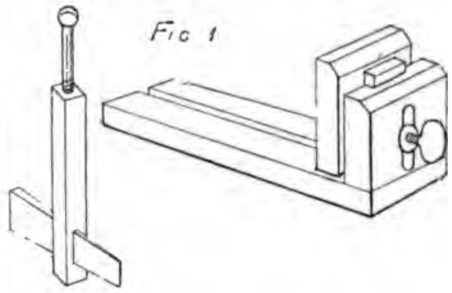
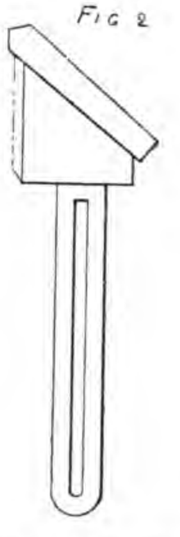


Fig 2



W. A. S. B.

HIGH-SPEED GOVERNORS.

[28734.]—"F. A. M." (letter 28679) will find the formula I gave in any good book on the steam-engine, such as Rankine's. He has, I think, sufficient ingenuity to work out the details of a flat spring governor, which consists of either two or four flat springs jointed at top of spindle and at bottom to sleeve, the balls being attached to middle. Good stiff crinoline-steel would do for a small affair. If the engine did not work more than 40lb., I should probably not lubricate such a small affair. A lubricator would be nearly as large as the cylinder.

T. C., Bristol.

PURE MATHEMATICS.

[28735.]—THERE are probably many readers of the ENGLISH MECHANIC who have a liking for the study of mathematics for its own sake, and without regard to examination papers or the requirements of the workshop, and who may thus frequently come across matters of interest not to be found in textbooks; and I have no doubt that the Editor of the "E. M." would allow space in these columns for the exchange of ideas on this subject, provided that such ideas are original, and are not expressed in too much detail.

For instance, here is a problem that I don't suppose was ever printed. A circle is inscribed in an isosceles triangle: it is required to show that (the sides remaining always the same length) the inscribed circle will be a maximum when the half-angle at the vertex is such that its cosine is equal to its tangent. Instead of the triangle and circle, we might take a cone and sphere, the result is the same. Again, two triangles with the above angle at vertex placed base to base so as to form a rhombus and a circle inscribed therein, the radius of this circle will be found equal to the distance between the centre of the maximum circle and the vertex of the triangle. I daresay other curious properties of this angle might be discovered. Expressed in degrees, there is nothing remarkable about the angle—it is about 38° 10′.

The following is more of a puzzle than a problem. The centre of gravity of an isosceles triangle is found by taking a point one-third of height, measuring from base. Now, suppose the angle at the vertex to become smaller and smaller, the c.g. will always be at one-third the height. If then we make the angle infinitesimal, the two sides will come together and form a line of infinite thinness; but the c.g. of such a line must be in the centre, so that we have two centres of gravity! This is, of course, absurd; but I confess that I was puzzled with it.

M.I.C.E., Bath.

PEOPLE'S KITCHENS.

[28736.]—AT a late culinary exhibition in Germany some cooking for the people was carried out with a view to demonstrating the degree of economy possible under such conditions. The food consisted of the following courses. Beef soup, beef, preserved green and dried white beans mixed, and potatoes. 540 dinners were given on one occasion to this number of soldiers, the cost being as follows:—

				£	s.	d.
6oz.	of beef	= 202lb.	at 6·54d. =	5	10	2
3½	„ preserved green beans	=115	„ 2d. =	0	19	5
2·82	„ dried white beans	= 95	„ 1·42d. =	0	11	3
17·6	„ potatoes	=594	„ 0·31d. =	0	15	4
0·32	„ kidney fat	= 12	„ 4½d. =	0	4	4
0·53	„ barley	= 17¾	„ 2·03d. =	0	3	0
0·32	„ salt	= 12	„ 1·08d. =	0	1	1
0·16	„ flour	= 6	„ 1·66d. =	0	0	10
0·16	„ onions	= 6	„ 0·50d. =	0	0	3
	Seasoning			0	0	8
	Total			£8	6	4

or per head 3·7d.

This does not include wages, fire, wear and tear, interest, &c.

It would be interesting to compare this with similar people's cooking in England, as also to show the quantity of actual nutrition supplied per head by the above menu, and if sufficient for working men.

Marienberg.

FORCE AND ENERGY.—TO "F.R.A.S."

[28737.]—I OBSERVE from letter 28688, p. 213, that "F.R.A.S." objects to the definitions of force and energy given by me on p. 176 in reply to a query headed as above. As he does nót state in what he considers the error to lie, I will quote the following authorities for his information:—"Force is that which moves or tends to move a body, or which changes or tends to change the motion of a body."—Todhunter. "It is a fundamental fact that if a particle were left wholly to itself it would either continue at rest or would move uniformly in a straight line. Any cause which changes or tends to change either of these states is a force."—Twisden. "On appelle *force* toute cause capable de produire le mouvement, ou d'en modifier la nature."—Drion et Fernet. "Unter 'kraft' versteht man eben Alles was den Bewegungszustand eines (freibeweglichen) korpers zu andern vermag."—Krebs. As regards energy (which is power to do work), I may quote Everett:—"Work $= \frac{ML^2}{T^2}$, being the product of force and distance."

"F.R.A.S." may not approve of these definitions, but he should know better than to bring a charge of ignorance against a correspondent who adopts the views of such authorities as those above quoted.

Wm. John Grey, F.C.S., Analytical Chemist.
Newcastle-on-Tyne.

THE ANGLE OF THE SIDE OF THE GREAT PYRAMID.

[28738.]—UNDER the heading of "Pure Mathematics" I sent some days ago to the ENGLISH MECHANIC an account of some curious properties *of the angle 38° 10′; but I had* no idea that my *little discovery had been anticipated by the great* pyramid builder, Cheops. The half of the angle at vertex of an isosceles triangle being 38° 10′, it will be found that the angles at the base are each 51° 50′. Now, the following is taken from Fergusson's "Architecture," Vol. I.:—

	Angle of side.	Angle of passage.
Cheops	51° 50′	26° 41′
Chepheren	52° 20′	25° 55′
Mycerinus	51° 0′	26° 2′

From which we see that the angle of the side of Cheops is such that (as explained in my other letter) a circle inscribed in the triangle formed by making a vertical section through apex of pyramid is a maximum—that is, the circle is greater than any other which could be inscribed in a triangle with the same length of sloping sides but with a different slope.

The half-angle at apex has also the peculiarity that its cosine is equal to its tangent. Another peculiarity is that the radius of the escribed circle, added to the radius of the inscribed circle, is equal to twice the height of the triangle.

It will be seen from the above extract that the angles of the other pyramids vary slightly from this; but the workmanship of these is far inferior to that of Cheops, and they are probably not very accurate copies of the older one. There is one curious thing about the "angle of passage"—this passage leads down to the interior, and the entrance is in every case at some considerable height above the base. It will be observed that the angle of the passage in the second pyramid is exactly half the angle of the side of the first pyramid.

There has always been great discussion as to why such an angle was selected for the slope of the sides. The most plausible theory was that the faces of the pyramid were intended to be practically four equilateral triangles; but even this does not come out very well when compared with actual lengths, the base of the Great Pyramid being 764ft., and length of sloping edge 720ft., making a difference of 44ft.

My theory, then, is that the angle was selected by the architect of the Pyramid because (like myself) he had been brooding over its peculiarities, or perhaps it was connected with some long-forgotten mystery. There is another peculiarity of the angle which I forgot to mention: it can be drawn by ordinary Euclidean geometry, and the problem is the only one I know in maxima and minima which can be so solved, excepting, of course, those problems whose solutions are obvious, and therefore we get rid of the difficulty that the differential calculus was not invented in those days. At any rate, my theory is as likely to be correct as the curious speculations of Prof. Piazzi Smyth and his followers, who seem to find sermons in every stone of the Great Pyramid.

It will be observed that if the circle inscribed in the triangle is a maximum, the sphere inscribed in the Pyramid is also a maximum, which adds to the interest of the case.

M.I.C.E., Bath.

SOME LITTLE-KNOWN PLANTS OF THE "FLORA MEDICA."

[28739.]—"HEMIDESMUS INDICUS," of the Tropical order "Asclepiadæ," a common climbing weed found all over India.

The roots of this plant were very long ago employed on the Madras coast as a substitute for sarsaparilla; thence they found their way to England, and were highly spoken of. For a period of half a century this cheap drug has been extensively used in the hospitals of India, both British and native, the trials of its properties having proved very satisfactory. Its diuretic operation is very remarkable: 2oz. infused in a pint of water, and allowed to cool, was the quantity usually employed daily, and by such doses the discharge of urine was generally trebled or quadrupled. It also acted as a diaphoretic and tonic, and so increased the appetite that it became a most popular remedy in all the hospitals, the patients themselves entreating its administration and continuance. The taste and smell of the infusion are balmy and sweet; it was used with the most decided benefit in numerous cases where sarsaparilla is generally given; indeed, its activity was proved to be more decided. I remember the time when it could be obtained in Calcutta and elsewhere at three-halfpence to three pence per pound weight. No good analysis of this drug has yet been made.

Eos.

BY taking the hours at which the pendulums of different clocks were stopped by the Charleston earthquake, Professor Simon Newcomb and Mr. Dutton conclude that the velocity of propagation of the shock was 1,700ft. per second, with a possible error, positive or negative, of 250ft.

EXPERIMENTS carried out by Mr. H. Arnold, at Wilhelmshaven, show that greater strength is obtained in Portland cement mortar by using a coarse-grained sand, rather than a finer one equally clean and sharp, and this result is confirmed by some recent experiments made in the laboratory of Cornell University.

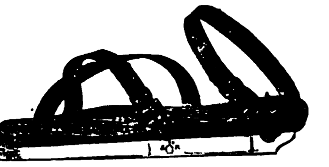
REPLIES TO QUERIES.

**** In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[64478.]—**Church Bells.**—I once asked a foreman in a well-known bell-foundry whether putting silver in a melting-pot was of advantage. He replied, "Of great advantage—to the founder, as the silver sinks to the bottom; the founder pours off the copper and tin, and when the silver has cooled, puts it in his pocket!" It may be that a bell made entirely of silver would sound well; but this is mere conjecture.—K. G.

[64702.]—**Evolution.**—Whether this query by "H. B. F." were "unmitigated impertinence" to the "F.R.A.S." or not, it seems a very pertinent one to the subject, and has immediately (perhaps by mere coincidence) a most pertinent answer. Letter 28710, by "Satine," p. 237, came at the very nick of time, to show "H. B. F." exactly what "self-evolution" must mean, if anyone believes in it. Nor can I see that the querist, or any of us, was the least bound to know (if any cared) whether "F.R.A.S." believed it or not. Whether his "confession of faith" had ever appeared is utterly beside the question. If any reader of a single letter cared what he believes, I can see no impertinence in asking him.—E. L. G.

[64819.]—**Racing Skates.**—The class of skates used by our champion speed skaters are called Fen skates. The older name is Wittlesea runners, as Wittlesea Mere, now drained, was once the famous skating ground of the Fens. All the fastest skaters of England come from the Fens, and they have a peculiar style, and use a special skate suiting that style. The skates have wooden tops, or "woods" about the length of the boot, with a steel blade about $\frac{3}{16}$in. thick. This blade is flat, or nearly flat on the ice, from the sharp heel to where the front or toe of the wood ends, when it rises with a gradual curve, and forms an extended prow. The sharp heel upon which the skater stops himself lies under the centre of the heel of the foot, unlike in the American and Norwegian speed skates, where the blade extends backwards behind the heel. The blade also projects from the wood more at the heel than the toe, giving the skate a pitch downwards from heel to toe. A heel strap and a long front strap crossing twice over the toe, bind the skate firmly to the foot, and a large heel screw and two or three sole spikes keep it from sideway movement. This firm yet simple attachment is necessary, as the powerful Fen stroke makes the skate peculiarly liable to shift on the boot. The Dutch, Americans, and Norwegians who rival our Fen men, all use different skates, and claim theirs are the best. Perhaps their skates suit their style of skating best, and all are thus right in their claim. See and Smart, who won this and last year's International professional, and the Englishman who won the International amateur race, all used a skate called the "Standard Racer." I may add that the fullest information about Fen skating and skates is given in a book called "The Handbook of Fen Skating," by N. and A. Goodman.—C. G. TEBBUTT.



[64884.]—**Lemons.**—In Tropical climates the juice of this fruit is invaluable in purifying the blood and acting as a solvent of bile. Great thirst usually attends disorder of the liver, in those dangerous remittent fevers of India, which this vegetable acid greatly alleviates. I can inform "M.D." that chiretta, in combination with the mineral acids, is a very potent cholagogue. A fat and lazy native of Madras complained to me that he was very ill—he had "no bile in his body!" After administering a short course of the above, he came to me saying "bile was pouring out of him!"—EOS.

[64887.]—**Small Turbine.**—The formulæ for turbines are given in the books; but for "one man-power" special designs might be necessary. I should say make a turbine of any good low-pressure pattern, the power being equal to the quantity of water in cubic feet per second, multiplied by the head (12ft. in your case), and [illegible]079. You will see you do not give an important factor—the quantity of water: it might be a thin thread or a veritable torrent. It is no satisfaction [illegible] answer such questions.—W. L. P.

[64889.]—**Bassoon Reeds.**—You cannot make ɔn reeds unless you can procure the suitable of reed or cane. All you would want is a knife to split, and one of the little iron-planes to shape them. They are never sold ly to suit the player, and he has to scrape , usually at the thick part, to soften.—L. M.

895.—**Manufacture of Rubber Substi-** ɩ.—I would recommend "Hammer" to search ecords at the Patent Office for the informa- ıe requires. He might no doubt find much in volumes of this paper; but it is quite certain f anyone discovered a useful substitute for rubber, or rather something that could be such, he would at once procure a patent. I no doubt that if "Hammer" advertised for information he would get it—on terms.— . DOR.

902.] — **Fire-Lighters.** — Coal-oil, tar, the oils, crude petroleum, and several other s will do to steep the blocks of wood in; but , question whether it pays. Why not add the c., when making the fire; or is it that you to make a commercial article? If so, would st the advisability of experimenting with ow-priced material of an inflammable cha- '—say, creasote.—OBERHOF.

924.]—**Chiretta.**—I have been trying this for some time, and have arrived at the con- ɪn that it will be very useful. The cold in- ɑ (make it with cold boiled water) is a more ınt beverage than much of the so-called bitter ıld in London: it is certainly cheaper, and is less if not beneficial. I for one am obliged ɔos" for drawing attention to it.—NUN. DOR.

955.]—**Chloride of Zinc and other ering Fluids.** — I simply notice Mr. ısley's rather weak attempt at criticism to out (1) that the information of welding steel ıot offered as new, and (2) that information ı to Mr. Maudsley and to me may be "stale, dreadfully stale," may be "new and valu- ' to a great many other people. I wrote for needing the information, not for those to ı it is "stale, stale, dreadfully stale."— ɪY W. STANLEY, 5, Billson-street, Poplar, on.

957.]—**Endless Chain for Raising Water.** ım much obliged to "J. A. P." for his reply ' question. May I trouble "J. A. P." with ɔllowing questions?—1st. Is it necessary for lates to be in close contact with the pipe or l all the way up to the discharge? 2nd. d this do to raise water from a well 40ft. ' 3rd. Would not the friction be consider- owing to so many plates rubbing against the ɑll at the same time?—GWALIA.

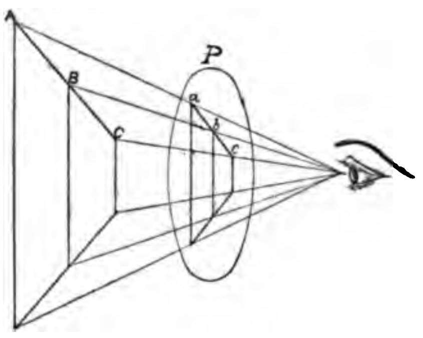
971.]—**Ordnance Datum Level.**—In my to query 64270, p. 517, Vol. XLVI., I stated ;h water at Liverpool is just 25ft. above low ." I am informed by an officer of the Royal neers (who has been engaged on the survey) I am in error: the mean range is about 6in.—F.R.MET.SOC.

971.]—**Ordnance Survey Datum.**—The ion of the Ordnance datum has no bearing on of the Old Dock sill. The Old Dock was up in the year 1827; but the level of the ıas always been used as the datum for the tide-tables and charts at Liverpool, and its ion is still rigidly preserved on a marble slab ted in the east wall of the Canning Dock. Ordnance datum is the level of mean tides at :pool obtained from the records of the self- ling tide gauge on George's Pier, and is in. above the datum of the Old Dock sill.— . J.

013.]—**Marine Boiler.**—The use of salt : in the boiler will tend to promote very rapid sion, and should be discouraged where pos- Where it cannot well be avoided great care e management of the boiler should be exer- and frequent cleaning insisted upon, so as to l against excessive deposits and consequent ıeating of plates. To counteract corrosion, has been used with very satisfactory results, ially in the boilers of the Navy.—A. S., y City.

019.]—**Gas-Engine.**—I have not seen an e made from Dorrington's castings; but as I r from your reply it is made on the non- ression principle, I should say you cannot ert it into a compression engine without more ıle, and expense too, than you would incur to castings especially made for a compression ıe. I should recommend (if it is possible) to hen the stroke to at least twice the diameter, ; more. Sketch and description of governor week.—ENGINEER, St. Mary Ch., Torquay.

027.]—**Perspective.**—The original question ɔt appear to me to refer to panoramic repre- tion, or to any but the ordinary perspective on ıe. In the case I alluded to, if A B C are upright equal posts on level ground, in a ıal plane, and P the picture plane, or base of the cone parallel to the plane of the posts, it is clear, however much smaller A and C may appear to the eye than B, owing to the angle subtended by them being less than that subtended by B, the representation of the posts on the picture plane will show the same proportional diminution, as they subtend the same angles; consequently, whatever bending the sky-line A B C may appear to have to the eye on each side of B, the same bending will the line *a b c* seem to have on each side of *b*. But A B C is a straight line, as is also *a b c*. This, I think, will satisfy "Art Student" that there is no occasion to represent the bending except by a straight line. As soon as the picture plane ceases to be parallel to the front of the houses, though still vertical, angular perspective comes in, and the sloping of the horizontal lines to their respective vanishing points is apparent. But here, as before, straight lines must be represented by straight lines.—G. G. B.



[65040.]—**Steam Engine.**—L. Terry's inquiry is not quite clear, though I presume that he wants to know what the water or steam consumption of his engine will be. The data given, however, are not sufficient. If he will consult any one of several books on indicator practice, such as, for example, Chas. T. Porter's work on "The Richards' Steam-Engine Indicator," he will find the method of computing steam consumption from an indicator card very clearly explained.—A. S., Jersey City.

[65063.]—**Vertical Sundials.**—In erect dials declining east or west—

(1) Tan. distance of substile from meridian $= \dfrac{\text{sin. decln.} \times \text{cotan. lat.}}{r}$

(2) Tan. diff. longitude $= \dfrac{r \times \text{tan. decln.}}{\text{sin. lat.}}$

(3) Sin. height of stile $= \dfrac{\text{cosin. lat.} \times \text{cosin. decln.}}{r}$

When the above calculations are made, "Iliad" or John Greaves can dispense with logarithms, and proceed to construct their dials by means of the ordinary dialing scales sold by mathematical instrument makers; or, better still, let them make the scales themselves, leaving the line of hours 1½ft. long so as to mark every minute.—H. L. M.

[65069.]—**Atmospheric Pressure.**—Though I cannot speak from experience in the way of actual test, I think it reasonable to expect collapse of the four or five-foot copper ball floats under the conditions. With the much smaller floats used in steam traps and similar devices, but, of course, under much greater pressure, collapse has been found a vexatious difficulty, and protection against it has been sought by special means, such as the introduction of strengthening rims. Even these have not always proved entirely satisfactory.—A. S., Jersey City.

[65080.]—**Shed Roof.**—I haven't time to wade critically through F. Caws's long rigmarole *re* this, but will point out that he just manages to get the roof to stand in a dead calm, and allows nothing for wind pressure or possible snow.—T. C., Bristol.

[65088.]—**Coffee-Maker.**—Allow me to sincerely thank the five correspondents who answered above query. I may state that I heated the coffee-maker by means of a small Bunsen burner applied directly underneath it, which failed to answer on account of the steam generated finding its way out of the pipe instead of the infusion of coffee. I am now going to try a gas burner blank in the centre, with a row of small holes round the circumference, so that the heat will be applied higher up the sides, in the same way that the flame of the spirit was, with which I have succeeded.—SHUNT.

[65093.]—**Engine.**—My apologies are due to "Novice" for the error in area I made in my hurry. I appear to have given the circumference instead. Area of 48in. diam. is 1809·5sq.in., so that

$$\text{power} = \frac{1809{\cdot}5 \times 9 \times 2 \times 16}{33{,}000} = 15{\cdot}8\text{I.H.P. for each}$$

effective pound pressure on the piston. If boiler pressure is 50lb., the effective average pressure, deducting 2½lb. for back pressure in condenser, = about 52lb. I am not sure how you use the word "absolute"; it is sometimes taken as being the boiler-pressure (as per gauge), and sometimes as the gauge-pressure, plus 15lb. If boiler gauge is 35lb., the average pressure would be about 40lb. In the one case I.H.P. would be 821, and in the other 632. Your calculation by Armstrong's rule appears correct, but the formula should be

$$\frac{(8 + (2{\cdot}75 \times 2)) \times 30}{5{\cdot}73} = 70{\cdot}68 \text{ instead of as}$$

printed. Taking the same argument that I used before—viz., grates 6ft. by 2·75ft. or 33sq.ft. to each boiler, giving an I.H.P. of 66, it would require ten boilers for the lower power and twelve for the higher power. In above you will notice I have taken the "16 strokes per minute" as meaning double strokes, or, in other words, as revolutions. If compression takes place towards end of stroke, boilers required would be eight and ten respectively. T. C., Bristol.

[65096.]—**Geocentric Longitude and Latitude.**—I am obliged to "F.R.A.S." for his replies to my queries. As regards the last, however, having reference to the conversion of R.A. and Dec. into geo. long. and lat., he has misunderstood me. My query had no reference to long. and lat. on the surface of the earth, but to geocentric long. and lat. of celestial bodies. I wished to know if there existed any tables for the ready conversion of the R.A. and Dec. of a celestial body into its geoc. long. and lat.? This conversion can, of course, be worked out by spherical trigonometry, and apart from the slight disturbance occasioned by the varying obliquity of the Ecliptic, a given R.A. and Dec. always corresponds to a given long. and lat.; and I am desirous of knowing whether there exist any tables in which these results are set forth without the labour of calculation in each instance.—FINSBURY.

[65112.]—**Watch Repairs.**—ERRATUM.—For "ruby ring," read "ruby pin."—J. W. M.

[65113.]—**Shafting Rollers for Wringing Machines.**—If "Dublin Subscriber" means the rollers of the ordinary wringing and mangling machines, he can do it as follows, without any screw tackle:—Put old rollers in lathe, turn them down to spindle an inch or two from the ends to escape the rings and wedges, then knock off ends of roller from spindle; he can then get spindle out by splitting remaining part of roller to pieces. If spindle is bent (they generally are), make it hot, straighten it, and get it to run true, particularly where bearings run. If square spindle, bore hole through centre of wood (sycamore is the best) half way from each end, eighth of an inch larger than the flat of spindle. Then get piece of square iron (longer than roller), and eighth of an inch smaller than spindle; get it hot and burn out the hole square, taking care not to make the hole too large; then drive in spindle with copper or white metal hammer, turn off ends to length, recess the rings in and drive wedges in between rings and spindle; then turn roller to proper size. If spindle runs out of truth after fixing, you can straighten it by means of copper hammer.—F. J. W.

[65126.] — **Harmony.** — In correcting the "Harmony Papers" in Vol. XIII., "W. H. S." has made two or three mistakes himself. First he makes D F A flat a minor triad, whereas it is diminished. Next, E G E as major, E G B being intended, I expect. Again, in describing the different forms of the triad, he says "but never two major thirds together;" but how about the augmented triad, C E G sharp. It is found in the minor scale, between the mediant, dominant, and leading note. In C minor it is E flat G B natural. It is a dissonant combination, I know; but then so is the dim. triad, it (the diminished triad) being an imperfect form of the dominant tetrad. The augmented triad being, according to some theorists (see Macfarren's "Six Lectures on Harmony at Royal Institution," page 176), an imperfect or incomplete form of the dominant minor 13th.—HUGH HARDING.

[65126.]—**Harmony.**—TO "MAJOR."—Have you Stainer's Harmony (Novello, Ewer, and Co.'s Music Primers, 2s.)? If not, get it. Mr. Grey's reply (p. 199) is, I fear, much too clever for you. We must disagree with him when he says, "In the key of C minor the triad borne by G is major." It is so only when the third—B flat—is raised. Normally, it is G B flat D (the triad minor on the tonic of G minor); but with the raised third it is G B natural D (the triad-major on the tonic of G major). If he tells us that in the scale of C minor B is always natural (that is, as you will understand later, a major third from G), we must again differ. If that were so, the triad upon E (E flat is the proper name), in the scale under consideration, would be E flat G B natural, an augmented triad. As you will learn, it is usual to designate intervals less than major by half a tone minor, and less than minor by half a tone, diminished. So our friend in the Tyneside is again slightly at fault when he calls D F A flat and B natural D F "diminished" triads. "Minor" or "imperfect" would be more truthful.—PHILOMATH.

[65132.]—**Cooling Water for Engine.**— As water boils in a pure vacuum at 102° and gives off steam equivalent to 1lb. pressure above pure vacuum line, thus causing, theoretically, only 14lb. instead of 15lb. of a vacuum inside the condenser, it is advisable not to deliver the water from hot well at more than 100°, although cases are known where it is delivered at as much as 150°, and still yielding, practically, an average vacuum of 8½lb., the injection water being at 122°. But the best practical results are obtained with injection water at 60° and hot well at 100°, requiring thirty times the quantity of water evaporated in the boiler for condensing purposes. Your engine uses perhaps some 40 cubic feet of water as boiler feed per hour, and thus would require 40 × 30 = 1,200 cubic feet per hour for condensing. A 24 hours' supply, which with good cooling arrangements would about suffice, represents 1,200 × 24 = 28,800 cubic feet, so that an enormous cooling surface in the form of reservoirs would be necessary. A possible way of cooling small quantities might be by elevating the water from hot well by a special pump to about 20ft. high, and allowing it to pass through sieves and over inclined surfaces, and finally falling to the tank; but, confined as your space is, and considering the power required to elevate the water, and the very questionable point of its having after all sufficiently cooled, it will be the better way to compound your engine and use it, as hitherto, as non-condensing, applying a good feed water-heater, an economiser for heating, to highest possible point. Small quantities of water from condenser may be cooled by elevating it to the roof gutters of factory and allowing it to circulate along them and through sieves, and to fall on to inclined surfaces in the form of rain; but you could at most deal in this way with 1-15th only of the quantity you require.—MARIENBERG.

[65141.]—**Watch Springs.**—The colour of the paper merely indicates the firm; but the higher the numbers are, the stronger the spring.—W. D.

[65143.]—**Storage Cells.**—Hitting exactly the right consistency of the paste is one great point in making it hold in. This can only be got by trials; but it has to be a good stiff paste. Next, the shape of the holes in the plates has a good deal to do with it. If they are made like two cones joined at their points, and the bases on the sides of the plates, the paste cannot fall.—ALBAN.

[65144.]—**Engine Query.**—The actual power of your horizontal engine is $8\frac{66}{275}$H.P., found by the following rule. Multiply area of cylinder in square inches by effective pressure in pounds per square inch, minus 3lb. for friction, and by speed of piston in feet per minute. Divide the product by 33,000, and the quotient will be the actual H.P.—ARTHUR BIRD, Brandon.

[65144.]—**Engine Query.**—No doubt "T. C., Bristol," will have seen his mistake long before this is published. I make I.H.P. to be—

$$\frac{\overset{\text{area of piston.}}{50{\cdot}26} \times \overset{\text{aver. press.}}{2} \times \overset{\text{rev.}}{23} \times \overset{\text{stroke.}}{140 \times 2}}{33000} = \overset{\text{nearly.}}{20\text{ I.H.P.}}$$

"W. M. J., Dublin," has calculated 140 *strokes*, not *revolutions*.—TARA.

[65144.]—**Engine Query.**—"T. C., Bristol," has made a nice slip by using the circumference for the area. Now the H.P. or work done accurately

$$= 2\frac{Apna\left(1 + \log._e \frac{l}{a}\right)}{33000}$$

A = area, p = steam pressure, n = number of revs., a = space described by piston before cut-off = ·5 stroke, l = length of stroke, $\log._e \frac{l}{a} = \log.\ 2 = {\cdot}693$.

$$\therefore \text{H.P.} = \frac{8^2 \times {\cdot}7854 \times 30 \times 140 \times {\cdot}5 \times 1{\cdot}693 \times 2}{33000}$$

Slide-ruling or multiplying out we get H.P. = 10·82.—S. I. C. E.

[65144.]—**Engine Query.**—The mean pressure upon the piston is approximately 25lb. per square inch, as you cut off at half-stroke, and the requisite formula is—

$$\frac{A \times P \times S}{33{,}000} = \text{I.H.P.}$$

where—

A = area of piston in square inches.
P = mean pressure per square inch.
S = speed of piston in feet per minute.

In your case, A = 65·9, P = 25, and S = 140 × 2 = 280.

$$\frac{65{\cdot}9 \times 25 \times 280}{33{,}000} = 13{\cdot}9\text{H.P.}$$

—FREDK. WALKER AND HYDE.

[65144.]—**Engine Query.**—If *lg* 30lb. this much above atmospheric pressure, therefore 30 + 15 = 45lb. is meant, and also that it is the pressure *of admission*, and not merely the boiler pressure *(which is always with saturated* steam, and so *some cases very considerably more than is* available at admission), the mean force of the steam may be found by the well-known rule—

$$p = p^1 \times \frac{l^1}{l} \times \left(1 + lg\ \text{nat.}\ \frac{l}{l^1}\right)$$

in which p the mean pressure, p^1 the initial or admission pressure per square inch, l the length of stroke, and l^1 that part of the stroke passed through by the piston before the steam is cut off. Thus, in your case—

$$p = 30 \times \frac{6}{12} \times (1 + {\cdot}6931472) = 38{\cdot}1\text{lb.}$$

Deducting atmospheric resistance = 15lb. remains nett, 23·1lb. per square inch of piston. Then for I.H.P.—

$$(8^2 \times {\cdot}7854) \times 23{\cdot}1 \times (12 \times 2 \times 140) = 9{\cdot}85$$

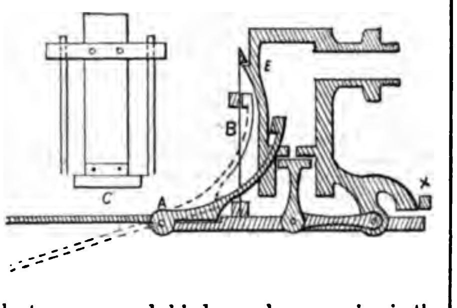
of which from 50 to 75 per cent. may be considered as effective or brake H.P., according to quality of finish and materials. A simple rule for ordinary non-condensing single-cylinder engines, is to divide diameter of cylinder by 2·5, and square the product = I.H.P. For condensing engines, divide by 2, and square the product. This gives approximate H.P. for average conditions, single slide-valve, 220ft. piston speed, and admission pressures of 50lb. per square inch absolute. It is, of course, only applicable for approximation and rough estimates. By this rule, and under these conditions, your engine would be—

$$8 \div 2{\cdot}5 = 3{\cdot}2\text{, and } 3{\cdot}2 \times 3{\cdot}2 = 10{\cdot}24\text{H.P.}$$

Conversely, the diameter of cylinder for an engine of a given I.H.P. may be found by extracting the square root of H.P., and multiplying by 2·5 for non-condensing, and by 2 for condensing engine. Thus engine power to be 10·24I.H.P., $\sqrt{10{\cdot}24} = 3{\cdot}2$, and $3{\cdot}2 \times 2{\cdot}5 = 8$in. The effective on brake H.P. will always be less than this, varying from 25 to 50 per cent., according to workmanship and materials.—MARIENBERG.

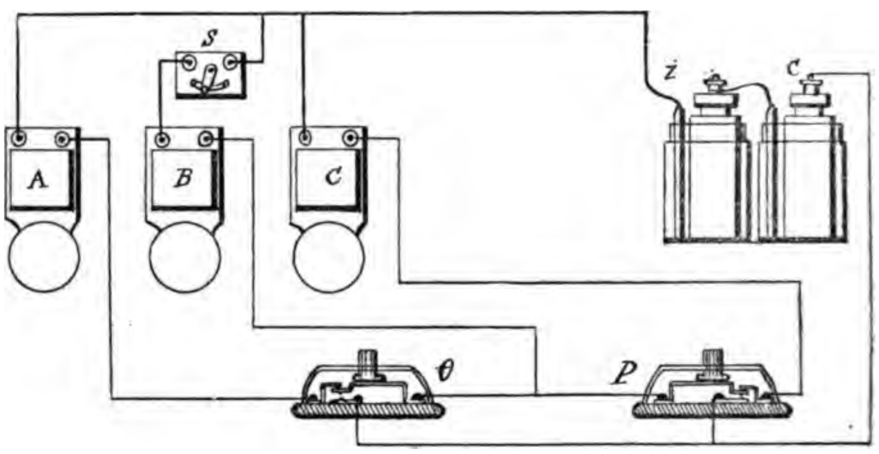
[65144.]—**Engine.**—I see I used circumference instead of area in this reply also. The area of 8in. dia. = 50¼in., or double what I gave, so that power will also be double, or, say, 8½ to 9I.H.P. I have allowed for losses between boiler and piston. —T. C., Bristol.

[65145.]—**Automatic Tank Filler.** — Make your lever with a knuckle joint as shown at A, which should also be provided with two curved arms, which pull back the spring B, when the float falls into the position shown by dotted lines. C shows the arrangement viewed from front, where the two arms are behind cross-bar on spring in the act of pulling it forward. The stop D is to prevent the valve getting out of its place; let the tooth E form a square corner; don't V it out like a ratchet wheel, or the lever will not release the spring.—ALADDIN.



[65154.] — **Beam Blowing Engine.** — Your valves appear to be leaky, both on steam and exhaust sides. The leakage on latter is serious, as it reduces the vacuum very materially. We are of opinion, from the appearance of your diagram, that you have arranged the indicator cord in such a manner that it exerts a side strain upon the indicator. This should be rectified in future diagrams and cord led straight from guide-pulleys on drum base to radius rod, or other point of motion. There appears to be nothing amiss save the leaky valves; if this is remedied the fall of pressure after cut-off will be regular, and the vacuum better at commencement of return stroke.—FREDK. WALKER AND HYDE, 4, Little Moorfields.

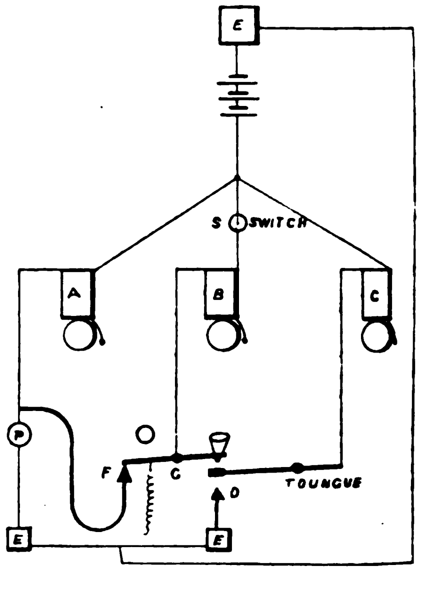
[65155.]—**Electric Bells.**—It is not possible to arrange the bells on the two wires in the manner you describe, but the accompanying diagram will show you the best method of connecting them up to meet your requirements. Double-contact pushes of the form described on page 380 of last volume must be used, and the switch S should be of the form shown in Fig. 46, page 569. Push P will ring bells A and B, while push O will ring bells C and B; but when the arm of the switch is moved over, A and C will ring separately.—F. C. ALLSOP, Brighton.



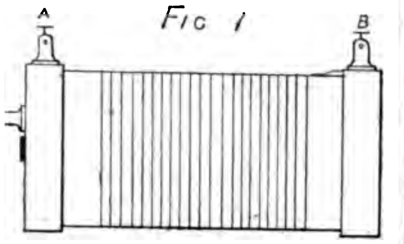
[65155.]—**Electric Bells.**—I send diagram, which works under the conditions you require—viz.:

With switch S "on" P rings A and B.
O rings B and C.
With switch S "off" P rings A.
O rings C.

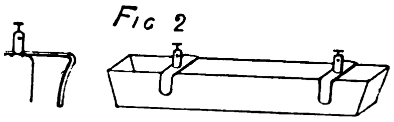
It will be seen that a special key or push is required, technically known as a "back contact key," with the addition of a tongue contact in between the two front ones. It works as follows:— The key is pivoted at G, and the spring keeps the back part normally in contact with stud F. On depressing key, the front contact, the tongue-piece, and stud D are all together, while contact at F is broken.—W. PERREN-MAYCOCK, A.S.T.E.



[65157.]—**Induction Coil.**—"Steam" would require to state more fully what he wants his coil to do before anyone can answer all his questions satisfactorily. The following general hints from a new contributor may, however, be useful. If the coil is merely to give "shocks," then two layers of No. 16 for primary, and for secondary quite a few layers (five or more) of almost any from No. 26 to No. 36 will suit. A pint mate will work such a machine easily. As flanges, that is entirely a matter of taste; the coil is required to give long sparks or to Geissler tubes the bobbin should be wound nany layers (fifteen or more) of No. 36 silk- d, with careful insulation. More battery will also be required. In this case I leave tails to experts like Mr. Bottone. I would ffer advice on two points—(1) Do not put secondary than, say, 1lb. of No. 36 on any n not in sections; (2) keep the last layers of lary well away from the binding-screw con- with the first layer, to avoid sparking working with a powerful current. That can ne in either of two ways—(1) If A, Fig. 1,



nected to first layer of secondary, and B to ayer, then keep wire well back from A; a flange on the bobbin will also help ame direction. (2) Put a small bind- crew at C, where the secondary wire , and make A a mere dummy, not in wood, and quite unconnected with wire. as to the condenser. From my own experi- I have come to the conclusion that the action condenser is not yet fully understood. I y construct my coils with a simple "cut- o that the machine may be used either with ndenser or without it. This is very inter- . My experience is as follows:—With small nd small battery power, such as would be or "shocks," the condenser makes little or ference to the physiological effect. Even coil of some size the same is true. With coil and a powerful current, of course, I not experimented physiologically; but the king-down" powers of the condenser I e to question. For lightning tubes, on the hand, the condenser is of immense value. It ses the effect many times. Insert a "cut- and you will be delighted with what you hereby learn. For regulator a brass tube is the arrangement is difficult to make, and it s the effect of the core. Use a water regu- but the glass-tube form is a humbug. The ing (see Fig. 2) is simple and very handy:



om your china merchant an old-fashioned rough (about 8in. by 1½in. by 1½in.) such as o be employed for holding flowers on a -table. Mount two bridges on this, one and one movable, with wires to dip into If the coil has not much wire on the ary, a slight pinch of salt in the water will ve its conductivity.—TEACHER, C.D.

58.]—**Model Gas-Engine.**—If those cor- dents who have not thought it possible to mall gas-engine to work will look in at the w of Messrs. Merryweather's fire-engine Long-acre, they will (unless it has been ed lately) see a small gas and pumping-engine ng a fountain. The cylinder is, I should about 4in. by 2½in. It has double eccentrics very heavy flywheel.—C. H. B.

58.]—**Gas-Engine.**—The engine illustrated to work, though it does not represent a good f gas-engine. The defective portion seems the igniter, which you should modify by ng a cast-iron box, with slide, to the opening side of your cylinder, and allow the jet to hrough, close to slide. Said slide may be l by a lever from the eccentric, and the jet be shielded by a plate. This modification not be costly, and you would then be able to the engine.—FREDK. WALKER AND HYDE, le Moorfields, E.C.

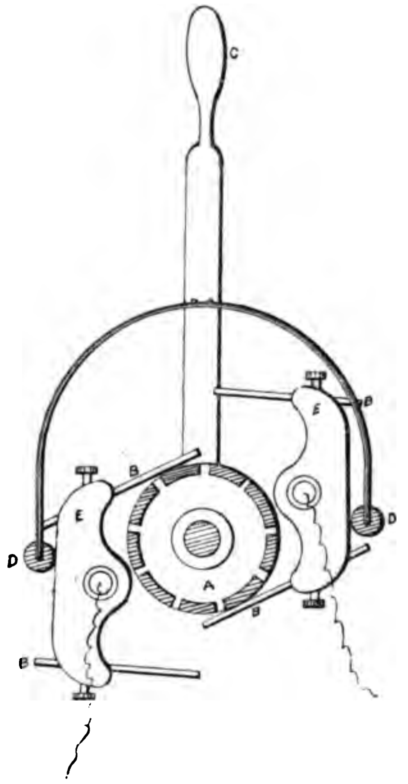
58.]—**Gas-Engine.**—Discard all clack and alves for the admission of gas and air, and the piston-valve alone the means admitting arge; you can then make sure of getting the proportions. The I.R. valve with a little erneath will stick, and the clack valve may oo heavy for the gas to lift sometimes, so that you may get too much air one time and too much gas another. The igniting apparatus is also very uncertain, the jet not being in the right position, and too far away from the opening in the cap. When the piston uncovers the passage, and the flame of igniting-jet is drawn towards the valve, a stream of air is also drawn in, and sweeps away the explosive mixture before the flame reaches it, thus causing a "miss-fire," at other times making the explosion late. A better plan would be to invert the gas-jet or burner, so as to keep it just above, clear of the opening, and inclined downwards towards it, and in the upper part of the brass cap insert a small jet, opening inside the valve. This would have the effect of charging the orifice with gas, which would be ignited by the outside flame, and a body of flame would be drawn into the cylinder immediately the piston in its ascent uncovered the opening into the igniting-valve or chamber. These suggestions I leave to your inventive abilities to put into practice.—ENGINEER, St. Mary Ch., Torquay.

[65161.]—**Elasticity.**—"Elag" seems to have ignored one important law of elasticity, which, stated with reference to this problem is: that if a pull of 1lb. stretches a piece of elastic 36in. long 2in., it will stretch the same piece when 18in. long 1in. The vertical component of the stretch of half the length of the rope is correctly stated as 18in. (tan. *a* − sin. *a*), and as each inch of stretch in the half-length is produced by 1lb., this expression also represents pounds, and must be equated to the half weight suspended at the middle, that is to 1lb, so that—

$$\tan. a - \sin. a = \tfrac{1}{18}, \text{ instead of } \tfrac{2}{18},$$

from which it will be found that the deflection of rope in centre is 9·1715in.—M.I.C.E., Bath.

[65163.]—**Electro-Motor, Reversing.**—TO MR. BOTTONE.—Any device, whereby the direction in which the current enters the armature is altered without changing the direction of the current in the F.M.'s., will do this. Below is figured the ordinary Reckenzaun's reversing gear,



where A is the commutator, B B the brushes in contact with it. On turning the lever C over to the left, the little rollers D D slide along the pivoted carriers, by so doing removing the brushes B B from contact, at the same time causing B′ B′ to touch the commutator. A commutator having its segments arranged in a spiral fashion round its axis can be made to reverse current, and, consequently, rotation, by simply sliding the brushes along its length. This latter device is due to Prof. Silvanus Thompson.—S. BOTTONE.

[65164.]—**Hot Brazing.**—You must have the article very hot when you put on the brass turnings or filings, previously mixed with borax and water. Chief points to look to are that the joint is perfectly clean, and that there is enough heat. If you are brazing two pieces of brass, you will want heat enough to nearly melt them, so be careful. Try on odd pieces.—ALBAN.

[65169.]—**Lever.**—Divide longer by shorter arm; quotient will be proportion of power to weight. Thus, if you have one weight, A, 1lb., just 1in. from centre, and another, B, 1½ from centre, on the opposite side, then to balance, B must be two-thirds of A. If you move B another ½in., it will be the half of A; another ½in. will make it two-fifths of A; next ½in. makes one-third, and so on.—ALBAN.

[65171.]—**Evaporation.**—This will depend upon temperature of liquid and pressure, and especially temperature of steam used. To evaporate 100lb. of water from 60° requires, first, to raise to boiling point (212 − 60) × 100 = 15,200 pound-degrees; and, second, to evaporate from boiling point, 966·6 × 100 = 96,660 pound-degrees, or, together, 111,860 pound-degrees. If steam of 30lb. super. pressure of a total heat of 1197° were injected into the 100lb. of water at 60°, it would require 1,197 − 212 = 985, and 111,860 ÷ 985 = 114lb. of such steam. In actual practice 15 per cent. more would be required by reason of the water carried over along with the steam. No more steam should be turned on than can be condensed by the condensing surface; and to evaporate from 202° you require per 100lb. of water evaporated per hour, with copper coil and copper jacket, about 7½sq.ft. of condensing or heating surface, which ought to use up all your steam, except perhaps a mere vapour arising from the condensed and the hot water passing over with the steam.—MARIENBERG.

[65172.]—**Ritchie's Revolving Magnets.**—There is an advantage in using the stoutest suitable wires on the moving bar, not only for the general reason quoted by "A. I. E. E," p. 221, from my book, but also to prevent heavy sparking at the breaks, which burns and scatters the mercury at the discharge of the extra current. Mr. Bottone, by an oversight, has reversed the relations of size of wire to the E.M.F. Generally in electro-magnets either fine or large wire will answer by varying E.M.F., or getting the required ampère turns from a fixed E.M.F.; but with rapid breaks these are best obtained by the ampères rather than the turns.—SIGMA.

[65175.]—**Oil Painting.**—Hunt was born at Liverpool in 1830 and educated at the collegiate school there. He first exhibited in the Royal Academy in 1854, and his picture was "Styehead Pass, Cumberland."—W. D.

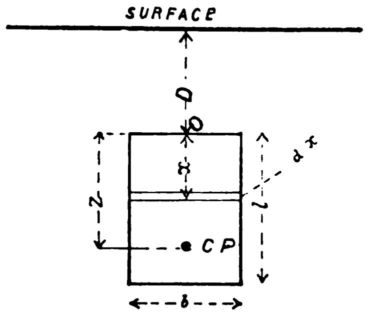
[65177.] — **Methyl Orange Indicator — Errata.**—For $NaOHyC_{10}$, read $NaOH_7C_{10}$. For Thompsen, read Thomson.—NO SIG., *alias* CHEMIST.

[65177.]—**Methyl Orange Indicator.**—TO "NO SIG."—I thank you very much for your excellent reply to my query; it is so different from the generality of answers, as the usual desire seems to be to appear to say much while committing oneself to nothing in particular. May I ask you what indicator you think best to use with $H_2C_2O_4$? I have prepared two solutions direct—viz., Na_2CO_3 and $H_2C_2O_4$, and wish to titrate one with the other.—YOUNG ANALYST.

[65178.]—**Hydrostatics: Centre of Pressure.**—Suppose the distance below surface to top of rectangular plate = D, and we require to find distance of centre of pressure below top of plate, which distance we will call Z. Take a narrow horizontal strip of width dx (afterwards supposed to become infinitesimal) at any distance x below top of plate, then the area of this strip is $b\,dx$, where b is the width of plate, and if we call the weight of one cubic foot of the liquid W, the pressure on the strip will be $W\,(D + x)\,b\,dx$, and the moment of this pressure round O at top of plate will be pressure multiplied by the length of the arm or x, the moment of the strip will therefore be $W b\,(D + x)\,x\,dx$, or $W b\,(D x + x^2)\,dx$. The sum of the moments of all such strips as make up the whole plate will then be represented by

$$W b \int_o^l (Dx + x^2)\,dx,$$

the limits of the integral being o and l. The two



terms of this expression can be integrated separately, and no constant is required to b added to the result, which will be sum of moments $= W b \left\{ \frac{D l^2}{2} + \frac{l^3}{3} \right\}$. But the sum of moments is also equal to the whole pressure on the plate multiplied by the arm Z, that is $W \left(D + \frac{l}{2} \right) b l . Z$; if these two expressions are put in the form of an equation (being equal to each other) we get $Z = \frac{l}{3} \cdot \frac{3D + 2l}{2D + l}$. It will be seen that if we put $D = o$ in this expression Z becomes $\frac{2l}{3}$, which agrees with what is already known. Again, suppose D to be very great compared with l, the second terms in the numr. and denomr. may be omitted, in which case $Z = \frac{l}{2}$, or at great depths the centre of pressure agrees with the centre of gravity.—M.I.C.E., Bath.

[65179.]—**Retorts.**—I should advise "No Sig." to place retort or still on a sand-bath and apply the gas flame underneath it. Luting would depend on what the chemical action is that it is required to stand.—SHUNT.

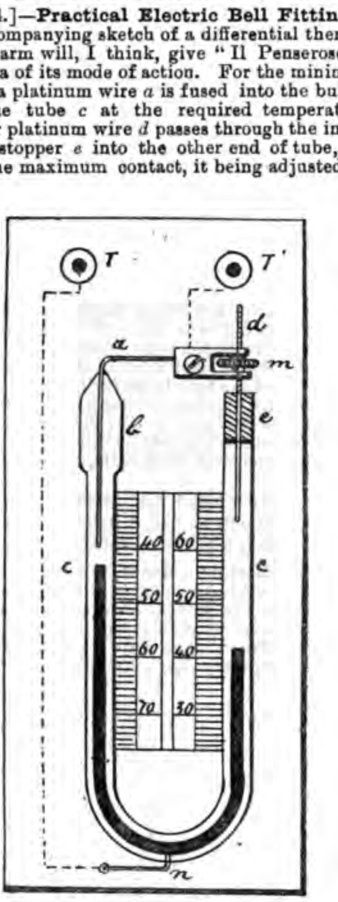
[65181.]—**Indian Jugglers.** —As your correspondent "G. G. B." intends to explain the basket trick, I need not take up your space further than to say that the trick is made far more exciting when they have a small bag of blood tied to the inside of the basket, through which the juggler passes the sword and brings it out dripping.—J. A.

[65181.]—**Indian Jugglers.**—The Indian basket trick, like the Mango-tree trick, depends upon momentary concealment by a blanket. What I remember of it, and I have seen it pretty often, is as follows:—The conjuror's four or five accomplices, with their paraphernalia, baskets of snakes, bags, and other impedimenta, squat in a half-ring on the ground, so excluding any too curious observation on their side. About a yard in front of this group the juggler places the basket, which is oval, and bulges out at the bottom as shown below. The

boy is brought forward, and feigns the greatest terror on being directed to get into the basket, but is eventually ruthlessly made to enter it. The opening is then closed with a wicker cover. The conjuror now takes a sword, and viciously forces it through the top and sides of the basket in several directions, carefully avoiding the boy, who is curled round the inside edge below. At every thrust of the weapon heartrending and excruciating cries are heard. These by degrees subside, and after a moan or two all is silent within. The boy is slain. At this stage the conjuror removes the cover, and dexterously throws a large cover or cloth over the basket. It is at this moment the boy effects his exit, and crawls under the blanket towards his accomplices behind the basket, who assist his retreat. The boy's movement is further disguised by the conjuror beginning to tread the blanket into the basket, which he does gradually, making it shake from end to end with great noise and fuss over the operation. Before it is all trampled in the boy is concealed among the accomplices. The conjuror again puts the cover on the basket, which, apparently containing the dead body of the boy and the blanket, remains exposed to the full view of the spectators. To gain time and to divert attention he now performs an attractive and independent trick. This finished he returns to the basket, removes the cover, and slowly withdraws the blanket, exposing it freely to view. Then looking into it he evinces the most lively surprise at finding no traces of the boy. Finally, he raises the basket, turns it upside down, and shows it empty to the spectators. At this moment the boy runs up to him from among the crowd. The trick is well done, and accompanied by a great deal of pantomime and by-play. But many people, in describing it, make it more wonderful by forgetting to mention the important part played by the blanket. When I have seen the trick performed the basket was not placed over the child as mentioned by "Eos,"—a plan which, if the blanket were thus thrown over the two, would make the child's departure more easy than in the case I have described, where the boy had to escape from the top; *but the trampling* in of the blanket could now be *omitted. I never noticed* any excitement on the *part of the mob, to whom it* was *familiar* enough, *being of daily, perhaps hourly,* occurrence. After all, the similar tricks performed in Europe are, in my opinion, quite as marvellous.—G. G. B.

[65183.]—**Hydraulics.**—I am sorry to find I stupidly gave the initial velocity with which the steam would first enter at the lower end of the bore-hole, instead of the required velocity of delivery at top end of bore-hole. The delivery is 92 gallons per minute.—FRANK CAWS, Sunderland.

[65184.]—**Practical Electric Bell Fitting.**—The accompanying sketch of a differential thermometer alarm will, I think, give "Il Penseroso" a good idea of its mode of action. For the minimum contact a platinum wire *a* is fused into the bubble *b* of the tube *c* at the required temperature. Another platinum wire *d* passes through the india-rubber stopper *e* into the other end of tube, and forms the maximum contact, it being adjusted for any temperature by milled screw *m*. A third wire *n* is fused in the glass tube at the bend, this wire being always in contact with the mercury. The bulb *b* down to the top of the mercury is filled with spirit. T T′ are the two terminals, the connections being shown by the dotted lines. Any rise of temperature above 65 will close the maximum, while any fall below 40 will close the minimum contact.—F. C. ALLSOP, Brighton.



[65192.]—**Potassium.**—The method "Principia" quotes for the determination of the above element may be applicable, but I very much question it. I have seen all the newest and latest editions of books on qualitative and quantitative analysis, but in none of them have I seen the above methods quoted. Has "Principia" ever tried them? Perhaps "T. L. W." has not dried his platino-potassium chloride properly. You should heat your precipitate to about 120° C., or even 150° will do no harm. Of course a great deal depends upon manipulation, some persons are not born to make correct chemical analyses. The determination of potassium is certainly rather difficult, and in my own case I never have used platinum chloride. In separating sodium and potassium, I first weigh as sulphate, and then, after converting into chloride, by means of lead acetate or baryta, titrate with standard silver solution. If your salt consists of a sulphate, the following is an extremely simple method of determining the potassium: Boil up a weighed portion of the sulphate with an excess of baryta water, then pass carbon dioxide through the liquid until it is thoroughly saturated, boil down to about half its volume to precipitate any bicarbonate formed, filter, wash, and titrate with a normal acid. The reaction that takes place is—

$$Ba(OH)_2 + K_2SO_4 = BaSO_4 + 2HOK.$$

Each cc. of the acid is equal ·00471gm. Ka_2O, from which K may easily be calculated. This method, I can state from experience, gives good results, and can easily be performed in an hour. If the salt happens to be a chloride, you can adopt the indirect method commonly described for sodium determinations—namely, weigh the chloride, and then convert into sulphate.—CHEMIST.

[65193.]—**Indicator Diagram of Gas-Engine.**—To test the brake H.P., multiply the circumference of flywheel by the number of revolutions the engine is making per mi
into feet, and multiply the sum by the
indicated on spring balance, and divi
I prefer using a disc of wood, wit
turned in the edge, and substitute a
band.—ENGINEER, St. Mary Ch., To

[65195.]—**Corns on Horses' F**
never known corns to be cured; but
made easier. If you are a shoeing smit
pare the corns out clean till the blood
frog and the crust should not on any ac
only level the crust with a rasp. The
be made very strong, and fitted not
heels. If your horse is very lame, a b
proper thing. The shoes should be n
the heels. If you are a horse owner, p
smith to follow these directions.—V

[65198.]—**Cost of H.P. of Engine**
same amount of cut-off, same pist
pressure, the cost of both will be th
beam-engine is a good wearing engine
able for high speeds. You will find
neers swear by it through thick and
Bristol.

[65201.]—**Bursting Pressure o**
The bursting stress on both these
same, supposing height and diameter
The pressure being independent of
water in the tank, but dependent o
and the bursting stress on sides =
× 62·5, where dia. = diameter and
tank, both expressed in feet.—ELAG

[65201.]—**Bursting Pressure o**
Find the pressure at any point due to
that point. You may take this at ½l
depth as near enough (·433lb., really).
pressure is evidently at the bottom.
pressure on the steel is—diameter
pressure, as found above. The shape
has nothing to do with it, provided
—T. C., Bristol.

[65201.]—**Bursting Pressure o**
Let D = feet diameter outer ring.
H = feet total head of water in t
C = pounds safe stress per inch
of material.
C = 13,500lb. for wrought iron i
compression.
C = 5,000lb. for cast iron in
20,000lb. in compression.
62·5 = pounds water pressure per sq
surface at 1ft. head.
Then D ½ H 62·5 = pounds pressure on
cylinder 1ft. high at level ½ H. And D ½ H
= inches section area of ring 1ft. high at le
And $\frac{D\ \frac{1}{2}\ H\ 62{\cdot}5 \times \frac{1}{2}}{C\ 12\text{in. per ft.}}$ = inches safe thickn
cylinder at level ½ H. To make the thick
each level proportional to the stress, theoreti
the cylinder must have no thickness at top (
line) level, because there is no stress there
likewise no thickness at bottom, because
stress is there neutralised by the face of
bottom. For it can be easily de
any plain cylinder closed at the b
open at the top has its maximum
not at the bottom, but at ½ H. B
practical conditions limit the applicat
in this, as in other matters. The ab
apply as closely to tanks like Figs. 1
as to plain cylindrical tanks with
And, as the strength is inversely pr
the diameter, if "R. M." would m
(Figs. 1 and 2) of uniform strength th
must make the inner rings of less th
the outer (the more so in the case of
account of its compressive exceeding
tensile strength). In apportioning
of the truncated cone, the value of th
same at each level as for the upright
the D is a variable, which can easily
by dividing the height into so man
calculating the stresses on each slice
must also be remembered that thou
pressure is not *nil* at the top of this
the solid top neutralises the stress at
FRANK CAWS.

[65202.]—**Keeping Tube at Re**
ordinary spirit-lamp, with two or t
each furnished with a wick, similar
lamps used to drive model locomotive
do this without the aid of any blowpi
coil will be necessary.—S. BOTTONE.

[65205.]—**Bottle-Washer to Dri**
—TO MR. BOTTONE.—A small dyn
constructed for this work, could be u
a few cells. Say that you could keep
going for six hours a day, you migh
11in. cells so as to get about four hou
a 5c.p. lamp of about eight ohms
BOTTONE.

[65204.]—**To Mr. F. C. Allsop.**
you to double the number of your
the bell without a relay. However

... one ... up the bobbins with ... Connect up as shown in Fig. 55. ... ell will scarcely be sufficient to work the ... nothing is gained by cutting down the ... ower.—F. C. ALLSOP, Brighton.

]—**Enamelling.**—If "Artist" will rub ... with a little powdered talc before coating ... dion, I think he will find no difficulty in ... s print to strip when dry.—TALC.

]—**Enamelling.**—The glass should be ... om the centre, previous to coating with ... with powdered French chalk, omitting ... n of the glass, or the print will not strip ... :ly. About three to four drops of castor ... ierally recommended to be added to each ... plain collodion.—J. W. M.

]—**Enamelling.**—I gave the process in ... [." some time since, but will go over it ... "Artist's" benefit. Get plate glass ¼in. ... round than the prints, clean very care- ... a chamois skin, powder over with talc and ... t off, pour on the enamel collodion in the ... as is done in the wet process, allow it to ... warm the plate gently on a sand or water ... ur on common negative varnish in the ... mer and allow it to cool. Dip the print ... solution of Cox's gelatine (1oz. to 10), and ... to the varnished enamelled plate. Go ... vith the back of the forefinger or a soft ... to squeeze out the air bubbles and surplus ... allow to dry for twelve hours, mount a ... on to the back of the print in the usual ... w to dry, then cut all round with a sharp ... id the enamelled photo. will jump from ... —at least, that is my invariable experi- ... Sc., Plymouth.

]—**Enamelling Photos.**—The prob- ... are that you are adding too much castor- ... collodion. Try to rub the glass over with ... araffin wax, and then rub it all off with a ... an flannel. A very good way of glazing ... phs, which are not to be afterwards ... is to clean a sheet of glass, flood its ... vith clean water, soak the photo. in water, ... urface downwards on the glass plate, ... ng it lightly so as to get it in optical con- ... the glass. When dry the paper will ... ie off the glass, and will be found to have ... illy glazed surface.—S. BOTTONE.

]—**Compressed Oxygen.**—You require ... pumps for this purpose. I should strongly ... to let the compressing of oxygen alone, ... we shall hear more of you through other ... the "E.M."—CHEMIST.

—**Logarithms.**—This will be more ... stood if we take the original equation ... the logarithmic equation is derived, ... it first. It is—

... tan. A = sin. L tan. H,

... he hour-angle, L the latitude, and A ... wish to find. If we make H = 90°, ... side of the equation is infinite, ... tiple of infinity is also infinite, and ... ust also be 90°. If the latitude is 0, ... or, A must also be 0, whatever H ... g that the shadow lines at any hour ... each other and to the meridian. ... the logs of both sides we get—

... = log. sin. L + log. tan. H.

..., the right-hand side is infinite, ... ing is added to infinity the result ... onsequently log. tan. A is infinite. ... n. A is infinite, and therefore ... ore. If L = 0, we have log. ... -hand side; but the log. of ... y, the addition of log. tan. H to ... lifference; hence the left side ... finity, or tan. A = 0, or A = 0 ... ., Bath.

... for **Porcelain.**—You can ... our pots by simply mixing some ... er, and applying with a brush. ... is 3 of lead to 1 of flint. Any ... l do to fire them in. Ground ... e, and felspar can be had from ... od Mill, Hanley, Staffordshire.

... **Chemist" or Mr. Grey.**—I ... bags were steeped in solution ... ed in alcohol before use.—

... **ser.**—As salt-water contains ... ns to deposit at $\frac{1}{32}$, or slightly ... you may evaporate ⅔ of the ... 24in.—T. C., Bristol.

... **Morse Circuit.**—If this ... ce at p. 225 of "Longdon's ... city to Railway Working," ... sketched, very clearly show- ... Any one of them can, of ... itched out of circuit.—

[65218.]—**Jumelle's Marine Glass.**—I suppose this query should be something about soldering brass, and without seeing the parts it is not easy to advise. If the surfaces are properly cleaned, warmed up, cleaned again, and then supplied with the chloride of zinc flux or soldering fluid, I see no reason why the joint should not be made. There are several recipes for the black enamel in back volumes.—NUN. DOR.

[65219.]—**Motor Dynamo.**—To MR. BOTTONE.—If you make a motor with a 5in. armature, you should have a dynamo of at least same size and equal power to work it. If well wound as a shunt machine, it will also serve as a dynamo. As a dynamo it would give about 10 ampères at 35 volts, and would require about ½H.P. to drive it. The little dynamo described in my book would drive it; but would not enable it to do any useful work. It would require a current of about 10 ampères at 35 volts to develop its full power, when it would give out about ½H.P.—S. BOTTONE.

[65221.]—**Photographic Lens.**—1. Lerebours' lenses do not possess a high reputation. 2. From the focus given for a half-plate lens it is probably of the rapid rectilinear type, and suitable for landscapes or groups. 3. Cut the slit exactly between the lenses. 4. Usually six stops. 5. No. 1 about F 40, No. 2 about F 30, No. 3 about F 20, No. 4 about F 15, No. 5 about F 12·5, and No. 6 about F 10. F 10, &c., = the focal length divided by the aperture of the stop.—B.SC., Plymouth.

[65221.]—**Photographic Lens.**—Lerebours' lenses were nearly all of them excellent. I possess a little quarter-plate portrait, which is a gem in its way; the field being remarkably flat, and the definition good. Your lens is a half-plate, *id est*, will cover a plate 6½in. by 4¾in. for portrait work. It does not really need a stop for this work; but if you must put them in, a slit should be cut in the sliding tube, midway between the back and front combinations. The stops may vary in size from ¼in. to 1½in.—S. BOTTONE.

[65222.]—**Reservoir.**—As you have about 900 cubic feet of water per minute, this works out at between 6 and 7H.P., as you state.—T. C., Bristol.

[65222.]—**Reservoir.**—To get 7 effective H.P. out of Poncelet wheel driven by 6ft. head, you would have to widen your sluice and wheel buckets to 21in., and you would need a supply of 1,031c.ft. of water per min. But your supply is only 911c.ft. Your sluice must then be, say, 1ft. high by 19in. wide, and this with a 6ft. head will consume all your water and give fully 6E.H.P. minimum.—FRANK CAWS, Sunderland.

[65222.]—**Reservoir.**—"Beardmore" gives the mean velocity of a surface running at 405 per minute to be 362·5ft.; then $362\cdot5 \times 4\cdot5 \times \cdot5 = 815\cdot6$c.ft. per minute, and $\frac{816\cdot6 \times 62\cdot5 \times 6}{33{,}000} = 9\cdot26$H.P. (theoretic). But I think it is admitted that even a good Poncelet would not give more than 60 per cent. of efficiency; if so, the actual power would be 5·5H.P. Besides, there will be some loss of head when the sluice is opened, which even the big reservoir will not eliminate. But while not approving generally of turbines, this is a case for one, the fall and quantity being moderate, and if the ground and contour were suitable, the reservoir (which may be a costly thing) could be dispensed with or reduced, as it is really not required, except perhaps for ornament.—W. M. J., Dublin.

[65224.]—**Designing Machine.**—If "Kenelm Collings" will advertise his address also, I will send him some of my designs, wth the positions of weights respectively. He can make a great variety of diagrams by altering the position of the pendulums on the arms, the weights being altered at the same time; also by substituting shorter laths to hold the pencil, which ought to be very finely pointed.—H. T., Stockton Rectory, Rugby.

[65226.]—**Lathe.**—You can easily fit a cone pulley; but as the sizes must be so very small, it would scarcely be worth while.—T. C., Bristol.

[65230.]—**Kainite** (or kainit) is mined at Stassfurt, in Prussian Saxony, some twenty-five miles south of Magdeburg, in Germany, and, as sold by the royal mines at this place, is guaranteed to contain 12·4 per cent of pure potash (protoxide of potassium) = 23 per cent. of sulphate of potassa. The total average analysis of the production of the works for the year 1882 was:—

	Per cent.
Sulphate of potassa	24·22
" " magnesia	16·67
Chloride of magnesium	12·19
" " sodium	30·95
Insoluble matter	0·97
Water	15·00
	100·00

It occurs in large deposits on the outcrop of the salt deposits at Stassfurt, and is treated at surface by grinding, &c., and thus made in fit condition for agricultural purposes. ... delivered on truck at Stassfurt, is- ... was—17s. per ton. Dr. Staute, assay... royal mines at Stassfurt, would, witho... give every information as to its uses ... direction of the royal mines inspection ... Stassfurt, every information as to pres... freight, &c., to Hamburg or other ... MARIENBERG.

[65229.]—**Bunsen Batteries.**—To M... TONE.—One pint Bunsen cell, if in good c... will fuse 1in. No. 40 platinum wire easil... such cells coupled in parallel—i.e., zinc to ... carbon to carbon—will fuse 2 or 3in. of t... wire. Perhaps the porous cell of one of you... is very dense, or most likely there is a fault ... connection between the top of the carbon a... binding screw.—S. BOTTONE.

[65232.]—**Direct Transformer or ... tensity Coil."**—Mr. Milnes will do well to ... to letter columns (Ap. 20).—W. PERREN-... COCK.

[65232.]—**Intensity Coil.**—There are ... 900 yards in 6oz. of No. 38; there are onl... yards in 2lb. No. 26. Hence, supposing that ... could get this latter to lie as closely as the for... the tension of the spark would be as 6 is to 9; ... it would be a thicker and fatter spark owing t... greater quantity. Paraffin wax is the best i... lator.—S. BOTTONE.

[65234.]—**To "Dutch Paul, Jeypore."**—T... ferocious fly you mention was either one of t... Ichneumon tribe, of which there are seve... species; or one of the insect-hunting wasps ... probably the latter.—EOS.

[65235.]—**Intensity Coil.**—It would be bett... to use the No. 38 wire for the secondary coil, ther... being a greater number of yards of wire in the 6oz ... No. 38 than in the 2lb. No. 26; hence you woul... get more power if you used the fine wire. I think a solution of shellac in methylated spirit would be preferable to paraffin wax as an insulator, and is much easier applied, no heat being necessary.—H. F. C., Liverpool.

[65237.]—**Varnishing Wimshurst Plates.**—The best method of varnishing the plates is to take a large brush, dip it in a saturated solution of shellac in methylated spirits, and apply it to coat both surfaces of the plate which has been previously placed on a revolving table. One large brushful should coat one side of a plate. The brush should not be removed from the plate till the whole of one surface is coated, which will prevent the formation of air-bubbles. The delicate test of feeling the plates for dryness is quite unnecessary, but if "G. H. D." makes the test before the plate is dry, he will certainly mess his fingers.—J. G.

[65239.]—**Voltmeter.**—Perfectly simple. Connect the electro-dynamometer to the terminals of the lamp while burning at its proper power.—W. PERREN-MAYCOCK.

[65239.]—**Voltmeter.**—One of the Crompton-Kapp potential indicators, specially fitted with soft iron needle, for indicating alternating currents, will do what you require.—S. BOTTONE.

[65240.]—**Dynamical Problem.**—The "monkey problem" caused a good deal of correspondence two years ago. P. E. Bateman would do well to obtain the numbers, and read in conjunction with any replies he may have.—T. C., Bristol.

[65240.]—**Dynamical Problem.**—The monkey would pull the counterweight up as fast as he would pull himself up, and if both started from same level, the weight and monkey would meet at the top. This would take twice as long as for the monkey to climb up if the rope were quite fixed at top.—FRANK CAWS.

[65240.]—**Dynamical Problem.**—If the monkey and the weight have exactly the same mass, and the rope is weightless and inextensible, the action of the monkey climbing upwards would be the same as if a force was drawing the two bodies together (as the attraction of gravity). This force would resolve itself equally between each body, and by the law of attraction each body would move upwards at a speed directly opposite to its mass, which in this case would be equal. Then the monkey would have to climb through twice the distance of rope from itself to the pulley, and would move both itself and the weight upwards at the same speed. The above is on the condition that the pulley is frictionless, which P. E. Bateman does not give; also that both monkey and weight are started at equal vertical distances from the pulley. Practically, the amount of the friction of the pulley would have to be deducted from the power resolved into moving the weight, which would give a corresponding additional speed to the monkey.—H. G. B.

[65240.]—**Dynamical Problem.**—This mon... question was very fully discussed ... about a year ago ...

monkey and the weight would arrive at the top at the same time. It is hardly a mathematical question, and it can be understood better by analogy. I remember the illustration I gave was this: Suppose two men sitting in as many Bath chairs at some distance apart on a smooth, level road, both being exactly the same weight, and the friction on the road being the same in each; then it is clear that if the two men each held the end of a rope, and one of them pulled the rope, the two chairs would approach each other until they met; here the friction on the road takes the place of gravity in the monkey case. If the rope passed round a pulley, the result would be the same. Again, suppose that the pulley was at the apex of two steep roads of the same slope, the chairs being on each side, the result would be the same; finally, we may suppose the slopes to become perpendicular, so that only gravity is acting, the result would still be the same.—M.I.C.E., Bath.

[65242.] — **Formula for Gradually Decreasing Scale.**—This query seems rather vague, as a gradually decreasing scale may mean anything. Thus it may decrease as the square roots, or it may be a logarithmic scale, or the difference between two divisions may be a certain percentage of either of them, or the difference may be a constant quantity, &c., &c. Taking the latter, suppose the first and last of the series to be 12 and 2, and number of divisions 100, then the second division from bottom of scale would be $2 + \frac{10}{100} = 2{\cdot}1$, and the next 2·2, and so on, each division being greater than the one below, or less than the one above, by $\frac{1}{10}$th.—ELAG.

[65247.]—**Lifting Boiler.**—If chain is new use a sling whose links are formed from $\frac{3}{4}$ iron, but have a little slack in the sling blocks, three sheaves at top and two at bottom, and a rope $3\frac{1}{2}$in. circumference, if new.—T. C., Bristol.

[65247.]—**Lifting Steam Boiler.**—Use one treble and one double sheave blocks, sheaves 8in. by $1\frac{1}{2}$in., $4\frac{3}{4}$in. rope (circ.), or $\frac{7}{16}$in. chain. To make sling pass a $\frac{3}{4}$in. or $\frac{7}{8}$in. chain round boiler so as to form a loop. The duty of these blocks will be, say, 65 per cent., so that when hoisting 5 tons, you will have about $1\frac{1}{4}$ ton strain on the rope or chain leading to winch. All gear must be good.—TARA.

[65247.]—**Lifting Steam Boiler.**—A short link $\frac{7}{8}$ths chain, with 1in. and $1\frac{1}{8}$in. end links, attached by a good smith, and these end links of good iron, would be right for 5 tons. Get a pair of blocks (iron), one with three sheaves and the other with four, or at least both with three sheaves, and to suit a rope of 4in. circumference, of manila. See that the blocks have good hooks; better to get some experienced person to pass them; then another chain over your beam equally good, and lead away your rope to crab winch.—W. M. J. Dublin.

[65249.]—**Gypsum for Garden.**—In this query your printer has put *so* instead of *do*, thus altering a question into a statement of fact.—THE BRAE.

[65250.]—**Colouring Leather.**—I have found the "Diamond" dyes, as advertised, an inexpensive and effectual method of colouring leather, which can be made any colour or shade required. Care should be taken to put the colour on evenly, and not to rub much when working on the book. The ordinary law calf I always use: I find it takes the colour best. Any oil-shop would be able to supply them.—LONDON V.B.

[65253.]—**Halation**—Is caused by the reflection of the light passing through the thin film, and reflected back again by the back surface of the glass plate. Can be best remedied by painting over the back with some non-actinic colour, either orange, yellow, or black.—S. BOTTONE.

[65253.]—**Halation.**—The scientific explanation is simply that the light is reflected from the back face of the glass as well as on the film, and so causes fog. Just as if you look carefully at a candle-flame reflected in a piece of glass, you will see an indistinct flare of light round the flame caused by reflection from the back of the glass as well as the front. I should not think your plan would answer, as you would get the picture *wrong way on*, and this would not improve it. Backing the plate is perfectly efficient, and quite as simple. —R. A. R. BENNETT.

[65253.]—**Halation.**—Is scientifically described in Captain Abney's "Instructions in Photography" (*q v.*). Rays of light entering a film are scattered by the particles of the silver salt, and obeying well-known laws of optics impinge again from the surface of the glass support; the best remedy is to use paper negatives, which reduce the fault to a minimum; no reflection can take place except in the film itself. The next best thing to do is to use a suitable backing to the plate in optical contact, that will only reflect non-actinic light. In my own work I cover the back of the plate, by means of a printer's roller, with some stiff, quick-drying carminette ink, and while "tacky" rub on a piece of orange paper. At one time I smeared the back of the plate with glycerine, and then rubbed down a piece of black paper; but the dampness ruined all my negatives treated in that way.—WALTER POTTER.

[65256.]—**Colouring Canvas.**—Steep in bark and water, as is done for tanning sails of fishing boats; or send to a tanner's.—T. L. W.

[65256.]—**Colouring Canvas.**—Boil or steep it in solution of catechu, made by boiling till dissolved one part of catechu in about 40 parts of water; then rinse it in water to which a little alum has been added, and dry. This will not only dye the canvas the reddish-brown colour you desire, but will also make it proof against wet and decay.—M. ISADER, Lewes.

[65257.]—**Brazing Solder.**—You will find one of the following solders easily melt and give good results:—(1) Tin, 2 parts; antimony, 1 part. (2) Copper, 4 parts; tin, 1 part; and zinc, 3 parts.—ARTHUR BIRD.

[65258.] — **Surface Condensing.** — Nothing special about the pumps. Make air-pump two or three times the size of feed-pump and an ordinary plunger pump to supply condenser. Use rubber valves.—T. C., Bristol.

[65259.] — **Oyster Spat.** — The best way to convey oyster spat is on tiles, and if "B." desires it, I can give him an address where he can procure an honest article, if he applies direct to me. The question of how to preserve it through the Tropical part of the voyage is one upon which I can give him nothing else but surmises, and I am afraid that it will be costly to do so, and not unlikely result in failure. If "B." wishes further information, let him advertise his address in the "Address" column, and I will write him.—GLAVE.

[65262.]—**Inflammable Liquid.**—This liquid is probably a solution of phosphorus in carbon disulphide—CS_2, to which a little sulphur has been added. Paper or wood dipped into this mixture and exposed to the air will take fire in a few seconds.—H. F. C., Liverpool.

[65263.]—**Diatom Mounting Dry.**—Try black japan, leaving it exposed to the air a short time before using. Please see advertisements of addresses wanted.—W. F. K., Maldon.

[65264.]—**Borax Toning Bath.**—Is very good for warm tones, but they are not the fashion at present; black and white got by the lime bath is more to my taste. The following is a good formula:—Gold chloride, 1 grain; borax, 60 grains; water, 12oz. To hot water add the borax, and when the solution has cooled to about 70° put in the gold solution.—B.SC., Plymouth.

[65264.]—**Borax Toning Bath.**—Solution of chloride of gold (one grain to one drachm water), 2 drachms; borax, 24 grains; distilled water, 4oz. This solution must be freshly prepared in the above proportions, as it will not keep. Any tone can be obtained with it, according to the depth of printing. A preferable toning solution for amateurs is the following:—Solution of chloride gold (one grains to one drachm water), 1 drachm; acetate of soda, 30 grains; distilled water, 8oz. This keeps well; but must not be used till one day after preparing.—J. W. M.

[65264.]—**Borax Toning Bath.**—I always use this as recommended by Mr. Werge—(1) 1oz. borax in 80oz. of water, (2) 15 grains of terchloride of gold in 15 drachms of distilled water; bath, 8oz. of No. 1 and 1 drachm of No. 2. Prints should be first washed in tap water till all milkiness disappears. The colour depends on the depth of printing, and the time five to twenty minutes or more; the prints are left in the bath. All the ordinary tones are obtainable. The above bath of 8oz. will tone one sheet of paper $22\frac{1}{2}$ by $17\frac{3}{4}$, or its equivalents in quarters, halves, and whole sizes, &c. When it has toned one sheet it may be thrown away. One of its advantages is that it may be used as soon as prepared.—G. G. B.

[65264.] — **Borax Toning Bath.**—A good recipe is (*a*) borax 100 grains, water 10oz.; (*b*) gold trichloride 1gr., water 10oz. Mix in equal parts before using. Another method: borax 1oz., dissolved in hot water and then made up to 80oz. in a Winchester quart as stock. For each grain of gold take 8oz. of stock. In using borax bath no silver must be left in the print. The borax bath will not keep good mixed like the acetate, but has the advantage of being ready for use at once. Photographic experts give it the credit for producing black tones, but not as good as the tungstate bath. Either of the shilling photographic annuals gives you a host of toning and other formulæ.—WALTER POTTER.

WIND-ROLLED snowballs are often noticed on the prairies in Dakota and Wyoming, U.S.A. The force of the storm rounds the masses of snow as neatly as an industrious schoolboy, and frequently millions of these natural snowballs may be seen whirling about, some the size of an orange, others like a cannonball, and some as big as a prize pumpkin.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

64630. Curling Stones, p. 20.
64648. Tricycles, 20.
64651. Convection Currents, 20.
64655. Pianoforte Repairing, 20.
64657. Hot-Air Engine, 20.
64661. Harp, 20.
64671. Oxy-hydrogen Microscope, 20.
64676. Polishing Artificial Eyes, 20.

64892. Mechanics, p. 112.
64899. Blast Furnace Gases, 112.
64910. Huge Aërolites, 112.
64917. Photo-Litho Transfer, 112.
64926. Band-Saw Machine at New York, 112.
64930. To "Moonstarer," 112,
64933. Spectacle Lenses.

QUERIES.

[65266.] — **Leclanche Zincs.** — Should these be amalgamated the same as for other batteries? I have never seen it done.—CONDENSER.

[65267.]—**Gas Engine.**—Would "W. O. S." kindly give the size of his igniting valve, also the size of the hole entering the cylinder and the distance of the hole from the bottom of the cylinder? A few particulars in respect to his piston valve would no doubt be interesting to a large number of "our" readers as well as myself.—S. B.

[65268.]—**Basic Sulphate of Mercury.**—Can any reader oblige me with a process for making this? What would be the cost for, say, 1lb.?—CONDENSER.

[65269.]—**Piston Valves.**—Are these applicable to small engines? What depth should the packing rings be compared with the ports?—T.

[65270.]—**Compensation Pendulum.**—I wish to make an ordinary one-second zinc and steel pendulum. A few hints will oblige. Is the length of rod measured to centre or bottom of bob? Proposed weight of bob 5lb.—A. W. G.

[65271.]—**Steam-moved Engine Valves by a Subsidiary Cylinder.**—Is this patented? If so, by whom and when? How is motion of engine slide-valve checked or cushioned without causing recoil? A sketch would oblige.—T.

[65272.]—**Soldering Fluid.**—Wanted formula for flux not containing chloride of zinc. For use with soft tin solder to solder brass wires either to zinc or copper background. Must have no obnoxious smell.—C. J. H.

[65273.]—**Braiding Patterns.**—Can any reader inform me how to put various patterns upon fine canvas for braiding over by a machine? I have tried stencilling with a zinc stencil; but I cannot make the pattern stick firmly to the canvas.—BRAIDER.

[65274.]—**Cost of Engines.**—Would "T.C., Bristol," or some one else inform me the difference in cost of working 6H.P. beam engine (single cylinder) compared with modern horizontal engine same size? Am told beam engine costs more to run.—J. BATES.

[65275.]—**Model.**—I am making a small model to go by clockwork, and it is to be worked by the clickwheel with the balance wheel in; but it does not go fast enough, nor is it strong enough with the balance in. Will some one kindly tell me how to arrange the wheels so as to go a little faster, and to be a deal stronger on.—A JOBBER.

[65276.]—**Roofing Felt.**—I should like to have some authoritative information on the manufacture of roofing felt. By purchasing the felt in its untarred and therefore light state, there would be a considerable saving in carriage. If "E. G." would kindly favour me with information as to the process of tarring the felt and finishing it for the market, it would oblige.—M. SMITH.

[65277.]—**Carbons.**—I have a number of Fuller cells under my charge, and lately several of the carbons have become electrically disconnected from their lead tops. Will some one kindly tell me how to put them right? Have tried soaking, but that does not have any effect upon them.—W. N.

[65278.]—**Water Colour.**—Will any reader kindly inform me what liquid will remove colour from paper for taking out lights, &c., after the colour has dried, without injury to paper or brushes, as it is sometimes necessary to insert a pale tint or small touch of colour in the deepest shadows, and I find I cannot do this effectually with water only? The above would be a very useful addition to the colour-box.—CHROMO.

[65279.]—**Electro Motor.**—Will some one kindly explain, in referring to this article in the issue of April 6, how the motor is started and how the speed is regulated? What is the little arm shown in screw, Fig. 6? Does the disc revolve on the boss? If so, would not the brushes be always in the same position? As regards the revolving armature shaft, would eight Leclanché batteries work this motor? If not, what is the cheapest way to form eight plunging bichromate cell batteries?—W. H. M.

[65280.]—**Electric Bells.**—I have lately made and fitted up an electric bell to street door. It works perfectly, with but one exception. Sometimes on the button being pushed the bell will not ring; but if pushed again a few minutes later the bell rings as well as could be wished for. The bell is not overworked, and the stoppage takes place after bell has been at rest some hours. Perhaps some reader has had similar experience and can tell what is wrong. Battery, one cell Leclanché.—TAMBAL.

[65281.]—**Slide Rule.**—What do the figures, called the 8 square line, under the girt line of a common slide rule mean?—M.

82.]—**Magnetism.**—When a piece of soft iron in contact with a magnet it becomes a magnet itself, milarly with a second piece that comes in contact he first piece. The magnetic power, however, de- s; but in what proportions? How much weaker is cond piece than the original magnet?—M.

83.]—**Pictures.**—Will some person kindly write a or two on the composition of a picture and com- on of colours. This would be science, not art (art the putting science in practice), and therefore would tedto the pages of THE WORLD OF SCIENCE. Such r or papers would enable some of us to form sounder ons on pictures.—P.

84.]—**Electrical.**—Will some one kindly advise the following case? I have constructed a coil 7in. magnet ¾in. (No. 16 iron wire), primary 2 layers No. ., secondary No. 40 s.c., 9oz. in weight. A brass tube over magnet as regulator for medical purposes, and leads soldered on to secondary to different powers. layer is well varnished and insulated. The condenser, eets tinfoil 6 by 4, insulated with paraffin paper, is ate, and joins on to two terminals on base-board, d underneath to spring and contact breaker by copper . I find with 6in. vacuum tubes I can get an inter- nt spark through (as well without condenser as with); an make no impression upon 8in. tubes. When con- r is in circuit the action seems stronger; but on ing up the platinum screw of contact breaker so as shorter vibrations it seems to become attached to et head before contact is made. I am using three ries, each 2 carbons, 5 by 2½, packed in broken gas n and porous pot containing sheet zinc, 6 by 4, rolled as to enter porous pot, the whole charged with bi- n. pot. 6oz., water 1qt., and sulphuric acid in propor- of 1 to 10 of the bichrom. fluid. Should I get better and more suitable for occasional use if I made ary battery, 2 carbons and 1 zinc in each cell, and ed the fluid in a well stopped bottle for future use? as to how many cells of the above I should require 5c.p. lamp to use for occasional experiments.— LCROCHAN.

285.]—**Electric Bells.**—Could any reader help in ollowing? A push at the hall door to ring bell on op floor. There is also a bell and indicator from the s on the first floor. The push at door is required to the two bells in the day, and at night the one on the nly. The hall door does not show on the indicator. the Editor's permission a sketch showing how to and connect the wires would oblige.—J. B.

286.]—**Frosting Window Panes.**—Will any er with successful experience kindly tell me the way ost window panes with a thick and durable coating of ate of magnesia (Epsom salts)? I have seen some were beautifully coated (on one side only) with a ing so thick as to prevent one's distinguishing anything gh it. The frosting varied in form and pattern on nt panes, some having a large pattern, others all , and some mixed; but all thick and beautiful. I old it was simply Epsom salts and beer. I tried some English and some with German beer, and some with r, and got my salts from different pharmacies, but ith the same result—viz. a beautiful frosting, but quite dry so thin as to be easily seen through. I be glad of any advice as to how to get a thick coating time, as the lady members of the family will not of any more experimenting, and a thin coating is useless. Also can the coating bear varnishing, so permit of the windows being washed, and what other are suitable, so as to get a variety of patterns. Please t give quantities in pennyworths.—A CHRISTIAN , Constantinople.

287.]—**Coil.**—Having made an intensity coil, whose is 8in. long and 1in. diam., formed by a slip of fined cartridge paper, 8in. wide, wound round a ruler diam. The reel ends are ⅝in. mahogany, soaked in fin. The primary wire (No. 16 c c.) paraffined two s, over which are 4 layers of paraffined cartridge r. The secondary wire, No. 36, about 12 layers fined, and 2 layers of paraffined cartridge paper be- n each layer. The condenser 50 sheets of tinfoil, 5 by 3, as described in the "E. M.," No. 1,170. The core 18 B.W.G., with vertical clapper in front. The spark the secondary terminals are fully constant, but in ng shocks from the primary by the loop circuit through der regulator, these are received by intermittent jerks. can I remedy it, or from what cause. I have taken coil to pieces and rewound it, softened teeth, core, and per, and tried different vibrating springs, but with no er result. The same effect if condenser is detached. clapper does not work uniformly. Is it caused by an ced current from the secondary, or what?—R. L. C.

288.]—**Self-testing Sums.**—Could any of your ers help me to a good system of self-testing sums? I the systems in ordinary use which depend upon the s of every answer adding up, say, 13, or several 13's— ., 6749553, or 28cwt. 3qr. 16lb. 6oz. But the iple of such a system once known, my victims olmasters and their pupils) can, after a time, find out rticular number that the adding up of the digits is ted to yield, and the system becomes valueless. I omething less easy of detection, but quite as easy correcting of the answers to anyone in the secret. ke sums for any such system, you take the answer nt and then work backwards for your sum. But ethod is not easily applicable to multiplication, ou want sums with multipliers containing two or igits. Having written down your answer, it is not le, without laborious trials, often ending in failure, whether a number of two or more digits can be to divide that answer without remainder. Is there way of manufacturing large numbers of multiplica- ums (simple and compound) to satisfy a self-testing ?—ASSISTANT INSPECTOR.

89.]—**Barometer.**—TO MR. BOTTONE.—I have a barometer. Tube ⅜in. bore and cistern 1½ by ⅝ by ⅝. the best mercury and washed it with nitric acid and , 1 part to 15, and then rinsed several times to purify filled the cistern full of mercury, and then carefully the tube to the brim with mercury, tapping the tube the air bubbles rose to the top. I then held gold- r's skin over the end of the tube and inverted ly in the mercury. Will Mr. Bottone kindly say if above dimensions for tube and cistern are correct, and his plan will give a sufficiently good working barometer. If not, will he give me particulars how to prepare the mercury for the tube, and the best way for filling the tube free from bubbles. I know that the mercury is sometimes boiled; but I believe this is a difficult and rather dangerous operation. I simply want instructions to make a good working mercury barometer such as an amateur can accomplish.—M.

[65290.]—**Direct Transformers or Induction Coil.**—TO MR. PERREN-MAYCOCK.—Would it be possible to utilise these for incandescent lighting—i.e., to transform a current from a primary battery of low E.M.F. and large current, to high E.M.F. and smaller current? If this is possible would you kindly indicate method of carrying it out? I may mention I am not an electrician; but it occurred to me that this could be done when reading your description of the above in conjunction with a lecture describing the Grosvenor Gallery system, in which it appears they utilise dynamos giving very high potentials and small current, and transformers to give smaller potentials and larger current, and I cannot see why this could not be done on a small scale by using a primary battery instead of a dynamo and reversing the process.—A. B. S.

[65291.]—**Beewalk Clock.**—Having seen a very pretty and ingenious form of clock, in which two bees indicate the time by moving round a dial painted with flowers, &c., I am thinking of making one like it, and will be much obliged if some reader will tell me if I can manage it as follows:—By buying a tambourine and painting the parchment for a dial, and fixing inside it the movement of an American clock, with the exception of the hands, in the place of which I propose fixing two arms with small magnets at the end of them. But would the clock be strong enough to revolve properly, and what size and shape should they be, and how could I best make the bees, or would it be best to have the bees magnets, and the arms plain, and are they always likely to be falling off?—DEAD MARCH.

[65292.]—**To "Hygienist."**—I am, and have been afflicted for about nine months with deafness and singing noises in my ears—the left especially is very bad. Some six months ago I went under treatment with an expert, and after paying him a guinea and a half, have to say that I might as well have thrown the money into the river. Another person I went to wanted £5, and he would cure me; but being a Yankee, I thought he would be too many for me, so resolved to let things take their course. I have not recovered yet, having had to borrow the expert's fee. I, with "Shon-y-Gof," shall be very grateful if you can put anything before me so that I may get some relief.—J. E. T.

[65293.]—**Stamping Metal.**—I should be glad of information how to stamp metal checks and small bars of German silver and brass with names and addresses. Are the steel stamps used made uniform in body like type, so as to strike a word at once, or are the letters struck separately? How am I to proceed, and what arrangement is used to insure the letters being level and straight? The letters I should use would only be 1-16 high and what kind of surface is best to stamp on?—QUICKSILVER.

[65294.]—**Great Lick Refractor.**—Will Mr. Sadler or any other of our astro. contributors give me a skeleton sketch of the body tube of this monster of Mount Hamilton, showing form of tube? If with conical ends and cylindrical centre, I should be glad to know (1) length of conical parts with diam. of each end, and (2) diameter and length of cylindrical centre part (if so constructed). As I have a 6in. c a. object glass of about 96in. focus underway, and should finish it to the same pattern if I can obtain the necessary information on the subject, which I have no doubt some of "ours" can supply.—J. K. B.

[65295.]—**Kinematics.**—Should be obliged if any reader will show method of solving the following question? A body, A, is dropped from a point a certain height above the ground. At the intsant of dropping A a body, B, is projected vertically upwards with a velocity sufficient to carry it to the point A is dropped from. Where will the bodies meet—i.e. what height above the ground, and when? Am fairly well up in fundamental formulæ from first principles, but cannot manage this question.—KINEO.

[65296.]—**Chalk Marl.**—Can any geologist furnish me with a list of the localities in Kent or Surrey where this deposit can be seen? I should also be glad to receive local directions in the case of any such localities. The material is required for the study of foraminifera. I know the marl is found at Charing, near Ashford; but have no idea where to look when I go there, and, being no geologist, have found it very hard to recognise deposits in a strange neighbourhood without a guide or full instructions.—RHIZOPODIST.

[65297.]—**Tension in a Cord.**—If two weights, P and Q, hang by a string over a smooth wheel, and P be greater than Q, what is the tension in the string?—(Magnus's "Mechanics," p. 100.) I am unable to see how the tension can be greater than the smaller weight Q. The answer given is $\frac{2PQ}{P+Q}$. Can any brother-Mechanic assist me in following the above?—ARTHUR PULLMAN.

[65298.]—**Science Examination.**—Would any reader kindly inform me the easiest method of determining the molecular weight and vapour density (Victor Meyer's method) of an organic compound? I am studying to pass the practical Honours examination, and am not acquainted with these methods, though well up in combustion and analysis.—W. M.

[65299.]—**Nitrate of Silver.**—I have a quantity of blackened silver precipitated from hyposulphite fixing baths, which I am unable to dissolve in nitric acid. Also a quantity of chloride of silver. I should feel much obliged for information how to turn these into nitrate of silver again.—PHOTOGRAPHER.

[65300.]—**Stereo. Metal.**—We make zinc scrap and have old compo. tube. What should I add to it to get a white cheap metal that would cast freely in raised figures and letters like a rough stero. plate? I have been using equal proportions of stero. metal, zinc, and compo., but it is rather rotten when cast.—RIP.

[65301.]—**Ammoniameter.**—Will some of our able chemical readers kindly give the value of the degrees on these in specific gravities? I have been using them, with official corrections from the Kew Observatory, but find they differ seriously from some of those in ordinary use by gentlemen who certainly know more about them than I do.—RIP.

[65302.]—**Common Perfumes.**—What can be best done with the wasted sweetness of a country garden—i.e., how can the various roses, sweetbriars, &c., be so dealt with as to afterwards yield up their perfume by some simple treatment by unskilled hands?—RIP.

[65303.]—**Lunar Objects.**—Would Mr. Elger or some one of the many selenographical readers of "Ours" kindly give me a sketch or diagram of the lunar formation "Damoiseau"? It is represented so small on Neison's map that it is a work of much difficulty to indentify any of the detail inside the ring.—AJAX OILEUS.

[65304.]—**Welsh Harp.**—I have in my possession an old Welsh harp in fairly good condition, but without strings. Will any reader kindly give me a hint how to string the same? Will ordinary harp string do? Should it be tuned diatonically or chromatically? How many octaves and what scale, &c.? Judging by the tuning pins and belly pins, the strings appear to have been in three rows.—J. D.

[65305.]—**Expansion of Brass Rod.**—What would be the elongation of a brass rod due to expansion between, say, 180° to 280° of heat? From 32° to 212° according to the data I have, it would be ·002 of its length; but as the table only gives the expansion for this limit, and not per degree of heat, I conclude that it is not uniform.—J. MILLAR.

[65306.]—**Base of Isosceles Triangle.**—Will some reader kindly give a simple rule for finding by ordinary arithmetic the base of an isosceles triangle, when the sides and included angle are given? I want to find the exact difference between pitch of teeth when measured on the chord and on the arc.—WHEELWRIGHT.

[65307.]—**Practical Biology.**—Several times, in dissecting the common earthworm, I have tried to isolate and mount in glycerine one of the ovaries, but have failed owing to their small size causing them to be lost in the surrounding substances. Will one who has accomplished the feat give a hint or two gained from experience, in addition to what one may find in Marshall's "Practical Zoology"?—PRACTICAL, Hull.

[65308.]—**Boiler.**—Will "T. C., Bristol," or some other kind friend mention whether a single cylinder, 4in. diam. by 5in. stroke, with a boiler pressure of 80lb. per square inch, would drive a 25ft. launch? What would be the consumption of coal for a speed of 6 miles an hour, and what the dimensions of boiler, and of steam exhaust ports? H. K. F.

[65309.]—**To S. R. Bottone.**—I wish to light a 10c.p. lamp from accumulators for a few hours of a night. I have your book on "Electrical Instrument Making." Will a shunt-wound 30c.p. dynamo of the Gramme pattern charge them? Also how many should I want?—G. A. LEE.

[65310.]—**Duke Violins.**—Can any reader supply me with information respecting violins by Duke? I should like to know what age they may be and the value of one of the best instruments, and as much further information as I can get.—W. H.

[65311.]—**Repairing Meters.**—Could any reader give me any tips on the repairing of wet and dry meters, the regulating of the indices, so as to set them working correctly. If there is any work published that would assist me, I would feel grateful for the information.—J. B.

[65312.]—**Alcoholometry.**—I want to get a method of determining the amount of spirits or alcohol which may be in a sample of stout, ale, cordial, &c., to be as practical and economical as possible. What is the cheapest way of producing drinkable alcohol or spirits? Is there any spirit produced from molasses, and how?—SPIRITS.

[65313.]—**Takigraphy.**—About a year ago the *Pall Mall Gazette* spoke of a simple and legible short hand under the above name, in use "at the best conducted library in the world—that of Columbia College, New York." Could any of your readers kindly give me some particulars of this system, and tell me where I can obtain a book of instructions?—ASSISTANT INSPECTOR.

[65314.]—**Gizzards for Micro. Objects.**—What insects other than crickets have good gizzards for mounting as microscopic objects? In a late number of "E.M.," a report of a meeting of a microscopical society was given where it was stated a number of curious gizzards from beetles were exhibited. Will any one give us their names?—ELECTRON.

[65315.]—**Kinematics.**—It would be useful and interesting to many of us if "A Fellow of the Royal A. S." would give a brief list of some of the "recent arbitrary changes in the terminology of kinematics and dynamics," with any remarks on same he may add.—F. C.

[65316.]—**Microscopical.**—Will Mr. Nelson kindly tell me how I can ascertain if my object glasses (1in. and ¼in.) are really or only nominally what they are called?—F. MALDON.

[65317.]—**Air-Pump.**—Will some one tell me what oil should be used for piston of an air-pump? Also is it possible to prevent leakage into the receiver?—F. MALDON.

[65318.]—**Chloride of Gold.**—How can I set free chloride of gold which has deposited on the sides of bottle?—TERRANOVA.

[65319.]—**Edison's Three-Wire System.**—Will some electrician kindly explain the principle of this mode of distribution.—STUDENT.

[65320.]—**Gas-Engine.**—Will some reader kindly favour me with practical information as to the fixing a 7H P. Otto on a stone or cement floor?—M.

[65321.]—**Model Locomotive.**—I wish to make a working model locomotive, about 2ft. long, to draw one or two carriages in proportion, round a circular railway.—ATHENIAN.

[65322.]—**Trigonometry.**—A considerable number of the questions set in mathematics at public examinations consist of trigonometrical equalities which are required to be proved. I should be glad to know if there is any general method of proving such equalities.—M. C. A.

[65323.]—**Case-hardening Cast Iron.**—Many replies to questions how to case-harden wrought iron have appeared of late in this paper, but as yet no simple and cheap method of case-hardening cast iron has appeared. The writer wants to case-harden articles about 2lb. and under, and from 1-32in. to 1-16in. deep, at a cost of 1½d. or 2d. each, including profit. Can any of your numerous contributors kindly assist me to accomplish this object?—L. E. H.

[65324.]—**Fans.**—Can any reader show me the error of the following calculations? My object is to ascertain the pressure per square foot (due to centrifugal force) of the air contained in an annular box on the outside rim of the same. Total centrifugal force = $W\frac{v^2}{r\,g}$, where W = total weight of air (at 1·209oz. per foot), v = velocity in ft. per second at radius, r = radius of gyration, g = force of gravity = 32·2. Taking depth of box 1ft. and inside radius r, the outer one being R, v^2 = (radius of gyration)^2 × A π^2 × revs. per second^2.

r = radius of gyration = $\sqrt{\frac{R^2 + r^2}{2}}$. Centrifugal force in ounces = $\dfrac{1·209\,\pi^3\,(R^4 - r^4)^2 \times \text{revs.}^2}{32·2 \times 2\sqrt{\frac{R^3 + r^2}{2}}}$ This pressure is distributed over a surface = $2\,\pi$ R. ∴ ounce square foot = $\dfrac{\sqrt{2} \times 4·836\,\pi^2}{2 \times 64·4} \times \text{rev.}^2 \times \dfrac{R^4 - r^4}{R\sqrt{R^2 + r^2}}$, or if revs. are taken at per minute, ounce per square foot = ·00146 revs.^{2} × $\dfrac{(R^4 - r^4)^2}{R\sqrt{R^2 + r^2}}$. The heading of thi letter is for the sake of indexing. The formula when put right ought, I think, to give the pressure to be expected from a fan running in a closed box, as well as for the case of a rotating box, as supposed for simplicity's sake.—N. A. F.

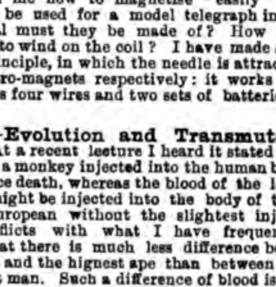
[65325.]—**Magnets.**—I have some horseshoe magnets made from best double shear steel 1¼ wide and 7-16 thick, hardened at a blood-red in cold water, which I wish to magnetise. Could I effect the same by attaching them to an electro-magnet, such as was described in the MECHANIC for April 27th, and what battery power should I require? I wish to use an electro-magnet, as I have others which differ a little in size, so that in the case of using coils they would not do for all. Also, which would give the best results—solid cores or cores built up of sheet-iron? And please say if I am right in choice of steel and way of hardening.—MAGNET.

[65326.]—**Curve of Vessel.**—The half-area of the midship section is 176·2sq.ft., the half breadth 15·135ft., the depth from the load water line to the rabbet of the keel 13·86ft. (the depth is divided into six ordinates). I shall feel obliged if any of the readers of the "E. M." will show how the length of the ordinates is found, so that I may describe a curve that will contain the above area. I would prefer it worked out in figures.—N.A. STUDENT.

[65327.]—**Telegraph Needles.**—Will some one kindly tell me how to magnetise "easily" a pair of needles to be used for a model telegraph instrument? What metal must they be made of? How much wire must I use to wind on the coil? I have made a model en my own principle, in which the needle is attracted by two small electro-magnets respectively: it works very well, but requires four wires and two sets of batteries.—FELIX HOLT.

[65328.]—**Evolution and Transmutation of Blood.**—At a recent lecture I heard it stated that blood taken from a monkey injected into the human body would soon produce death, whereas the blood of the lowest type of savage might be injected into the body of the highest type of European without the slightest injury. This rather conflicts with what I have frequently heard asserted, that there is much less difference between the lowest man and the highest ape than between the lowest and highest man. Such a difference of blood is a very real barrier, to my mind, between man and monkey. How do evolutionists account for this?—C. H. T.

[65329.]—**Radius of Gyration.**—The section of a rotating ring is such that the width w at any point multiplied by its distance r from centre is equal to the width w_2 at any other point multiplied by its radial distance r_2. The radius of inside of ring being r, and its outer radius R, what is the square of its radius of gyration?—GLATTON.



Imitation Kefir.—A very good and agreeable imitation of the Tartar beverage known as "kefir," which is, like koumiss, used extensively in phthisis and other wasting diseases, may be made by the following simple method described by Dr. Levy in a German chemical journal:—Freshly prepared sour milk is briskly shaken up and then placed in a soda-water bottle, together with 2 per cent. of syrup. The mixture is well corked and kept in a warm place for three or four days. At the end of that time a most agreeable effervescing beverage is obtained by uncorking the bottle. It contains some 2 per cent. of alcohol. If required for use more speedily, a few drops of lemon juice should be added to the syrup.—*Lancet.*

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to Hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, May 9, and unacknowledged elsewhere:—

FOWLER, LANCASTER, AND CO.—H. Hamond.—F. A. Cobbold.—Foster and Williams.—British Gas Engine Company.—W. A. Walton.—Michael Reynolds.—Amateur.—J. Seal.—Vulcanite.—R. T.—E. R. Blake.—J. M. Wellwood.—L. A. S.—P. A. N.—Lanky.—J. Brown, Belfast.—X.—S. I. C. E.—W. P. Maycock.—Arthur Mee.—Broscenicus.—W. J. R.—S. Bottone.—Eos.—An Old Leysian.

G. CHARLTON. (Can you not find what you want in the articles on "Electric Bell Fitting"? If not, try p. 542, No. 1167, p. 297, No. 1132, where burglar alarms for windows and doors are illustrated. See also the indices of back volumes for several devices of the kind.)—AMATEUR. (If you subscribed to the ENGLISH MECHANIC only when it "cost 4d. weekly," we are afraid you did not subscribe very often—perhaps you mean some other paper. You will, however, find in recent volumes the methods of producing the electric light in the cheapest and simplest manner.)—PSYCHE. (Several motors of the kind have been described; but the question is, which would you prefer—a steam-engine or an electromotor with battery? How long do you want it for at a time, and how heavy is the sewing machine?)—J. B. (We cannot help you further. The recipe appeared in Vol. XXIX. p. 520. We tried it at the time, and found that it gave all the gloss or shine that could be desired. Perhaps you have obtained something else instead of shellac.)—W. S. (Very likely some of the preparations recently mentioned; but have you tried borax or plaster of Paris?)—J. H. B. (At the metal merchant's you can obtain solders of all degrees of hardness; but if you must make it you will find recipes in back volumes. Naturally it takes longer with the blowpipe, unless the parts are well heated first.)—H. Y. DICKINSON. (If received it was inserted or answered; but we have no recollection of it, and know nothing of the clock. See Hints No. 3, above. The query is much too vague: a brief description of the clock should be given.)—T. L. W. (See some of the handbooks on the microscope, if you cannot refer to back volumes and recent numbers.)—AVIS. (Beale's "How to Work with the Microscope" (Harrison); Carpenter's "The Microscope and its Revelations" (Churchill); or for a lower priced work, Lankester's "Half-Hours with the Microscope" (Allen); but any bookseller ought to be able to show you catalogues from which you can make a choice. See the "Student's Handbook to the Microscope," published by Roper and Drowley, Ludgate Hill, E.C.)—AN APPRENTICE. (They don't use "oil" for the purpose; the cylinders are covered with "blanket," and over that a sheet of paper, and the ink does "set-off," so that the paper has to be renewed from time to time.)—F. CHILTON. (Do you mean japanning? If so, see No. 860 for an article on Japanning and Japans. An enamelling oven was illustrated on p. 174 this volume.)—SAMBO. (Try a little weak solution of chloride of lime.)—TERRANOVA. (Grind with fine emery and a piece of cork.)—REV. E. A. HUTTON. ("The Organ Built" appeared in Vols. XIV., XV., XVI.; the "Amateur's Organ" in Vols. XVIII., XIX., XXI., XXII.; but in every volume from, say, IX. onwards there is more or less valuable information about organ building.)—A. M. J. (No, a sailing ship does not sail faster than the wind blows; but an ice yacht can, and often does. 2. See catalogues of booksellers; but a work by Prof. Ware (American), which we think you can obtain from Trübner's, is generally recognised as the best on Perspective.)—J. H. (Several recipes for cements to stick leather to iron have been given in back numbers. See p. 574, No. 1195, for the best.)—TIMBRE. (You can obtain information about patents that have expired by searching the records at the Patent Office, or by employing an agent to do it for you. Any of the patent agents who advertise in our columns will do such work at moderate fees. The price referred to means the price of the blue book, or specification of a patent. If you know the number, or the name and date of a specification, you can obtain a copy on application to Mr. Reader Lack, Sale Office, 38, Cursitor-street, Chancery-lane, E.C., inclosing the price.)—PALMER. (The method of working out the sun's distance from the parallax has been given many times. See, for instance, p. 592, No. 1169.)—J. M. SMITH. (We do not know of any work on the subject of "Umbromania." That is one reason why we gave the article on p. 75.)—CRIPPS. (Procure Prof. S. P. Thompson's "Elementary Lessons in Electricity and Magnetism," Macmillan and Co., or Sprague's "Electricity," from E. and F. N. Spon, 125, Strand. The latter will give a thorough insight into the science, but costs 15s. If you want to pass an examination get the first named.)—J. A. LOCKWOOD. (There is a book published by Trübner and Co., Ludgate-hill, E.C., called "507 Mechanical Movements.")—J. S. (Count the syllables in the lines, and you will see what is meant by "metre.")—A. B. (We are afraid you will have to purchase such a boiler; but you will find illustrations in back volumes of the various forms. 2. Liquid fuel has been used for many years near London; but see indices for several articles on the subject.)—GLAVE. (Where do you find any mention of it? Sulphite of magnesia can be obtained in crystals by mixing dilute solutions of sulphate of magnesia and sulphite of soda. It may also be made by passing sulphurous acid into a vessel containing water, holding in suspension the common white magnesia until saturated, then filter and nearly neutralise the filtrate with magnesia. Concentrate, and the sulphite is deposited in crystals, having the formula $MgSO_3, 6OH_2$.)—G. FRYER. (Rather too elementary. Besides, descriptions have been frequently given, and any one intending to make an American organ would, if wise, buy the cavity-board.)—D. GROSVENOR. (No—"we" do not say so. We quoted the authority. You seem to have mixed up yards with feet; for one pound of No. 18 B.W.G. wire measures 137ft. Or is it possible you have been weighing covered wire?)—X. P. (We have frequently given such information. Look through back numbers, or in Reed's "Engineer's Handbook," Reed and Co., Sunderland. As you must go to sea before you can sit for a certificate, you will learn all about it from one of the engineers.)—T. R. A. 2. (The answer remains as before. You can make the medium by dissolving guttapercha in any of the solvents given, or you can purchase it ready prepared at the shops. From what you say in the P.S., however, it is clear that you want something which at present has no existence—so far as we know. Water is scarcely a solvent of guttapercha.)—ONE OBSCURED. (An appropriate signature. Please read some elementary textbook. If you will promise not to mention it, we may venture to say that the "real reason of darkness" is the absence of light.)—SORREL. (You can try what you can do with benzoline or turpentine and blotting-paper; but we are afraid you will not remove printer's ink from a coloured illustration without injuring the latter.)—J. R. M. (It is done with a diamond point. Photography has nothing to do with it.)—ENARC. (You were answered as soon as possible—probably as "Guard," on p. 202. The method of cold-soldering was given in Vol. XXXV., p. 81.)—TOOLMAKER. (No doubt it was either borax or plaster of Paris.)—M. W. SOULT. (It would do for some of the experiments. See indices about lighting the lamp.)—E. WILLIAMS. (How many do you suppose there are? See the indices of back volumes, or procure the specifications of the various patents.)—J. MATTHEW. (What is the "sensitising solution of tin" for? You can make cyanide of mercury by boiling two parts of sulphate of mercury with one part of ferrocyanide of potash and 8 parts of water. 2. Recipes for silvering glass in nearly every volume. See p. 471, No. 1164.)—

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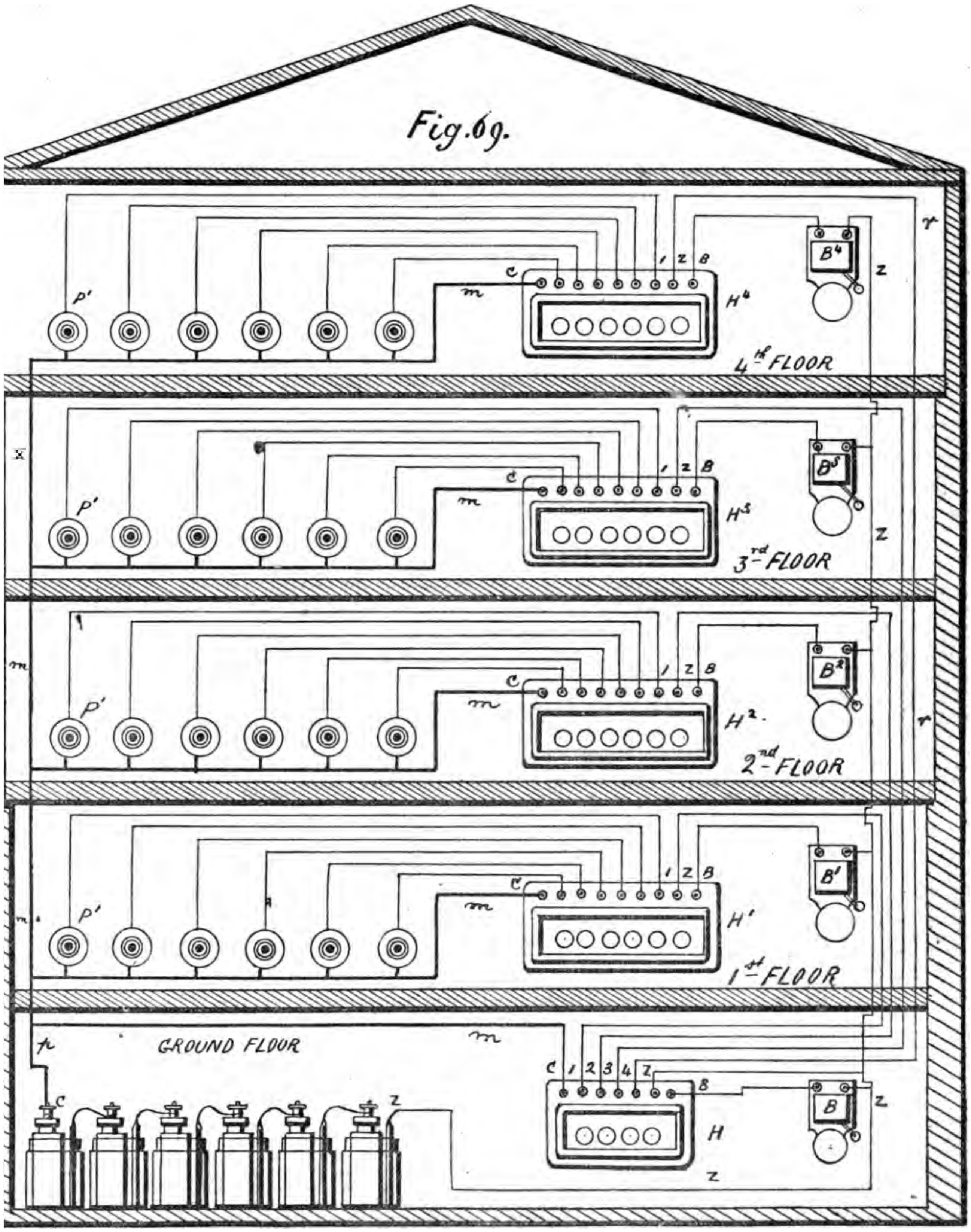
e English Mechanic
WORLD OF SCIENCE AND ART.
FRIDAY, MAY 18, 1888.

ACTICAL ELECTRIC BELL-FITTING.—XI.

g up Private Houses, Clubs, Hotels, &c.—(*Continued.*)



hotels and other large establishments he arrangement shown in Fig. 69 is y adopted, as being more convenient sing one big indicator, which would in n necessitate running the whole of the o the ground floor. The indicator H on the ground floor merely indicates from which floor the summons has been sent, while the indicators H^1, H^2, H^3 and H^4, placed on the respective floors, indicate the particular room. A bell and indicator are placed on each floor, the indicator being of the form shown in Figs. 31 and 66, in which a relay is employed to close the bell circuit.

Suppose, now, the push P^1 fourth floor is pressed, the circuit through the push is as follows:—Pole C of the battery D, main wire *m*, push P^1 fourth floor, terminal 1 of the indicator H^4, magnet coils of the movement, relay coils, terminal Z of the indicator, wire *r*, terminal 4 of the indicator H, magnet coils of movement, relay coils, terminal Z of the indicator, wire Z, and zinc of the battery. This attracts the armatures of the relays in the indicators H and H^4, causing the bells B and B^4 to ring. The circuit through the bell B^4 is from the main wire *m* to terminal C of the indicator H^4, relay armature, terminal B of indicator, bell B^4, wire Z, and zinc of the battery. The circuit through bell B is from main wire *m*, terminal C of the indicator H, relay armature, terminal B, bell B, wire Z, and zinc of the battery. If push P^1 third floor is pressed the same action takes place, only with indicators H^3 and H^4 instead of H^4 and H. The action is, of course, the same for the rest of the indicators, only with different terminals of the indicator.

It is in a case like this that a good, substantially made pendulum indicator is so much to be preferred to any kind that requires a shutter or vane to be replaced by the attendant before it can be used again, as with the almost incessant ringing of bells in a large hotel the most careful of servants will repeatedly forget to replace the shutters.

The main wire (shown darker) from the pushes is, in the diagram, taken to the positive pole of the battery, and to this pole, provided the wiring has been done in a substantial manner, it is, as was stated in the previous article, advisable to put it. On referring to the diagram, however, it will be seen that if the main wire *m* is broken—let us say, at the point X, the top indicator, with all its dependent pushes, will be disconnected, and the further down the rupture occurs, the more pushes and indicators are cut out, until a rupture in the wire at *p* will cause a break-down in the communication throughout the entire building. Now, in a badly wired building, where the insulation of the wires is poor, staples been injudiciously used, and the situation of the wires turally damp, a continual leakage takes place between the wire *m* and all the remaining wires. By the electrolytic action of the current the copper is eaten away from the main and deposited on the other wires, the main wire getting thinner and thinner until a jar or variation in the temperature causes the final separation, stopping all communication.

Thus in the case of a large hotel where the insulation has broken down, and owing to the place being full, it is not convenient to at once remove the faulty wires, the rupture of the main wire may be prevented by simply reversing the battery connections, by this means putting zinc to the main wire. The main wire now, instead of being eaten away, increases in thickness, and if a rupture occurs it will be in one of the other wires, which will only affect that push or bell to which it happens to be attached. This continuing of the communication is, of course, only at the expense of the battery, and the faulty wires must be renewed as soon as possible.

The front and back door bells would, of course, be separate from the system of bells from the various rooms, and likewise the communication with the lift to be described in the following article. F. C. A.

THE IRON AND STEEL INSTITUTE.

THE annual meeting of the Iron and Steel Institute was held last week under the presidency of Mr. D. Adamson, to whom the Bessemer medal was presented by Sir Henry Bessemer himself. Mr. Adamson was one of the first, if not the first, to take the Bessemer steel in hand, and after thoroughly testing it he persuaded Messrs. Platt to construct two steam boilers of the then new metal, and they are still doing good service. In those days there was no Iron and Steel Institute, and it required some courage and much judgment to trust to a new and untried metal; but Mr. Adamson was satisfied with his tests, and having taken a license to manufacture from Sir Henry Bessemer, he, with some partners, started the works which have since become famous as the property of Messrs. Cammell and Co., the first established exclusively for the manufacture of Bessemer steel. Mr. Adamson, in his presidential address, referred to the remarkable change which has been recently witnessed in the relative quantities of steel and iron used in shipbuilding; but mentioned that for parts of locomotives case-hardened iron seemed to stand better, a fact which he thinks points to the desirability of discovering a method of treating steel so as to secure a homogeneous metal with the enduring surface of case-hardened iron. Silicon, he thinks, may possibly solve that problem; but the president also referred to the manganese steel made by the Messrs. Hadfield, and recently described at some length in a paper read by Mr. Hadfield before the Institution of Civil Engineers. The president, being what is known as a "practical" man, made a short and sensible address, doubtless being desirous of hearing the papers which were down for reading. The first was by Mr. T. Turner, the lecturer on metallurgy at Mason College, and dealt with silicon and sulphur in cast iron—a paper which should be studied by the chemists of ironworks. Mr. Turner's conclusions are that in the blast furnace there are three agencies which tend to eliminate the sulphur in the Cleveland practice—first, the high temperature, which tends to prevent the absorption of sulphur by the iron; secondly, a slag rich in lime, which readily combines with the sulphur; and, thirdly, the action of the silicon, the amount of which affects the quantity of sulphur retained by the iron. For every proportion of silicon he holds that there is, with certain conditions of the furnace, a corresponding maximum proportion of sulphur, and that if by any means an excessive proportion of sulphur should be present, remelting will eliminate it, and produce a condition of equilibrium. Mr. Snelus commented on this paper by pointing out that the quantities of silicon and sulphur were practically constant in the materials introduced into the blast furnace, while in the slag considerable variation was found, a result which he thought might be explained by the varying reducing powers of the gases in the furnace. A high reducing power, he thinks, causes silicon to pass into the iron, while the sulphur goes to the slag and forms sulphate of calcium. M. Gautier thought Mr. Turner's view was new in attributing to silicon the ability to expel sulphur from iron, and he referred to the fact that sulphide of silicon is easily made by heating silicon in an atmosphere of sulphydric acid—conditions which might occur in a blast furnace. He mentioned the opinion of Herr Ledebur, of Freiburg, that most of the blow-holes in iron castings are due to sulphide of silicon, and suggested that the best conditions for getting rid of sulphur are a slag low in silica but rich in lime. Sir I. L. Bell said that the operations which went on in a blast furnace were of so complex a nature that it was impossible to arrive at a comprehensive conclusion, and that if in making one quality of iron, the quantity of silicon varied in the product, the cause must be sought in the difference of temperature. Mr. R. A. Hadfield said that the experience of his firm did not agree with the arguments of Mr. Turner. They used irons high in silicon, and wanted them free from sulphur; but they found occasionally as much as ·25 and even ·32 per cent.; but a fact worth noting was that in an alloy high both in phosphorus and silicon they never had any trouble, owing doubtless to the manganese, though he does not think that altogether explains the low percentage of sulphur. As a matter of fact, in manganese steel the sulphur is rather higher than in ordinary steel. A paper by M. Gautier, on "The Melting in Cupolas of Wrought Iron or Steel Scrap with Ferro-Silicon," was then read, and in the course of the discussion which followed Sir H. Bessemer stated that analogous results were obtained at his works a quarter of a century ago, and that owing to the wording of his patent specification its terms were evaded, and he had been deprived of a large sum of money. In the process patented, pig-iron was reduced to malleable and mixed with highly carburised iron, from which mixture remarkably durable stamp-heads for quartz-crushing machines had been made. The process described in M. Gautier's paper is, however, costly, and it is doubtful if it will ever come into use.

Amongst the other papers read was one by Mr. A. Wilson, of Stafford, on "Water Gas," in which the author referred to the fact that the subject had been introduced to the Institute some years ago, but that little practical use had been made of the gas outside of the United States, which may be accounted for by the fact that the plant then described was too complicated. Since then, however, great improvements have been effected, principally by German engineers, chiefly for metallurgical purposes, so that now the plant is extremely simple and durable. The system of lighting by this gas has also been adopted with great success at several large works on the Continent, and it is also largely used in America, and seeing that it offers a convenient and beautiful means of illuminating, possessing the convevience of town gas with the brilliancy of the electric light at less than half the cost of either, the author of the paper thought that it must commend itself for adoption in this country also. In England a very extensive water-gas plant has been erected by Mr. Sampson Fox at the Leeds Forge Company's works. In all water-gas apparatus the principal part consists of a generator, in which the fuel, by the aid of an air blast, is raised to a high temperature, to be afterwards cooled by a jet of steam for the production of water gas. During the heating up by means of the blower, Siemens's or generater gas is produced, while the cooling effected by the steam produces water gas. The characteristic, therefore, of the water-gas generator consists in producing alternately Siemens's gas and water gas. According to the use which it is desired to make of the Siemens's gas, the fuel which is used, and the manner of passing the steam or passing the air, and vice versâ, there has arisen a combination of apparatus of different construction. In the first apparatus, constructed in Germany, there was no object in view but the production of heating gas for metallurgical work or that which limited its employment to heating and melting purposes. It was then found that the water gas burned without an excess of air and produced so high a temperature that a platinum wire was melted by being placed in the open flame. The best proof, however, which it is possible to have of the high temperature of water gas is found in the incandescent magnesia light on Fahnehjelm's system (see p. 385, Vol. XLI.). The flame heats a comb, composed of little magnesia rods, to whiteness, producing a light superior to the incandescent electric light, but without having the bluish tinge of the arc lamp, and consequently more nearly the splendour of sunshine than any other system of lighting. The light possesses the advantage of absolute steadiness. The magnesia comb is supported by a wire slipped into a socket on the carrier of an ordinary gas-bracket. The burners used are exactly the same as those used for town gas, and so are the globes, and all the fittings concerned. In substituting lighting by incandescence with water gas, therefore, no changes whatever are necessary in the existing pipes and fittings.

Major Cubillo, of the Spanish Artillery, read papers on steel castings for the manufacture of guns, which were of purely technical interest, but drew from M. Gautier the remark that he was experimenting with lead as the hardening dip for steel castings for guns. Messrs. Pattison and Stead, of Middlesbrough, and Messrs. Harbord and Tucker contributed papers on the behaviour of arsenic in steel; and Mr. H. Le Neve Foster introduced Lovibond's tintometer to the notice of the Institute as an accurate instrument for the measurement or matching of colours, advocating its use as a means of obtaining a permanent standard for the matching of carbons in steel by the Eggertz colour method.

WILLARS'S IMPROVED SPANNERS.

SPANNERS and wrenches have long engaged the attention of the inventor; but although there is a considerable variety to be found at the tool-shops, patents are still taken out for improvements. In the annexed engravings we show the designs patented by Mr. E. Willars, of Cropston, Leicestershire, the object of which is to produce a spanner which may be conveniently worked or used at different angles, and which is specially adapted for use when the nut to be operated upon is confined within very limited space. Figs. 1 and 2 are side and edge views of the improved spanner, showing the jaw and handle connected by means of two outside link plates. Figs. 3 and 4 are side and edge views of a modification. Figs. 5 and 6 are side and edge views of a similarly constructed spanner, but showing the jaw and handle forked and connected by means of an internal link plate. In Figs. 1, 2, 5, and 6, A is an iron, or other suitable jaw, of convenient size and shape, at the back of which is a suitable toothed disc, B, both being preferably made in one piece or casting. On the two sides of the toothed disc B, and working on a rivet or equivalent B¹ at the centre of the disc, are two suitably shaped link plates C, having their opposite ends pivoted in a convenient position to the handle or lever D of the spanner. The working end of the handle or lever D may be suitllowed or recessed to allow of its free ınt when in a line with the links, over bined toothed disc B and jaw A, and ɛr edges of the handle D are left pro- thus forming two lips or pallets E, when required, engage with the teeth lisc B, and produce rotary movement of bined toothed disc and jaw. It will be l that when the handle forms a con- ɔn of a straight line joining the pivots shown in the drawing, the toothed can be turned round so as to place the t any working angle with the handle. he jaw A is fitted to the nut, and pres- ıt upon the handle, the latter turns

FIG. 1

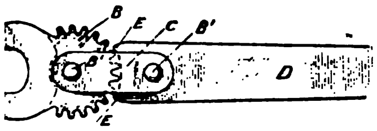


FIG. 2.

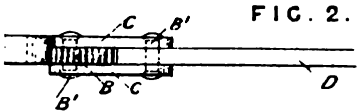


FIG. 3.

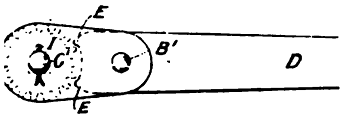


FIG. 4.

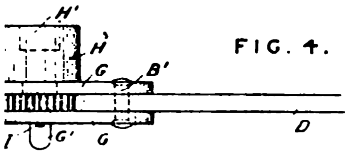


FIG. 5

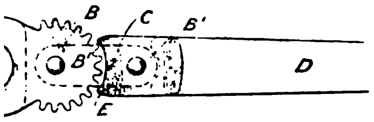
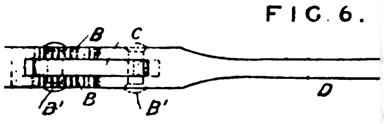


FIG. 6.



its pivot B¹ until one of the lips E s with the teeth of the disc, when the ecome rigid and act like a solid spanner. and 4 represent the application of the on to a box spanner, and show a wheel F, working within two suitably- plates G. Passing through the toothed F, and plates G, may be a pin or G¹, which projects a convenient dis- beyond the plate G, and on which may ıred a circular or other shaped block end or flat portion being suitably re- at H¹ to receive square, hexagon, or haped nuts. Also between the two G is a handle or lever D, suitably hol- and provided with lips or projections, E, of engaging with the toothed wheel F, ating the block H as desired. The or lever may be pivoted between the G by means of a bolt or equivalent B¹. ndle G¹ may be made of such a suitable as to allow the block H to engage with t on a plain surface. A suitable cotter pin I will serve to hold the spindle and gid. It will be readily understood that entee does not confine himself strictly construction of spanners as shown, as us modifications of the same may be ithout departing from the principle.

FRICTION.

third report of the Research Committee Friction appointed by the Institution of cal Engineers was the subject of an inter- iscussion at a recent meeting, and will s be referred to as an authority in future. aratus employed consisted of a steel ring pressed between two cast-iron discs, the bearing surfaces of which were coated with phosphor bronze, giving an area on each disc of 40sq.in., after allowing for the oil channels—four grooves cut in each face of the ring. The pressure was applied by means of a spring, and a mineral lubricating oil was employed. The experiments detailed in the report, which can be had by all interested on application to the secretary, form a useful addition to our knowledge of the subject of friction as applied to machinery, and their real value will be best gathered by the remarks made in the course of the discussion. At the commencement a letter was read from Mr. Turnbull referring to defects in the design of the bearing (a collar bearing); but Mr. Tomlinson, one of the committee, said that they purposely adopted an apparatus difficult to lubricate, for they wanted to try the bearing under its worst conditions. The bearing they had tried was something like the shaft-bearing in a marine engine. They were now scheming a machine to test pivot bearings. It was a difficult problem to manage when they had to deal with pressures ranging from 3,600lb. to 600lb. Mr. Tomlinson said the committee had asked for help from members, but had found that they had had to depend entirely on themselves. Mr. W. F. Smith, of Salford, pointed out that the behaviour of a bearing depended on the relative hardness of the materials. Two soft materials working together would become abraded, and the surfaces would, at high speeds, so adhere that they became practically one solid mass. In practice they found that with the increased duty required for a bearing they had to increase the rubbing surfaces and use harder material. He described some devices adopted by his firm which had been found to work well, and in speaking of cylindrical bearings said that occasionally he had to deal with a shaft which was made of steel too soft to stand the friction of the journal in the bearing. He had had instances in which the metal had been abraded. In such cases the only course had been to case-harden the journal; but it was far preferable to have the shaft of a metal sufficiently hard to stand the work. Prof. Unwin pointed out that in some cases in the report there may have been a good deal of accumulated heat in the bearing. It was a curious fact that friction was independent of speed in the experiments, and he could not help thinking that this fact was connected in some way with the question of lubrication. He asked whether the lubrication was less with lower speeds. Mr. Schönheyder said it was well known to mechanical engineers that the slide block of a steam-engine would only carry one-tenth the pressure per unit of surface that could be carried on a round journal, and the machine under discussion represented a slide block. He would prefer to see the bearing tried under the conditions of practical working. He regarded the practice of applying water to a bearing as "brutal."

Prof. Barr referred to the theory advanced by Prof. Reynolds before the Royal Society as to friction in a journal, in which the latter showed how the lubricant was constantly carried up by the revolution of the journal in the bearing. He had been designing an apparatus, in which he had proposed a water-pressure diaphragm, such as was used in the Emery testing machine. He wished to ask whether the oil appeared on the outer or inner rim of the rubbing surfaces of the apparatus. Mr. Greig, of Leeds, pointed out the necessity of admitting air to bearings, and Mr. Wicksteed, of Leeds, pointed out that a journal that can only bear 100lb. to the square inch when lubricated on the pressure side may be loaded to 600lb. to the square inch when lubricated on the lower side. But in the collar bearing under consideration the maximum load put on was 80lb. to the square inch. He expressed surprise at this, as he had known collar bearings pressed to four times that extent, although the speeds were lower. Mr. Wicksteed illustrated on the blackboard the bearing of a drill spindle, the shoulders of which were two square inches, and they had to thrust through metal, the total resistance being 6cwt., or 3cwt. per square inch of bearing surface. There were two hardened steel faces and a loose hardened steel washer between them. In these cases the lubrication was rude, but the arrangement had worked without trouble, the loose washer reducing the speed. Mr. Wicksteed thought that experiments might, with advantage, be carried out on a marine propeller thrust-bearing working in oil.

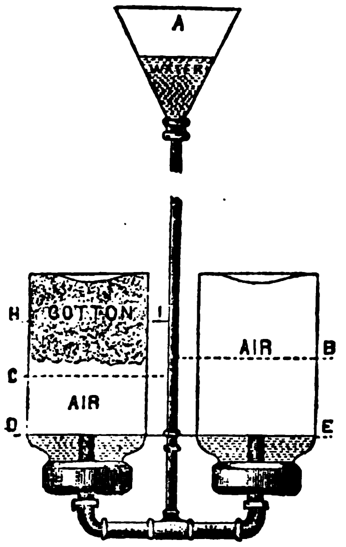
Mr. Scott Moncrieff, speaking of lubrication, said there was much to be done before engineers could claim to have a good grasp of this question. He had made a number of experiments with the late Mr. R. D. Napier in order to arrive at some conclusion on the friction problem in connection with the differential clutch that gentleman invented. He was surprised to find how widely the results of the trial now before the meeting differed from those he had obtained in his experiments. He wished to point out that there was a great difference between vegetable and mineral oil lubrication in relation to speed. With the former the friction increased with the speed, but with mineral oil the reverse held true.

Mr. Holroyd Smith said that in worm-gearing for car-driving he had found an advantage in making threads which, in place of being square in section, had sides inclining towards each other at a certain definite angle, and this angle was found, on comparison, to correspond with that best suited for friction gearing. One advantage was that better lubrication of the surfaces was obtained, and any cross strain on the spindle was better compensated for. He suggested that, in a thrust bearing, a groove should be turned where the collar springs from the shaft in place of the corner being rounded off in the usual way, as the groove would serve to hold oil. As to lubrication, he would be glad to know whether the friction of a lubricated surface was to be regarded as similar to that of a skate gliding over ice, or whether it was that the lubricant formed a number of minute rollers? He thought more attention should be paid to roller bearings. Mr. Daniel Adamson did not think the experiments had any value for workshop practice. He considered more information was wanted as to the metal of which bearings should be composed, and also the oil used. He instanced the case of cotton spindles. Of old these were lubricated with sperm oil, but with higher speeds a thinner mineral oil had to be used. A thick oil was good for slow speeds and heavy loads, but a thin oil should be used for high speeds and light loads. He referred to a case in which he had introduced oil under a footstep bearing by means of a force pump, and concluded by saying that it appeared to him the experiments were on too small a scale. He had filed a flat on a journal so that the oil might be carried round. Mr. Paget, of Loughborough, thought the committee had brought home to engineers the fact that they had been considering friction as a crossbreed between the friction of solids and the friction of fluids. What should be aimed at was that friction in bearings should be always fluid friction. Mr. Mair, of Messrs. Simpson and Co., Pimlico, at whose works the experimental machine was made, pointed out that some of the speakers appeared to be under a misconception as to the action of the testing machine. It was only the ring that was still, all else revolving, and, from its narrow width, there was little difference between the speed of the outside and inside edge. There was therefore little centrifugal force to influence the spread of the oil. Mr. Beauchamp Tower said that the friction shown in the diagrams was due to want of lubrication, and the supply of oil could be so regulated as to get, as a result, any curve that might have been drawn beforehand. But this was not a result the committee was appointed to arrive at, and, as a matter of fact, the supply of lubricant was regulated in accordance with the requirements for smooth running. Prof. Unwin had said that heat would limit the weight a bearing would carry, which Mr. Tower considered to be the fact. Prof. Unwin also appeared to question the fact of the friction being independent of the speed; but the details quoted in the paper supported that. The committee were unable to account for it, but could accept the testimony of the experiments. In their former experiments with a journal bearing, the data collected showed that they had a nearer approach to fluid friction, but in the present case the phenomena were more akin to those attendant on the friction of solids. Mr. Schönheyder had exclaimed against the use of water to cool the bearing; but he would remind that gentleman that water was constantly used on the thrust bearings of marine engines, and a water service was maintained to cool the slipper guides of torpedo-boat engines. Prof. Barr had proposed a hydraulic bearing, and this had been tried with oil in place of water. Use would probably be made of this during the forthcoming experiments with a footstep bearing. Mr. Greig had insisted on the necessity of ventilating a bearing, which was another way of saying that heat should be carried away. With regard to what had been said about the smallness of the load, he might mention that, a few days previously, he had met Mr. Thornycroft, and had asked him what load he generally put on the main bearing of a torpedo-boat engine, and had learnt that 50lb. to the square inch of surface was considered a fair allowance. He thought this satisfactory as showing they were not below good engineering practice in their experiments. Mr. Scott Moncrieff had asked what was the rate of lubrication. He repeated that the oil was supplied as wanted. As to the nature of oils for lubricating, that subject, he thought, was well thrashed out during the reading and discussion of the previous report. Mr. Holroyd Smith had asked about roller bearings, and had appeared to think they might be adopted with advantage. He, however, doubted if they would be equal to well-lubricated cylindrical bearings. Ball bearings are all but universal in bicycles and tricycles, where they are found to be very advantageous; for heavier work, the difficulty would be to get balls or rollers to stand. Even in the light duty they are subject to in cycles broken balls are by no means unknown, but in such cases the operator soon has notice of the mishap by the extra work thrown on him. Were a steam-engine or other mechanical motive power used serious damage might occur before the accident was discovered. As to carrying a vertical shaft on oil, he had no doubt they could do that. By means of a small force pump sufficient pressure could be maintained, and the oil could be kept in by packing round the shaft. He considered the remarks of Mr. Paget as to the friction being a compromise between fluid friction and solid friction as aptly describing the conditions.

The outcome of the experiments on friction, so far as they have gone, seems to be much the same as was arrived at years ago by rule of thumb, and, summed up in a few words, it is simply that every bearing where possible should be so made as to support on a film of lubricant whatever it bears, the metal surfaces never being allowed to rub on one another.

THE MECHANICS OF A LIQUID.

A LIQUID comes in handy sometimes in measuring the volume of a substance where the length, breadth, and thickness are difficult to get at. It is a very simple operation, only requiring the material to be plunged under water and measure the amount of displacement by giving close attention to the overflow. It is a process that was first brought into use in the days when jewellers and silversmiths were inclined to be a little dishonest and to make the most of their earnings out of the rule of their country. If we remember rightly, the voice of someone crying "Eureka" was heard about that time from somebody who had been taking a bath up in the country some two miles from home. Tradition would have us believe that the inventor left for the patent office long before his bathing exercises were half through with, and that he did the most of his travelling at a lively rate while on foot; but it is more reasonable to suppose that bath tubs were in use in those days, and that he noticed, as every good philosopher should, that his bathing solution was running over the edge of the tub as fast as his body sunk below the surface. Taking to the heels is something that we hear of even at this late day.



It was not many years ago that an inventor of a siphon noticed how water could be drawn up hill with a lamp wick, and the thought struck him that with a soaking arrangement of this kind in one leg of the siphon a flow of water could be obtained that would always be kept in motion. Without taking a second thought he dropped his work in the hay-field, and ran all the way to London, a distance of twenty miles, to lay his scheme before a learned man of science. He must have felt like being carried home on a stretcher when he learned that a performance of this kind was a failure. Among the others who have given an exhibition of this kind we notice an observer who was more successful. Being an overseer in a cotton mill, he had only to run over to his dining-room and secure two empty fruit jars and pipe them up, as shown. He had had trouble in measuring volume by the liquid process by having everything he attempted to measure get a thorough wetting, and there were many substances that were to be experimented upon that would not stand this part of the operation, such as fibres and a number of pulverised materials. One of the jars was packed in tight, nearly half full of cotton, *and the other left entirely empty*. The question now is to measure the volume of cotton without bringing any of the fibres in contact with the water. The liquid is poured into the funnel in the upright tube under head enough to partially fill the jars when the overflow that stands on a level with the line D E is open, to allow the air in each jar to adjust itself as the straight portions are wanted to work from. The overflow is then closed, and head enough of water put on to compress the air in the empty jar down into half its volume. It may take a pipe long enough to reach up into the second story, but it need not be a large one, and pipes round a cotton mill are plentiful. In the jar containing cotton the water has not risen so high, their being not so much air to compress, and comes to rest on the line C. Now we have this simple condition to work from. If the water has risen so as to occupy half of the space that has been taken up by the amount of air in one jar, it must have done the same in the other, and if it could have been carried to twice the extent in volume would reach the bottom of the jar in the one containing nothing but air, and to the line H I in the jar containing cotton.

The fibres then must have had an amount of material substance about them to fill the remaining space entirely full, so that a particle of air could not be taken into account anywhere. The cotton has produced the same effect that a solid substance would do if it just filled the space shown above the line H I, for the water has risen into half the space that is left below it. This enables an overseer to look into the material substance of textile fibres by bringing into use the elasticity of atmospheric air, reserving the liquid process for measuring volume to govern the amount of compressibility.—*Boston Journal of Commerce.*

IMPROVED PRIMARY BATTERY.

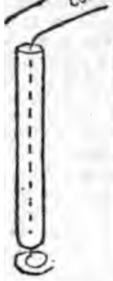


FIG. 1.

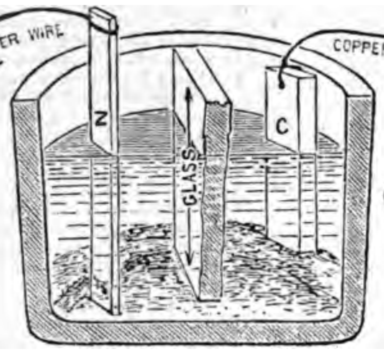


FIG. 2.

FIG. 3.

AMONG other things brought out here (Sydney, New South Wales) by me nearly four years ago was an *electric pen* apparatus with a Fuller bichromate battery. The difficulty of obtaining suitable cells and zincs for replacement caused me to seek some other form of cell by which the expense and internal resistance of porous pots could be avoided. After sundry experiments with a view to narrow the matter down, I arrived at a stoneware jar containing the usual bichromate potass solution plus sulphuric acid, a piece of thin platinum wire clothed with pure black indiarubber, and a ⅛in. tube cemented to the wire at an inch from the bottom. The spare inch of wire was then made into a flat spiral capable of picking up a small quantity of mercury (Fig. 1), the indiarubber tube being simply for insulation, so that the platinum should not affect the result. On plunging this into the jar of solution a good current was produced for a short time; when withdrawn for examination, it was found that *part* of the mercury still adhered to the platinum wire, although action had ceased; a fresh dip of mercury restored the effect. On investigation I found that the mercury had been used with zinc, and was, in fact, *an amalgam*. The absence of zinc meant absence of effect. On this result a simple and effective cell was formed. (Fig. 2.) A small jar (2oz. Liebig's extract of meat jar) was divided off by a *glass partition* cemented in with bicycle-tire cement (more expensive than Chatterton's, but much stronger for grooveless partitions, jointing parchment paper cells for Leclanchés, indiarubber, guttapercha, shellac, and bitumen) reaching *nearly* to the bottom of jar; mercury is then poured in (dotted in Fig.) to form a "sealed joint" to separate the fluids; carbon on the one side of the partition (but *suspended* so as not to touch the surface of the mercury) in bichromate potass, sulphuric acid solution, and on the other side zinc standing in the mercury in *plain water* to assist in counterbalancing the bichromate fluid on the other side, so as to require less mercury to make a safe joint. Of course, the jar is represented wider than is really the case, so as to prevent confusion in the sketch. I was led to this form by many cir stances, among others the peculiar way in wh zinc in bichromate battery was "undermi where it was outwardly protected by a ce which resisted the action of the dilute acid tion in the porous pot.

For cheapness and handiness, glass tumble drinking glasses with what are known as *bottoms* (Fig. 3) would make up very handy for experimental purposes.

Further experiments led to a "thistle tube glass arrangement, the tube (Fig. 4) being be a gas-flame as shown, mercury placed therein, copper wire being passed down the stem int mercury. This is simply placed in a jar of tion containing the carbon, but the mercury receive occasional replenishments of small p of sheet zinc, which readily dissolve in it.

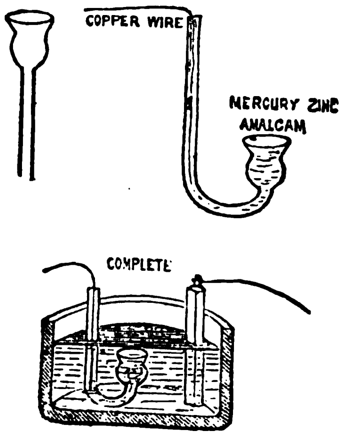


FIG. 4.

FIG. 5.

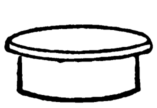
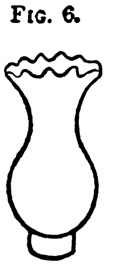
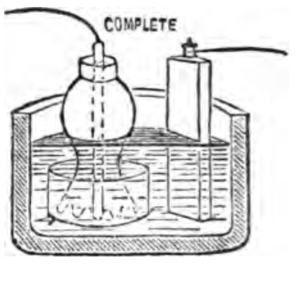


FIG. 6.





thistle tube is convenient for lifting in and and when it can be lashed to a spring clothes clipped on the top of the jar.

But for permanent use a small shallow p earthenware (such as Needham's metal poli sold in—Fig. 5) has a round zinc rod cement firmly, so as to form a means of lifting in a plete state out of the outer battery jar, merc then poured in to form a "water joint," a paraffin lamp chimney with a "crinkled" top (Fig. 6) is then inverted and passed down the zinc rod into the mercury and filled with *pure water* to counterbalance the pressure of the *surrounding* fluid (bichr. potass + ac. sulph., usual solution), in which stands the carbon.

Note.—This water remains purely free from any acidity for months, and by careful tests I find that the addition of sulphuric acid simply weakens the battery by setting up a "counter" current. In the "porous-pot form" the acid seems quite necessary to lower the resistance of the fluid, but here it is different. Of course, a preferable form to avoid risk of cement giving way would be to make the glass and the dish in one (in glass), with piercings to insure the continuity of the body of mercury in contact with the zinc and the bichrom. ac. fluid.

The thistle tube arrangement I do not like, owing to having to supply the zinc, and the surface of mercury is too small, too; but the other arrangements I have tested for six months successfully.—P. SELBY, in *Elec. Review.*

CARMINE INJECTIONS.*

TROUBLE with carmine gelatine fluids, when used for micro-injections, arises in two ways —either from an excess, or deficiency, in the amount of acid used to precipitate the carmine. In the first case the carmine will precipitate in a too coarsely granular form, while in the second all the ammonia not being neutralised, the ammoniacal solution of carmine will diffuse through the walls of the blood-vessels. Different formulas for carmine injection fluids attempt to overcome the difficulties named, but either stating the exact quantity of ammonia and acid to be used, or by the skill of the maker, who is to judge by sight or smell when sufficient acid has been added.

When the operator attempts to go by a formula giving definite quantities, he is often baffled by the varying strength of the ammonia. When he is not thoroughly experienced, and tries to make a fluid, trusting to his senses to inform him when the necessary amount of acid has been used, his knowledge gained by previous failures and successes being lacking, he will conclude, with many writers on histological technique, that experience is required in order that good injections may be made, and either give up in despair or waste valuable time in gaining the experience necessary.

All this may be obviated, and an experienced manipulator produce as good a carmine fluid as one who is thoroughly conversant with micro-injections by determining, before making the fluid, the exact amount of acid which it will take to neutralise a given quantity of ammonia: that quantity which is to be used in the fluid made. To this end, take a drachm of the aqua ammonial, which is to be used, add to it gradually, with constant stirring, acetic acid, testing with blue litmus paper. The instant the paper changes to red stop adding the acid, and note the amount which has been used. Suppose that it is 1⅚dr., as was the case the last time I made up an injection fluid, then the proportion of acetic acid to ammonia will be 11 to 6, and if the entire amount of ammonia to be used be 4 drachms as in the formula to be given, then the amount of acid needed will be 7⅓ drachms. In this way the proper amount of acetic acid to ammonia may be found in any formula. Having had uniformly most excellent results with the following, I can unhesitatingly recommend it as one of the best, if not the best, of the gelatine carmine warm flowing masses:—

CARMINE SOLUTION.

Carmine No. 40	4 drachms.
Aqua ammonial fort	4 drachms.
Water	6 ounces.

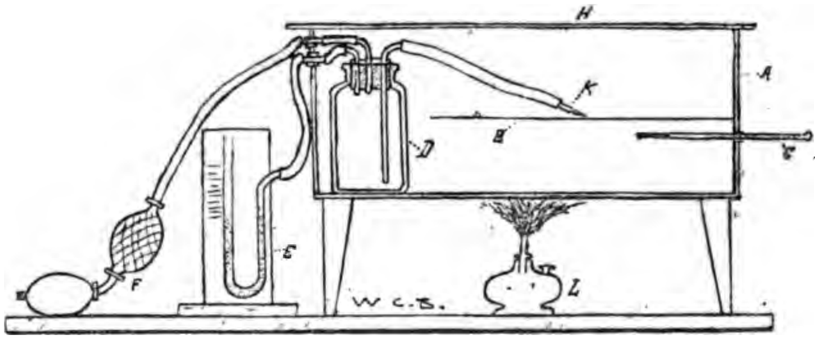
Grind the carmine in a mortar, gradually adding the water, then add the ammonia, and heat gently until the carmine is dissolved.

GELATINE SOLUTION.

Gelatine	1⅛ ounce.
Water	7⅞ ounces.

Soak the gelatine in the water until soft, and then dissolve by heating.

Take 5oz. of the gelatine solution and add to it the solution of carmine. Add to the remainder of the gelatine solution sufficient acetic acid, as found by previous trial, to neutralise the 4 drachms of ammonia contained in the carmine solution. Heat the solution containing the carmine and that containing the acid to about the same degree, by placing the bottles containing them in a pan of water kept hot on a stove or over a lamp. Add gradually, with constant stirring, the gelatine solution containing the acid to that containing the carmine. Filter while hot through two thicknesses of flannel. The fluid can be poured into the flannel shaped into a bag, when pressure on the sides of the bag will cause the contained fluid to pass through the cloth. Add 4 drachms of chloral hydrate, and shake until dissolved.



EXPLANATION OF THE FIGURE :—A, bar for holding object during injection; B, shelf; C, thermometer; D, injecting bottle; E, atomising bulb; F, manometer; H, glass cover; K, injecting canula.

The chloral will preserve the mass for quite a long time, but, if it is to be used within a day or two, the chloral is not necessary. A mass made up by the formula given, is sufficient in amount to inject a small cat or rabbit entire. Should a mass be needed only for a single organ, the quantity of all the ingredients can be reduced, retaining the relative proportions.

In my experience injection of the whole animal gives the best results, except when special injections of a single organ is to be made with two fluids, when careful injections of the organ itself is better. In all cases a manometer should be used, together with some form of constant pressure apparatus. A syringe cannot be recommended, but the injecting jar of Prof. Gage is very useful, and less complicated than a water-pressure apparatus. One can easily be extemporised out of a wide-mouth bottle, and fitted with a manometer made from a piece of bent glass-tubing fastened to an upright board, with a scale in inches or millimetres marked on it. The only other articles necessary are a tin box, with a shelf inside, on which to lay the animal while injecting; a sheet of glass large enough to cover the box, a thermometer, a few feet of rubber and glass tubing, and a couple of spring clamps for closing the tubing, when it is necessary to stop the flow. The whole apparatus, when put together, to be shown as in the figure. With good atomiser bulbs I have had no difficulty in maintaining a pressure of 100 millimètres while injecting.

The injecting canula, for fastening in the blood-vessel, can be made from a small glass tube, by heating it over an alcohol lamp, and drawing it out so that it will be decreased in size just back of the point. This will prevent its slipping out of the blood-vessel when tied in. It is better however, to have brass canula and stop-cocks, such as are furnished with Beck's injecting syringe, and which may be bought of any dealer in microscopical goods.

Before making an injection the apparatus should always be arranged, and then tested by closing the exit tube and gradually raising the pressure to 100 millimètres, so that any defects or leaks may be found and remedied before the injection is begun. Before killing the animal the box is filled below the shelf with water at 40° C., and a lamp placed underneath to keep the temperature at that point. The melted injecting mass is then poured into the injecting bottle, in order that it may attain the same temperature. About 12oz. of a ¾ per cent. salt solution is poured into another bottle, also arranged with injection tubes and placed in the box. The animal is chloroformed, and before the action of the heart ceases, a window is cut in the thorax, the pericardium opened, the heart drawn out with a tenaculum, and its apex cut off. The escape of the blood is aided by holding the animal up, first by the head and then by the tail. As soon as the blood ceases to flow a canula is passed through the left ventricle into the aorta and fastened in by a ligature passed around the artery. The animal is then placed in the box, the canula connected with the delivery tube of the bottle containing the salt solution having first forced the solution through the tube until all air is displaced, the box covered with the glass, and the solution injected at a pressure of 50 millimètres, until it escapes clear from the right side of the heart.

The canula is now disconnected from the bottle of salt solution and connected with that containing the carmine fluid. Beginning the injection with a pressure of 50mm., this is gradually increased to 100mm., but no more. After a time the veins entering the right auricle may be tied and the injection continued until the eyes, tongue, ears, and feet show by their colour that the capillaries are filled. The aorta is then ligated, and the animal placed in ice-water, or a refrigerator, to remain until cold, when the parts desired are to be removed and hardened in alcohol. This method will, of course, not inject the lungs. They must be injected through the pulmonary artery, and then distended by injecting the air passages with alcohol through the trachea.

CELLOIDIN AS A MICROSCOPICAL ACCESSORY.*

THE patented article, celloidin, comes into the market in the shape of cakes, rather transparent, and looking like ordinary glue. Another form is in small shavings or chippings. This is made from the purest pyroxylon, by E. Schering, Berlin, is non-explosive, free from precipitates, and costs about 3m. per cake.

Inasmuch as a cake dissolved will furnish material enough for imbedding 100 to 150 average size specimens, it is, considering its many advantages, quite inexpensive.

It has great advantages for imbedding many tissues, and for certain organs—for instance, the eye—results may be obtained which cannot be had by various other methods. To cut sections of the eye, an organ composed of tissues of such varying density, it is desirable to have an imbedding mass in which the tissues may be kept in a fluid solution, without injury, until thorough saturation is insured, and which will maintain the various parts of the object in perfect relationship for cutting, and after sectioning.

For this organ, and for tissues that have no connection of parts—tissues that immediately go to pieces, so that it is impossible to distinguish the relationship of parts—this mass offers superior advantages.

The use of celloidin is a cleanly process, nothing further being required in its application than a few stoppered specimen jars and some corks for fixing the imbedded objects for cutting. No amount of experience is necessary in its use to insure good results, and it is comparatively rapid in its action.

In other modes, wax and paraffin specimens must be kept in a molten mass over a water bath, maintaining the heat at a certain temperature for a length of time, varying from six to twelve hours. Should the heat go above a certain degree, the specimens will be most likely ruined, and if, on the other hand, it falls below the required degree, the process must be repeated.

The celloidin solution permeates the tissues thoroughly, fixing the parts in their natural position, does not shrink the tissues, and the process can be discontinued at any time, or delayed any length of time without resulting in harm to the objects.

It is perfectly transparent, and sections so imbedded may be stained and mounted with the imbedding material, which takes the staining but faintly; and when a specimen is cleared and mounted, the faint tinging on the celloidin does not detract from the appearance of the section, or in any way interfere with its usefulness.

Celloidin solution is made by dissolving the chippings in an equal part of absolute alcohol and ether. To 4oz. of the above, add sufficient celloidin to make one solution of a syrupy consistence; the second somewhat thicker. Unless kept thoroughly stoppered with ground glass, the solutions will thicken by evaporation of the solvents. A quantity of the solvent serves at any time to reduce the solutions to the desired fluidity.

Specimens should be brought from absolute alcohol and placed in a mixture of equal parts of ether and absolute alcohol for about six to eight hours, and then may be carried into the thinner solution.

Let most objects remain here for 24 hours; when they are to be removed to the thicker solution, objects can be safely left in either solution for an indefinite length of time, so that for delicate objects in which it is especially desirable to insure thorough saturation and fixing of the parts in natural relation, they may be left in the solution for some weeks previous to imbedding.

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* By Dr. W. C. BORDEN, Port Douglas, Utah, in the *American Monthly Microscopical Journal.*

* By J. MELVIN LAMB, M.D., Washington, D.C., a paper read before the Washington Microscopical Society.

I find the method of imbedding by the use of a coil of paper about the cork troublesome, on account of the formation of air-bubbles. The simplest and most effectual manner to fasten the specimens to corks is as follows:—Soak the cork for a short time in absolute alcohol, then flow over the surface on which you imbed a film of thin celloidin, letting it partially harden. Place the object in the position desired for sectioning by the aid of the amount of celloidin that will adhere to it from the vial. Let this stiffen slightly, then add, at intervals of a minute, a few drops of the celloidin (depending, of course, upon the size of the object) by allowing it to flow over the object and about the base of it. Repeat this until a fair amount is covering and supporting the specimen. By this means you have only the required amount of celloidin about the object to support it firmly, and not a large mass to draw the knife through. After a few moments a film sufficiently firm will have formed to hold the object in position. The entire mass is now to be placed in a jar of alcohol of 80 per cent. to harden—requiring 24 to 48 hours. If the cork is shallow and broad no weights will be necessary; merely invert the object in the alcohol and the cork will serve to float it and keep it immersed.

The mass is now ready for the microtome, and the blade should be flooded with commercial alcohol. After sections have been obtained the imbedded object can be returned to the 80 per cent. alcohol, when it can be preserved for future use.

In clearing sections avoid the employment of absolute alcohol (unless used cautiously) or clove oil, as these agents rapidly dissolve the celloidin. Sections so imbedded are best cleared in creosote and mounted in xylol balsam.

MECHANICAL DENTISTRY.*

NO branch of dental practice requires more skill and judgment than that of the construction of artificial dentures. It is the duty of every dentist to become so dexterous in this branch as to be able to supply his patients with artificial teeth which may be worn without the slightest discomfort, and so closely resemble the natural ones as to be readily mistaken for them.

The utility of artificial teeth depends upon their proper construction and direct application. Perfect mechanism is not the sole element of success, generally it is not the most essential one; we must have a knowledge of the anatomy and physiology of the mouth—its pathological condition—if we expect to become skilled in dental prosthesis.

We must know when to use gold or some other materials, when to secure a piece by clasp bands or simple adaptation; also the proper time for its insertion. Accurate impressions are indispensable with atmospheric pressure. In the construction of every kind of artificial plates we must remove all roots or teeth that are decayed, which will not yield to treatment.

All tissues in contact with the base-plate should be in a healthy condition. As all alveolar ridges and palatine arches are of unequal density, we must, therefore, make a thorough examination of every part we wish to modellise to ascertain the relative softness and hardness.

The mouth should be rinsed with water previous to taking the impression. The most accurate impressions can be taken with plaster of Paris, but in deep arches wax should always be used first in the impression cup to copy the roof of the mouth. Remove, and trim the wax as much as desired; then fill with plaster and insert; press the rear of the cup up first, forcing the contents to the front of the mouth. In this way there will be no trouble from the plaster causing choking or nausea.

Never remove an impression until the plaster will break without crushing.

After the model has been taken from the impression, it should be scraped more or less, to correspond with the softness of the alveolar ridge and the palatine arch.

If there is only a small part of the roof hard, scrape the impression, instead of the model, at that point.

In all cases the plate should be in contact with the parts; but with slight relief of pressure over the hard portions. If this is not done, you will have an imperfect fitting plate.

A great many dentists have formed the erroneous idea that it is necessary to construct the plate with an air chamber, to secure its adhesion to the mouth, and that the tenacity is according to the depth of the cavity. This is a great mistake. There is no form of space cavity, or air chamber, that gives such firmness as absolute contact over the entire surface.

It is true the base with an air chamber when first introduced will adhere more readily than without, as long as the cavity acts in the retention of the plate; but it eventually draws the membrane into the space. The plate is then held only by contact.

If the air chamber is over a certain depth, it will cause the mucous membrane to become diseased. Every day's experience furnishes abundant proof of this fact.

If the space is not filled with membrane, after the plate has been worn a few days it shows imperfect adaptation.

Next in importance to accuracy of the impression is correctness of articulation. This must be perfect. The teeth, if possible, should be set well under the alveolar ridge. If they are set outside, it is difficult to retain the best fitting plate during mastication.

The lower teeth should strike those on the upper jaw, both sides, at the same instant, with the exception of the last molars, which should just clear. This matter should never be overlooked.

Unless judgment, science, and art are exercised in constructing the work, from the taking of the impression till its completion, a total failure may be expected; or, at least, the plate will never be worn with satisfaction.

The firmness with which plates can be made to adhere to the mouth is wonderful, if made correctly. The work of nature can never be equalled by artificial teeth, but it is surprising how near they can be made to resemble them in looks and usefulness. The human teeth are so liable to decay that few persons reach adult age without losing some of these valuable members. As there will always be mechanical work for the profession, we must so perfect ourselves in this branch that we may be able to surmount every difficulty that may be presented to us. We must know what kind of material to use for a base when gold and porcelain crowns or bridge work are suitable. Crowning and bridge work are the most useful, if constructed rightly, to take the place of the natural teeth.

Many other useless roots can be crowned with gold or porcelain, and are far better than teeth with large fillings. By bridging from one tooth or root to another, we can insert teeth, where they have been extracted, that will perform the service of the natural ones, preferable to partial palates.

Crowns and bridge work, as constructed by some of the profession, are filthy and injurious to the health. We must have a knowledge of how they are to be constructed if we perform the operation, and wish to become skilled in mechanical dentistry.

Notwithstanding the high state of excellence to which prosthetic dentistry has arrived, at no previous time was there so much injury inflicted by artificial teeth as at present, resulting solely from an incorrect application.

The construction of artificial plates is performed by everyone who makes any pretence to dentistry. Unfortunately, it is but little understood by a great many. The readiness with which they can be made, and cheapness of material, have helped forward a style of practice in the highest degree detrimental to the profession.

A dentist who properly respects himself or his patrons should not be guilty of performing such work as we see nearly every day. This poor grade of work is owing largely to the better operators discarding the practice of mechanical dentistry.

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[*] By Dr. E. E. SHATTUCK, Kansas City, Mo., in the *Archives of Dentistry*.

THE Niagara River Hydraulic Tunnel, Power, and Sewer Company proposes to construct a subterranean tunnel from the water level below the falls, about 200ft. under the high bank of the river, extending through the rock to the Upper Niagara river at a point about one mile above the falls, where a head of 120ft. is obtained. The tunnel is then to extend, parallel with the shore of the river, one and a half miles at an average depth of 100ft. below the surface of the earth, and at a distance of about 400ft. from the navigable water of the river, with which it is to be connected by means of conduits or lateral tunnels. These conduits will lead to wells 100ft. deep, sunk to the tunnel, and in which will be placed turbine wheels. The water in the river will only be diminished in volume 1 per cent., or in depth an inch or so.

ALLOYS formed by melting two or more metals together present some very curious characteristics, amongst which is the fact that the melting point of the alloy is in general much lower than that of either of its constituents. Wood's alloy, for instance, which consists of lead, tin, cadmium, and bismuth, melts at about 150° Fahr., while the lowest fusing point of any of the metals separately is that of tin, 446°. It had, until recently, been supposed that this alloy could only be formed at a comparatively high temperature, but Mr. William Hallock has now shown that when the several metals are mixed together in filings and exposed for twenty-four hours to a temperature equal to that of boiling water, the alloy is produced in a liquefied state.

SCIENTIFIC SOCIETIES.

ROYAL ASTRONOMICAL SOCIETY.

THE usual monthly meeting took place on Friday, May 11th, Mr. W. H. M. Christie, president, in the chair.

The following gentlemen were balloted for, and elected Fellows of the society:—Thomas Dallmeyer, 19, Bloomsbury-street, W.C.; Alfred Robert Johnson, M.A., St. John's College, Cambridge; Reginald Carter Nelson, 19, Roker-terrace, Sunderland; Sir Henry Thompson, M.B., 35, Wimpole-street, W.; and John Walther, M.D., C.M.Edin., West House, Eastbourne.

Two papers were read by Mr. Knobel—the first by Prof. Adams, entitled "Remarks on Sir George Airy's Numerical Lunar Theory," and the second by Prof. Oudemans, "On the Conditions that in a Double Image Micrometer the Value of a Revolution of the Micrometer Screw shall be Independent of the Accommodation of the Eye." Both papers were of a technical nature, and not suited for discussion.

Mr. Crossley, at the request of the President, gave an account of the dome he has erected at Halifax to cover the 37in. reflector which he purchased from Mr. Common. When the telescope was erected at Ealing it was covered by a wooden and iron house, which, though it protected the telescope when directed to an object of low altitude, left it exposed to the wind when directed to an object nearer to the zenith. This caused vibrations of the tube in windy weather, and left the observer unpleasantly exposed. Mr. Crossley has therefore erected a circular dome 38ft. 9in. in external diameter over the telescope in its new position. The internal diameter of the dome is 36ft. 3in. This great size was necessitated by the fact that the telescope is mounted with the centre of motion behind the speculum, so that the dome must have a diameter of more than double the focal length of the telescope. The wall on the top of which the dome runs is 15in. thick, on the top of the wall is a cast-iron rail made in 24 segments, on which 14 wheels run, supporting the base of the dome. The dome is built on 23 iron ribs 15° apart, a space of 30° being left for the opening of the shutter. Beside the opening for the shutter there is a gallery by which the observer mounts to the eyepiece. The gallery, and the staircase leading to it from the observatory floor, both move with the dome. The dome weighs about 14 tons, and the gallery and stairway up to it about 2 tons. The whole is moved round by an hydraulic engine in a little room at the side of the observatory. The hydraulic engine may be set to run slowly so that it moves the dome round with the stars once in 24 hours, or it will turn it round through the whole circle in five minutes. At the foot of the telescope are hot-water pipes, by which the observatory is warmed in cold weather; before observing cold water can be run through these pipes from the hydraulic engine so as to cool them in a few minutes.

The President: I understood that this 3ft. reflector was one of very short focus, and I had not recognised the difficulty in mounting it; but when Mr. Crossley informed us that the dome was 39ft. in diameter, and I considered that we had been able to house Mr. Lassell's 20ft. reflector in a dome of 30ft. diameter at Greenwich, it struck me that there was something rather curious in the arrangement. But that is, of course, due to the form of mounting.

Mr. Crossley: That is the drawback to that form of mounting; but it has its advantages.

Mr. Turner: It seems that great improvements have been made by Messrs. Cook and Sons in building domes. When in Russia we found that the dome at the Pulkowa Observatory was not in so satisfactory a condition as could be wished. It took two men and an engine to move it, and it did not seem to be water-tight, for they had about 14 little pans to catch the water. The new dome has proved unsatisfactory, and the dome has to be left in the right position in bad weather, so that the water runs into the pans.

Mr. Newall: I have a dome 40ft. in diameter, with a telescope 30ft. focus. Unless the wheels are well oiled, it takes longer than 5 minutes to turn. The walls are of galvanised iron, ¼in. thick.

Prof. Alex. Herschell: As a contrast in point of size I may mention that I have recently been visiting Mr. Perry at Alnwick, and he has the late Mr. Cooper Key's 18in. telescope mounted in a little dome of only 15ft. in diameter. This is much more handy to manage. The telescope is mounted on Mr. Berthon's plan, with counterpoises on either side.

Mr. Ranyard: The late Mr. Webb's telescope was mounted in the same manner. For a cheap form of mounting it is very steady and convenient. With regard to what Mr. Crossley said about heating his observatory with hot water, it is very important for the sake of preserving the instrument to keep up the temperature in cold weather. I think that the danger for observing purposes has

rer-exaggerated. Judging from the results
d by Mr. Isaac Roberts, who has a sitting-
rith a fire opening into one side of his
atory, I think that when the opening of the
is large, it makes very little difference in
inition.

ain Noble: I think I can corroborate Mr.
d about the heating. A few years ago I
Mr. Rand Capron's observatory; he had a
heating apparatus in a room in absolute
nication with the dome, and I had an
nt view of Jupiter through his equatoreal
is heating apparatus quite near.

President: I am inclined to agree with
ppears to be the more modern view. You
onsider the comfort of the instrument and
observer, as well as the definition you may
night. If you leave the observatory room
t any artificial heating in the daytime, you
h a deposition of moisture that it is im-
e to observe at all at night. Even if
is a slight sacrifice of definition it is
to be able to see something. At Green-
re find that whenever a thaw sets in the
r has a holiday with the transit circle. Yet
ot exactly a holiday; it is most annoying to
He finds the object-glass covered with mois-
d the microscopes illegible, so that he can
rork at all, and has to give it up. I think
e view that the room should be kept at such
erature as to prevent deposition of moisture
y sound one, and that has been carried out
Cambridge Observatory, where the transit
oom is heated with hot water; and at Green-
e have arranged for warming the two prin-
omes with hot air. Hot water was not
le; but hot water would be better than
cause with hot air you are liable to get
which may injure the brass-work of the
ent. There seems to be very great diffi-
n working these large domes. I think I
ood Mr. Crossley to say that it took five
s with an hydraulic engine to turn this dome.
ssell dome, which covers a telescope of
focal length, can be turned completely round
conds by the chief assistant of the Obser-

I think that shows that so long as you
ome of moderate dimensions there is no
y for these complicated appliances of
, which are liable to fail at the critical
t.

Tupman read a paper by Mr. W. G.
ray on the Greenwich Observations of
Polar distance with reference to the position
Ecliptic, and the differences of temperature
ed by thermometers in different parts of the
tory. A discussion of a technical nature
d.

Ranyard read a paper on a simple method of
g electrical control to the driving clock of
toreal. He said: This is a matter to which
rable attention is being directed at present.
ving a three-foot sector made which will be
by an endless screw on the axis of an in-
wheel, similar to that used by Sir Howard
and described by Lord Crawford and Dr.
their paper in the *Monthly Notices* for Nov.,
I propose to make use of the instantaneous
from the pendulum passing through this
d wheel, to move a little lever which
a small weight from one side to the
f the fulcrum of the crutch, which
the revolving disc of the clock
r. My governor is similar to that
by Mr. Common in his description
mounting of his 37in. reflector in the
s of the Society. When the little weight
e side of the fulcrum it depresses the crutch
eases the pressure on the revolving disc,
allows the clock to go faster during the
ler of the second. If the weight is moved
other side, it increases the pressure and
the rate. If the clock is going exactly right
rent passes through a horseshoe magnet,
rings the lever back to the central position
e little weight is exactly over the fulcrum
rutch, and no effect is produced by it.

following papers were taken as read:—
outt, "Observation of the Occultation of
by the Moon, 1888, March 9"; E. Nevill,
tations of Stars Observed during the Lunar
of 1888, January 28"; Mr. Graham, "Ob-
ns of Sappho made at the Cambridge
atory with the Northumberland Equatorial
quare Bar Micrometer"; A. B. Biggs,
vations of Comet *a* (Sawerthal) 1888, made
uary and March at Launceston, Tasmania";
R. Belding, "Sextant Observations of
a 1888, extracted from the Meteorological
ot on board the Barque *Atlantic*"; Royal
atory, Greenwich, "Observations of the
m of Comet 1888 *a* (Sawerthal)" (commu-
by the Astronomer Royal); Radcliffe Ob-
y, Oxford, "Observations of Comet *a* 1888,
al" (communicated by Mr. Stone); Royal
atory, Greenwich, "Observations of Comet
Sawerthal" (communicated by the Astro-
Royal); A. M. W. Downing, "The Positions for 1750·0, and Proper Motions of 154 Stars South of − 29° Declination, Deduced from a Revision of Powalky's Reduction of the Star Places of Lacaille's Astronomiæ Fundamenta."

ASTRONOMICAL SOCIETY OF FRANCE.

THE April meeting was held in the Society's new rooms, 28, Rue Serpente. In accordance with the by-laws, a part of the officers and council were renewed.

M. C. Flammarion, re-elected President for a second year, returned thanks to the Society.

The President then gave an address upon the labours of the Society during its first year, and the progress of astronomy in that period.

M. Gerigny read the annual report of the finances of the Society.

M. Auwers, President of the Astronomical Society of Leipsig, sent a letter of felicitations to the Society.

M. Jourdan sent a photograph of a new cosmographical clock, showing at once the hour at any point of the globe, and giving various other astronomical indications.

M. Ricco has observed the spectrum of the comet at Palermo on March 14, 19, and 24.

M. Libau sent an observation of the comet at Marseilles on March 31, and a list of probable occultations of stars by planets in 1888; M. A. Martin, observations and drawings of sunspots; M. P. Gourdet, a note on the variability of 66 Ceti, and an observation of Mira Ceti; M. Dumenil, meteorological observations during January, February, and March, 1888; M. Guiot sent drawings of Mars and comet Sawerthal; M. de la Fresnaye, an elementary demonstration of the expression of velocity in function of the radius vector in elliptical movement; Frère Theodore, observation of the recent lunar eclipse at Pointe à Pitre; M. Duprat, observation of a slow meteor at Constantine (Algeria) on March 24; M. Moussette also observed a slow meteor at Paris on March 24.

M. Mantois called attention to some American papers giving details of the great Lick telescope.

M. Trouvelot read a letter from M. Pickering, kindly offering a set of star photographs. The Society's thanks were addressed to M. Pickering.

M. Fenet presented a stereoscopical photograph of the moon.

WESTERN MICROSCOPICAL CLUB.

The Eyes of the Lower Animals.

ON Monday evening the members of the Western Microscopical Club met at the house of Mr. R. T. Swain, Addison-crescent. The subject of exposition, "The Eyes of Invertebrates," was very ably and interestingly dealt with by Mr. M. F. Woodward, demonstrator of zoology at the Normal School of Science. Mr. Woodward began by a definition of the most essential difference between the vertebrate and invertebrate eye, which, he said, lies in the fact that in the vertebrates the sensiferous elements are turned away from the light, while in the invertebrates they are directed outwards towards the light. There are, however, one or two exceptions to this rule; thus, in the vertebrates the pineal or median eye of lizards has its sensory elements directed towards the light like an invertebrate eye. So also amongst the invertebrates we find the eyes of the scallop (pecten) and onchidium (a sea slug with eyes on its back) possessing the vertebrate character of their retina.

The lowest animals possessing undoubted eyes are the jelly fish (medusæ). In these we find eyes round the margin of the "umbrella." In one (Lizzia) there is a cuticular lens and a retina composed of three elements—sensory, nerve-ganglion, and pigment cells.

Among worms we find eyes in various stages of completeness, the most perfect one being found in Alciope, where there is a complete optic vesicle with cuticular lens and retina.

The eyes in the starfish are placed at the tips of the rays forming the termination of the ambulacral nerve. Each consists of a number of small conical eyes, situated on a common stalk. Each of the conical eyes possesses a small lens buried up in a pigmented retina.

In the mollusca ("shell-fish") we find eyes varying from the simple optic cup of Nautilus to the highly organised eye of Sepia. In the former we find a simple and integumentary pit, at the bottom of which is the pigmented retina with its optic nerve. There is no lens, and the eye is open to the surrounding medium.

In the common snail and most gastropods the eye consists of a closed vesicle with cornea, lens, and retina, the latter being much pigmented.

The eyes of the higher cephalopods have at first sight a great resemblance to a vertebrate eye, as they possess a cornea, an anterior chamber with a pigmented iris, a lens composed of two halves and a posterior optic chamber, whose hinder wall forms the retina. The nervous elements of the retina are, however, directed towards the light, as in all invertebrate eyes.

The development of the cephalopod eye has been worked out by Lankester and Grenacher. It consists of an integumentary pit, which finally becomes a closed vesicle, the hinder wall of which forms the retina, while the posterior segment of the lens is formed in connection with the anterior wall. A second pit is now formed in the top of the other, the closing of which gives rise to the anterior chamber, cornea, iris, and anterior half of the lens.

In the insects and crustacea and arthropods generally we find an eye which, though it begins much on the same plan—viz., an integumentary pit—yet develops along very different lines, and in the compound eye of insects shows very little resemblance to the other invertebrate eyes.

The simplest arthropod eye is found in insect larvæ, and is known as an ocellus. It consists of a sight pit, at the bottom of which are the sensory and pigment cells, and is covered by a cuticular lens. In spiders and scorpions these simple eyes become rather more complicated, and consist, except in the lateral eyes of scorpio, of a lens, under which is the epidermis modified to form the vitreous layer, while under this is the retina, and now we find the sensory cell aggregated together round chitinous rods, known as rhabdoms.

In the compound eyes of insects and crustacea we find a number of small lens or corneal facets overlying a delicate layer of cells, the corneal epidermis (= vitreous layer), and under this we have the great rods or ommatidia. These consist of a conical lens surrounded by cells, and a long rod-like body composed of the retinulæ, with an axial chitinous body, the rhabdom, and receiving behind the nerve ending which perforates the basement membrane. There are also pigment cells and tracheal (air) vessel.

The development of the compound eye begins as an imagination of the integument (epiblast); it becomes a closed vesicle, the outer wall of which forms the retina, while its inner wall forms the optic ganglion. In this we see an essential difference to the molluscan eye, where the retina develops from the inner wall.

In conclusion, from the comparison of different invertebrate eyes it appears that we can explain them all as beginning as a simple integumentary pit, which becomes differently modified in the various groups.

The subject was well illustrated by some beautiful sections by Mr. W. F. Woodward.

The Conductibility of a Vacuum.—M. Foeppl, in *Annales de Wiedemann*, gives the results of some experiments apropos of this vexed question. M. Edlund, in maintaining his theory, claims to have recognised phenomena of a luminous character, even when the vacuum has become so perfect as to prevent a visible discharge between the electrodes. M. Foeppl has studied the currents of a secondary closed circuit, actuated by an induction coil. This first was formed on a glass tube 7 millimètres outer and 4·2 millimètres interior diameter, and was composed of two layers of 18 turns, having an outer diameter of 67 millimètres. The electrodes of this glass coil were connected to the two ends of a second coil, also on glass, so arranged as to form a galvanometer, within which was placed a circular mirror magnet, suspended by a fibre of cocoon silk. The primary coil was 24 centimètres in length, 7·1 centimètres inner and 15·3 centimètres outer diameter, and was composed of 12 layers of 72 turns of copper wire 22 centimètres diameter, without the insulation. With this apparatus, and a current of 22·5 ampères, M. Foeppl could not discern the least movement of the needle, either on closing or opening the circuit. Neither could he discover the least phosphorescent light in the glass coil, with large range of rarefaction. The specific resistance of a vacuum, as shown by mathematical calculation, is at the least 48,000 times that of mercury, or about 3,000,000 times that of pure copper.

Black Varnish.—To make a good black varnish for ironwork, take 8lb. of asphaltum and fuse it in an iron kettle, then add 2gal. of boiled linseed oil, 1lb. of litharge, ¼lb. of sulphate of zinc (add these slowly, or it will fume over), and boil them for about three hours. Then add 1½lb. of dark gum amber, and boil for two hours longer, or until the mass will become quite thick when cool. After this it should be thinned with turpentine to the proper consistency.

To Prevent Steel Implements Rusting.—The following is said to be a good application to prevent metals rusting:—Melt 1oz. of rosin in a gill of linseed oil, and while hot mix with it two quarts of kerosene oil. This can be kept ready to apply at any time with a brush or rag to any tools or implements required to lay by for a time, preventing any rust, and saving much vexation when the tool is to be used again.

SCIENTIFIC NEWS.

THE orbit of Sawerthal's comet has been calculated by Herr A. Berberich, of Berlin, who finds that the comet is moving in a very elongated ellipse, and has a period of probably 2,370 years. Its spectrum has been examined by Prof. Ricco, Prof. Tacchini, and Mr. Maunder, all three observers giving a similar description—continuous, faint, fairly broad, and crossed by three faint bands corresponding to the carbon bands characteristic of cometary spectra. On May 20 the position of the comet, as given in Dun Echt Circular No. 155, will be R.A. 0h. 5m. 58s., N. Dec. 35° 51·7'.

Two more small planets have been discovered —No. 276 by Herr Palisa, of Vienna, on April 17, and No. 277 by M. Charlois, of Nice, on May 3. No. 276 is Herr Palisa's sixty-fourth discovery.

Herr Berberich calls attention, in the *Astronom. Nach.*, to the approaching return to perihelion of Encke's periodical comet, and, reviewing the records of its brightness at different "returns" between 1786 and 1885, he notes the remarkable circumstance that it has always been most conspicuous when it appeared near a time of maximum solar spots.

Wolsingham Observatory Circular No. 20, from the Rev. T. E. Espin, states that "A star, mag. 8·1, not in the D.M., was observed here on the nights of May 8 and 9, R.A. XXh. 41m. 7s. Decl. + 44 24 (1855). The colour of the new star is red. The spectrum is not continuous."

The Cincinnati Observatory in No. 9 of its *Publications* gives a zone catalogue of 4,050 stars observed during 1885-86 and part of 1887 with the 3in. transit instrument. The region covered lies between S. Dec. 18° 50' and 22° 20', and most of the stars down to those of 8½ mag. have been observed, with a considerable number of the fainter ones. The Right Ascension was deduced from transits, recorded on a chronograph, over a system of five vertical wires; the Declinations, from bisections by a micrometer wire, two readings being taken for each star whenever practicable. The probable error of a single observation was found to be R.A. ± 0·123s., Decl. ± 1·84", the observations being a little rougher than could have been desired, in consequence of the low magnifying power used. An important portion of the work has been the comparison of the resulting places with those for the same stars in earlier catalogues, and a considerable number of errata in Lalande's, Lamont's and other catalogues have been detected.

The first *soirée* of the Royal Society was held last week, when Mr. Lockyer exhibited the spectra of different bodies at certain temperatures, the significance of the hydrogen experiments resting on some hypothesis which regards the element hydrogen as the base of all matter. Mr. Shelford Bidwell's apparatus for measuring changes in the dimensions of rods and rings of various metals produced by magnetisation is so delicate that, according to the *Times*, it will measure changes of length to a 25,000,000th of an inch! A delicate instrument for measuring temperature was found in Mr. C. V. Boys's Radiomicrometer, which is said to consist of "a circuit made of antimony, bismuth, and copper hung in a magnetic field by a fibre of quartz so fine that, if magnetised to twenty times its size, it would still be finer than spun glass." Mr. Boys also made a number of experiments with soap-bubbles. The skeleton of an Akka recently exhibited by Prof. Flower in connection with his lecture at the Royal Institution on the Pygmy races, was on view, and geologists were interested in the series of photographs illustrating Mr. Cadell's experiments on artificial mountain building. The borings of the Delta of the Nile, exhibited by Prof. Judd, attracted much attention. The alternations and mixtures of blown sand and Nile alluvium were found to continue down to a depth of 121ft. from the surface, and 95ft. below the level of the Mediterranean. At that depth a remarkable change in the deposits took place, and beds of gravel containing both pebbles and subangular fragments of quartzite, chert, compact limestone, with some metamorphic and igneous rocks, were found; and similar beds occur at intervals down to the greatest depth reached. Up to the present time no contemporaneous organic remains have been found in these deposits. The result of the borings up to the present time is to prove that no rock exists at a depth of 345ft. at Zagazig; a depth of 45ft. at Kasr el Nil; and 84ft. at Kafr Zayat; or at 73ft. at Tantah.

The death is announced of Dr. Sigismond Wroblewski, professor of physics at the University of Cracow. He was seriously burnt while experimenting with some petroleum lamps.

Prof. A. Schuster, F.R.S., has been appointed Langworthy professor of physics and director of the Physical Laboratory at Owens College, vacant by the death of Prof. Balfour Stewart.

The Royal Commission appointed "to inquire whether any, or what kind of, new university or powers is, or are, required for the advancement of higher education in London" is composed of the following:—Lord Selborne; ex-Lord Chancellor Ball, of Ireland; the Hon. G. C. Brodrick, warden of Merton; Justice Hannen; Sir William Thomson, of Glasgow; Prof. Stokes, of Cambridge; and the Rev. J. C. Welldon, head master of Harrow.

Within the past month, says the New York Correspondent of the *Daily News*, Mr. Edison has made several improvements in the phonograph, to which he attaches great importance. Mr. Edison has announced so frequently that the phonograph would be ready for sale within a few weeks, that he is now somewhat averse to saying anything about the future. His factory is turning out the instruments at the rate of twenty per day, and, unless something unexpected interferes, the first orders will be executed by the middle of June, or sooner. There are 2,000 orders now on the books, some of them from Japan.—It would not be fair to Mr. Edison to hold him responsible for all the statements made about him and his business by newspaper correspondents.

A writer in the *Evening Standard* asserts that saccharin "has been shown to be three hundred times sweeter than cane sugar, and as it can be produced wholesale at from twenty to thirty shillings per pound, it is clear that, so long as the supply of coal-tar holds out, saccharin will be able to run sugar out of the market. This, however, is a question with which the buyer need not trouble himself, since it is all but certain that before long it will be produced by synthetic means, which will render the manufacturer independent of the chemistry of Nature." We venture to think there is still a little hope for sugar.

According to one of the judges—instructing a Q.C.—Hamburg sherry is a "chemical compound." At least, that is what the newspaper reporter makes him say.

The Norwegian Greenland exploring expedition is by this time fairly on its way. It consists of Dr. Nansen, Lieut. Dietrichsen, Mr. Sverdrup, Mr. Christiansen, and two Laplanders. They are all physically competent for the task, and Dr. Nansen's intention is to land on the east coast of Greenland in about 66° N. lat., and to walk across the continent on snowshoes to Disko Island, which is in the parallel of 70° N. lat. Greenland, so far as we know, is a glaciated peninsula, with a coast-line of some 800 geographical miles, 340 of which have been fairly well explored. The plateau character of the ice obtains only at a considerable distance from the rugged coast and ice-margin, from whence the coast gradually rises into the interior. The greatest height which it has been observed to attain is some 6,000ft. or 7,000ft. On the west coast there are some Danish and Eskimo settlements; but on the east coast only a few Eskimo are found. Those travellers who have attempted to cross the inland ice, after first overcoming the obstacles on the coast, have invariably found the ice to become smoother and smoother, and to give place to loose snow, whence, as far as the eye can reach, a desolate but level expanse of snow stretched into the interior. From the earliest times it has been described as a snow-covered plateau. The expedition will be left entirely to their own resources: they must reach the west coast, which has settlements, or starve. There will be no possibility of again reaching their ship, though at the spot where they are landed a "cache" will be made, where provisions and ammunition will be stored. If, therefore, the travellers are forced to return to the east coast, they may eke out a bare existence—chiefly by subsisting on the game, fish, seaweeds, &c., they may there discover—and finally reach Cape Farewell. It will readily be seen, however, that the precarious nature of their conditions renders success in their main object to be an essential point. Should Dr. Nansen succeed he will give an account of his travels before the Royal Scottish Geographical Society.

We learn from an American electrical paper that Mr. Alfred Vail, of New Jersey, with "the exception of Prof. Morse, probably did more than any other individual towards perfecting and introducing the telegraph. Yet we can never forget that it was Prof. Morse that conceived the idea of the telegraph, and had it not proven a great success, we doubt if any other name than his would have been associated with it." After that, we are prepared to learn that the Americans discovered Great Britain.

There is an exhibition of works in wood open at the Carpenters' Hall, London-wall, every weekday up to June 2, from eleven a.m. till five p.m., and on Wednesdays and Saturdays from eleven a.m. till nine p.m. Admission free.

The next meeting of the Geologists' Association will be held at University College on June 1, when a paper on the "Natural History of Gypsum," by J. G. Goodchild, will be read. The excursions already fixed are:—May 21 and 22 (Whitsun excursion), Charnwood Forest; June 9, Upminster; June 16, Reading; June 23, Godstone and Bletchingly; June 30, Rickmansworth; July 7, Lewisham; July 21, Bedford; August 6 to 11 (long excursion), South Wales and Monmouthshire.

A preliminary meeting, called by invitation of the Council of the Yorkshire Philosophical Society, to consider the desirability of forming a Museum Association, was held recently in York. Among the museums represented at the meeting were those of Liverpool, Manchester, York, Sheffield, Nottingham, Bolton, Bradford, Sunderland, and Warrington. It was unanimously decided that a Museum Association should be formed, and that it should consist of curators or those engaged in the active work of museums, and also of representatives of the committees or councils of management of museums.

During July the following courses, for technical teachers and others, will be given in the new buildings of the City and Guilds of London Institute:—Elementary Principles of Machine-Designing, by Prof. W. C. Unwin, F.R.S.; Practical Lessons in Organic Chemistry, intended mainly for teachers of technological subjects, by Prof. Armstrong, F.R.S.; the Construction and Use of Electrical Measuring Instruments, by Prof. Ayrton, F.R.S.; Experimental Mechanics, by Prof. Henrici, F.R.S.; the Principles of Bread-making, by William Jago; Photography, by Capt. Abney, F.R.S.; Mathematical and Surveying Instruments, by Arthur Thomas Walmisley; Gas Manufacture, by Lewis T. Wright; the Application of Modern Geometry to the Cutting of Solids for Masonry and other Technical Arts, by Lawrence Harvey; and the Craft of the Carpenter, by John Slater.

To Copy Engravings.—An exchange gives the following method, which may be worth trying; but it should not be used upon engravings of any value, as the original would probably be spoiled:—Place the engraving a few seconds over the vapour of iodine. Dip a slip of white paper in a weak solution of starch, and when dry in a weak solution of oil of vitriol. When again dry, lay a slip upon the engraving, and place both for a few minutes under a press. The engraving will be reproduced in all its delicacy and finish. Lithographs and printed matter cannot be so transferred with equal success.

Black Coating for Brass Objects.—The above composition is made by dissolving 1·05oz. carbonate of copper, while being well stirred, in 8·80oz. of spirits of ammoniac, 17·60oz. of water being added to the solution. The brass objects should have been well polished with emery paper, and are fastened to brass or copper wires. They are plunged for a short time in the solution, and when completely blackened are rinsed in water. They are then dried in sawdust, and finally rubbed with oil varnish diluted with oil of turpentine. This black coating is said to be durable, and to stand exposure in the open air.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, *332, Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

⁂ *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

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O *TEMPORA!* O MORES!—THE LICK OBSERVATORY—THE LUNAR ECLIPSE OF 1888, JAN. 29th—A MODEST DEMAND FOR A STAR CATALOGUE—THE TRAPEZIUM OF θ ORIONIS: BIG v. MODERATE TELESCOPES—LONGITUDE IN THE SOUTHERN HEMISPHERE—RESENTING A DEFINITION OF FORCE WITH TOO MUCH ENERGY—THE TERMINOLOGY OF MECHANICAL SCIENCE—CONVERSION OF R.A. AND DEC. INTO CELESTIAL LONGITUDE AND LATITUDE.

[28740.]—I HAVE on more than one occasion protested here against the contemptible scientific quackery which has discredited the *Times* newspaper, and against any advertising charlatan being suffered anonymously to puff himself, *proprio nomine*, in its columns. A curious illustration of the kind of literary morality which seems to prevail in Printing House-square, and which I have denounced, may be found in the recently published "Memoirs" of Mr. and Mrs. Bancroft, who tell the story of the notorious Mrs. Langtry's *début*, and relate how the editor of the (wofully miscalled) "leading" paper set his ordinary dramatic critic entirely aside, and deputed a private personal friend of Mrs. L.'s, the late well-known diner-out, Abraham Hayward, to write the notice of her first appearance. "Dear Mr. Bancroft," writes Hayward, "I have agreed with Chenery to write the notice. I know nothing of Mr. ——, but I have a stall given me by a lady." Thus the weak-minded people who looked to the *Times* for an honest and impartial criticism of Mrs. Langtry's dramatic ability were treated instead to fulsome praise by one of her private friends. I would earnestly urge all who have any respect left for the most expensive London morning paper to ponder this story well. They will be better able to appreciate the value, if not to guess at the origin, of advertising puffs of "magnificent theories"—and so on and so forth, when presented to their notice in three or four columns praising their author.

In connection with the ante-penultimate paragraph of letter 28688, on p. 213, I perhaps should explain that of course I am aware that Mr. Keeler observed the new star in the trapezium of θ Orionis (vide letter 28169, p. 31), and, equally, of course, that he is one of the permanent staff of the Lick Observatory; but it was really *discovered* by Alvan Clark.

I can endorse what "R. W. J." says (in letter 28691, p. 214) with reference to the value of Mr. Foenander's coloured drawings of the lunar eclipse of 1888, Jan. 29th, inasmuch as he depicts the various tints assumed by the earth's shadow in its passage across our satellite practically identically as I saw them (also in a clear sky) myself. I fancy, though, that the central obscuration was more marked, as observed everywhere in this country, than Mr. Foenander shows it in the copy of his drawings in my own possession.

Every astronomer who reads these lines will remember the Congress which assembled in Paris in 1887, on April 16th, for the purpose of discussing the projected photographing of the entire celestial vault, and will recollect in substance the decision at which that Congress arrived—viz., that the photographs should be obtained in various parts of the world by the aid of instruments identical in size and structure, so that the resulting charts should furnish data enabling us to determine, with the greatest possible accuracy, the positions and brightness of all stars down to a given (photographic) magnitude, and that provision should be made for the best means of utilising, both now and in the future, the results of the data so obtained. As a kind of rider or supplement to these fundamental resolutions, it was decided to take a second series of plates down to the 11th magnitude, in order to secure greater precision in the micrometric measurement of the reference-stars, and render possible the construction of a catalogue. Now all this was feasible and intelligible enough, and a permanent International Committee was appointed for the purpose of carrying out the undertaking. To this Committee (as I learn from the current number of the *Observatory*) one of the original English delegates, Dr. Gill, of the Observatory at the Cape, has addressed a suggestion in a communication which has been published, of so astonishing a character as to demand all the publicity that can be given to it. It is neither more nor less than this—that 2,000,000 stars should be catalogued! In other words, he calmly proposes that a central Bureau, comprising chief, assistants, secretaries, and a staff of measurers and computers, shall take the photographs and measure the exact position of every star to the 11th magnitude inclusive on them, thence to make a catalogue;—a work which would occupy 25 years at £10,000 a year, or 50 years at £5,000 per annum! Who ever could or would use such a catalogue, he does not condescend to inform us. I am delighted to find the editors of the paper whence I have derived the details of this preposterous scheme denouncing it in the language which it deserves. For myself, I am lost in amazement that anyone claiming to be sane should ever have put it forward. Does Dr. Gill want a billet (say, the headship) in this charming little Bureau? Is he simply trying to advertise himself *à la* Pears, or what? As far as this country is concerned, any contribution to the preposterous scheme on which I have been commenting would bring even less return to the nation than did the stupendous sum which the *Challenger* expedition cost.

I must candidly confess that I am unable to agree with the dictum of Mr. Burnham, quoted by Mr. Monck in letter 28716, on p. 233; as I firmly believe that objects may be, and have been, seen with object-glasses of perfect figure and great general excellence, which larger ones have entirely failed to show. I am not one of those who bow down implicitly before the image of a big objective; it may be because the largest I have ever had the opportunity of looking through have been distinctly and noticeably inferior to others of more moderate dimensions. I am, of course, prepared to be reminded that the light-grasping power of an objective varies as the square of its diameter, and so on; but I am here speaking of practice, and not of theory.

Perhaps I may supplement the very excellent letter (28719) of "Sigma," on p. 234, by saying that if Mr. Hampden cares to consult the back volumes of the *Monthly Notices* of the R.A.S., he will find accounts of the determination of Australian longitudes, that of the Cape, &c. Now, no *theory* of the shape of the earth is involved in this at all. It is a question of practical measurements effected with a 10-foot rule, a zenith sector, a theodolite, and a transit instrument, aided by the electric telegraph and a few good chronometers.

Will Mr. Grey (letter 28737, p. 238) kindly read letter 28688 (p. 213) over again? If he will favour me by doing so, I think he will find that I made no objection to his definitions of force and energy. What I did object to was his charging Mr. Clodd with ignorance in employing those words in a perfectly definite sense and with a perfectly definite connotation for a specific purpose previously carefully defined. I use the words myself in the sense in which Todhunter and Everett employ them, but am perfectly prepared to relinquish such use on due cause being shown. Mr. Grey knows as well as I do how the terminology of dynamics and (what is now called) kinematics has chopped and changed about since he and I first studied mathematics. By the bye, "kinematics" itself is a relatively new term, and the introduction of the conceptions involved in it has taken place well within the memory of the majority of those who will read these lines. In this connection I really think that "F. C." (query 65315, p. 245) need only study the works of what has been irreverently termed the $(t + t')$ school to find what he wants for himself.

Now that I understand what "Finsbury" requires (reply 650[illegible], p. 239), I can only say that among the very numerous astronomical tables I have met with, I have never come across one for the conversion of the co-ordinates of R.A. and Dec. (the obliquity of the Ecliptic, of course, being given) into longitude and latitude. But I shall be very happy to give the necessary trigonometrical formulæ, and even to work out an example at full length, if it will be of any use to my querist.

A Fellow of the Royal Astronomical Society.

SATURN.

[28741.]—DR. TERBY (letter 28717), in translating my expressions into his own language, has added some little. The words *non pas le vérité* are Dr. Terby's, not mine. If I had written a single word conveying a charge of a desire to see "not the truth," or of a want of good faith, I would immediately apologise. My only allegation is that there is an amount of self-deception in these matters, and I can assure Dr. Terby he will find others of the same opinion.

I mistook his description of the shadow on ring. It is my fault, not his; but since it has drawn another interesting letter from him, I am scarcely sorry.

It is scarcely necessary to go back to instances (both astronomical and microscopical) of self-deception in observation by even the most eminent and practised observers. Did not Struve see and measure a star he afterwards found did not exist, and have we not on Venus had many doubtful discoveries? I do not charge Struve with any desire to see "non pas le vérité," but he did desire to see something. I could give the names of living astronomers who are said never to fail to see what they are told is there. I make these remarks not controversially, but as explaining my position.

On looking over observations of the shadow of ball on rings, I find that the shadow on A is described sometimes as convex, and sometimes concave, on B mostly concave, but frequently rectilineal, and sometimes partly convex, and partly concave. Often the entire shadow is concentric with limb, when, of course, it must be convex on B. Now, the shadow of a ball cannot be anything but circular in section, and if thrown upon a flat surface must either be convex or nearly straight. By this last I mean it may take the form of a very elongated ellipse and be apparently straight. In order to become concave we have to suppose a deviation from flatness in the surface receiving it. I know this has been supposed, but I submit the evidence is not satisfactory. But the rapid alterations cannot thus be accounted for. Within a very short period the shadow is seen, or supposed to be seen, in a variety of shapes which presuppose a variety of changes also on the surface of the rings. I have not calculated what amount of alteration would be required to be visible here, but I imagine less than 200 miles would have no shadow of a chance of being seen. But this represents more than the whole thickness of the rings. Are such continual changes possible, of such enormous magnitude, and in such brief periods? Is it not more likely that some of the observers have been deceived?

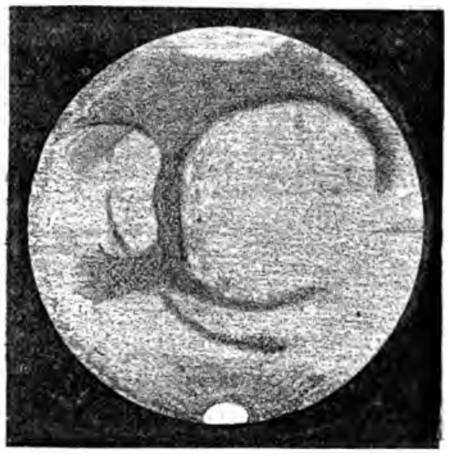
Σ 1516 Draconis is described in Webb as having a "third star, O Σ 539, Du's *min. vis.* $9\frac{6}{10}$" achro. Mr. Tarrant describes this as his min. vis. with $10\frac{1}{4}$in. It may be worth the attention of our variable-star observers since I see it with $6\frac{1}{2}$in. on many occasions, and with 9in. when sky is too thick to allow of Coma Berenices being seen with unaided eye.

I find it impossible to see how—given the respective positions of the sun, Saturn, the rings, and the earth—the shadow of the globe upon the rings can ever possibly appear concentric with the contour of the ball. It must always be a section of the flatter side of an ellipse. If the rings are true planes, it is impossible the shadow can be concentric. If they are not, then a great deal of ingenuity of construction would be required in order that the shadow might accurately be of same curve as the edge of planet.

E. Holmes.

MARS.

[28742.]—IT is somewhat odd that, as far as my knowledge extends, scarcely a single view of this curious planet has appeared in the columns of your all-embracing journal! On the evenings of the 2nd and 3rd inst. I secured excellent observations, the result of which I now inclose. It was deeply interesting to me to note the *dazzling* brightness of the north polar "ice," the deep blue colour of the "hour-glass" and adjacent "seas," and the vivid general impression of land and water afforded by



the planet. So bright was the polar cap that it seemed to project from the disc. The whole view was at once charming and suggestive. Power 400 and upwards on an 8½in. Calver mirror.

Llanelly. **Arthur Mee.**

CHEMICAL MANURE MAKING.

[28743.]—IN reply to "The Brae" (letter 28724, p. 236), the formula for commercial nitric acid is $HNO_3 + xNO_2$, where x stands for the different quantity of NO_2 perhaps in every sample (so it cannot have a stated regular formula). The concentrated acid, when heated to about 86° C., begins to decompose into water, oxygen, and nitrogen peroxide, so that we may say that nitric acid contains water, oxygen, and nitrogen. The amount of N in commercial acid cannot be ascertained (as mentioned); but if we take the formula as HNO_3NO_2, the amount of N is found thus. The molecular weight of HNO_3NO_2 is 109. In 109 parts by weight of HNO_3NO_2 there are 28 of N ∴ the amount of N in 1lb. of HNO_3NO_2 is got by simple proportion—i.e.,

$$109 : 28 :: 1 = \frac{28}{109} = \cdot 2568807.$$

The rest of the question is harder, and impossible to answer with accuracy, unless you use pure $Na_2CO_3 10H_2O$—no doubt common washing crystals contain these elements to a great percentage, but our common washing soda contains the chloride and many other impurities. (I should strongly advise "The Brae" to work with pure compounds, as it is utterly impossible to work theoretically with impure ones unless we know the exact amount of impurities, and, again, that would lead to more trouble and expense, and also would require a knowledge of quantitative analysis.) You would certainly obtain the sodii nitras from evaporation (if pure), and of course from that estimate the amount of soda saturated.

Liverpool. **A. J. T.**

A GOOD BLOWPIPE.

[28744.]—THIS (letter 28730) closely resembles "Spong's spirit blowpipe" which I bought in London fifteen years ago—a very handy tool for reaching narrow corners and bends in joints. A sponge is saturated with methylated spirits, and the flame driven through a small bent tube. It was figured in "E.M." very far back. **Eos.**

SOME LITTLE-KNOWN PLANTS OF THE "FLORA MEDICA."

[28745.] — THE *Calotropis gigantea;* order, *Asclepiadæ*—a large shrub covering acres of sandy waste lands, abounding in acrid, milky juice. The roots, bark, and inspissated sap are used extensively for their emetic, diaphoretic, alterative, and purgative properties, known for centuries to the Indian practitioners, and which have attracted the notice of European physicians. The milk, when dried on the water-bath, loses 75 per 100. The residue yields to alcohol 17, and to water 4 parts. The watery extract prepared previously to the action of alcohol is 11 grains. The alcoholic tincture is precipitated by water, yielding a white resin. The alcoholic extract, in doses of 10 grains, acts as a powerful, but uncertain, cathartic, and frequently causes violent vomiting. It has been used in an extensive series of trials, and it cannot be regarded as a remedy on which reliance can be placed.

The dried bark of the root is of greyish-yellow colour, heavy, and very peculiar smell, acrid, nauseous. It yields to water at 70° 15 per 100 of gummy saccharine matter, and a peculiar extractive principle which has the singular property of gelatinising as it is heated, then liquefying again, and, as the solution cools, gelatinising as before. This principle was named *Mudarine* by Dr. Duncan, its discoverer (from *Mudar*, the native name of this plant), with whom Dr. O'Shaughnessy carried out a series of clinical and chemical experiments.

The powdered bark of the root, in doses of from half a drachm to one drachm, proves emetic after an interval of from twenty minutes to an hour, generally causing much nausea, and in about one case in three inducing a cathartic operation. In doses of from 2 to 5 grains, taken every half-hour, it proves nauseant, powerfully diaphoretic, and, after several doses, gently cathartic. On the whole, this preparation may be deemed one of our best substitutes for ipecacuanha, producing similar emetic and diaphoretic results. Combined with opium, it affords a good representative of "Dover's Powder." In dysentery it may be safely substituted for ipecacuanha in several formulæ, twice the quantity being used in each dose.

In Indian medicine the powdered root bark and the dried milk are used in a multitude of disorders, and enjoy a high reputation as alteratives in the treatment of lepra, elephantiasis, and other cutaneous diseases. The clinical experiments in hospitals of Drs. Playfair, Duncan, and Royle leave no doubt of the root bark being really efficacious in incipient leprosy and numerous skin diseases. Dr. Duncan's chemical experiments appeared in the *Lancet* volume of 1829—30. I was much surprised by its beneficial effect on a man who had been affected with skin leprosy for some years. I administered the inspissated milk extracted by myself from an old plant. I lost sight of him soon after. **Eos.**

PURE MATHEMATICS — CENTRE OF GRAVITY — COSINES OF VERY SMALL ANGLES.

[28746.]—I WAS pleased to see the letter signed "M.I.C.E., Bath" (28735, p. 237), and its suggestion, for no doubt there are many who take a delight in mathematics for its own sake, and even amateurs may sometimes throw out hints that practical or professional men may find useful.

I should, however, recommend the avoidance of two extremes: the "higher" mathematics (properly so called) on the one hand, as being out of place in a popular magazine, and unintelligible possibly to the majority of its readers; and on the other hand, properties of figures that are merely curious, and nothing else. [For example: I read once (in an American periodical) a letter pointing out, as curious discoveries, the fact that, in the reciprocal of 7, the first two figures were 14, the next two 28, and so on, in geometric progression, and the fact that the reciprocal of 9 was ·11111, &c., *ad infinitum!*]

The puzzle that your correspondent mentions at the close of his letter is easily explained. Gravity can have nothing to do with (purely geometrical) lines and planes. A body having a centre of gravity must be a solid of some sort. Hence a triangle as such (i.e., as a portion of a geometrical plane) can have no gravity at all. The very thinnest piece of paper, cut into the form of a triangle, is really a solid, and must be regarded as a triangular prism. Now, if this triangular prism has one of its angles rendered smaller and smaller until it disappears, then it follows that when the two sides coincide the prism disappears too, vanishing into a geometrical plane which has no gravity. The two centres of gravity found by your correspondent is only a *reductio ad absurdum*, showing that there is none at all.

I will now hazard a proposition that may be, for all I know, well known, though I have never seen it in print. It is well known to those accustomed to tables of natural sines and cosines that the cosine of 1′ is so very nearly equal to unity that it is always printed as such. Now occasionally it might happen that a more exact value is wanted. Is there a rapid way of finding it from the table? Similarly those of still smaller angles—say cosine of 1″? Yes; there is a very simple way, and it depends on the fact that the square and square-root of a decimal fraction, commencing with several 9's, are similar respectively to the square and square-root of a similar decimal with a greater or less number of nines, *as far as two figures beyond the cessation of the nines.* Thus, square root of ·9915 is ·9957; required square-root of ·9999915? Answer, ·9999957. Observe, we have simply to interpolate the additional number of nines.

Now for the application to the finding of the cosines of very small angles. Look in the tables for the cosine of the angle, which is ten times (or 100 times or 1,000 times, as the case may be) the angle, whose cosine is wanted, and interpolate two nines, or four nines, if the 100-fold angle is looked for; six nines if the 1,000 fold, and so on.

Example.—Required cosine of 1′. Look for the cosine of 100′, and interpolate four nines.

$$\cos. 100' = \cdot 99958$$
$$\therefore \cos. 1' = \cdot 999999958$$

Again, required cos. 10″ and cos. 1″.

$$\cos. 16' 40'' = \cdot 999988$$
$$\therefore \cos. 1' 40'' = \cdot 99999988$$
$$\therefore \cos. 10'' = \cdot 9999999988$$
$$\text{and—} \quad \cos. 1'' = \cdot 999999999988$$

A similar rule may be used for finding the secants of very small angles, the only difference being that in this case ciphers have to be interpolated instead of nines. **F. S. S.**

THE BOEHM FLUTE.

[28747.]—I HAVE no desire to write a history of the flute, although there are few publications which describe fully its scientific basis, and none that go into its manufacture. I cannot, however, pass over a few facts which mark its development during the last forty years or so, and thus endeavour to show as clearly as possible who made these improvements without raising discussion as to each item which has contributed more or less to its present perfect condition. Modern flute literature is scanty and contradictory, the inventor of a single key generally claiming "an entirely new system," and often even appropriating all the good points or successes of his predecessors, thus making it difficult to give to each his due share and no more. The question is not yet decided as to which is the best system of keys, nor the best sizes of holes; yet, if they are judged by their popularity among professional players, it would not be far from the truth, as these men virtually stake their prospects and future reputation by selecting any system to the exclusion of others. They, therefore, ought to be well-informed, as they stake all on the venture. So that, in looking through our orchestras, and examining the flutes that are there found satisfactory, will be the best test of the present efficacy of any one system or flute. High prices will not deter any professional player from getting the best article if he really believes in it; but with amateurs I fear that this choice is regulated by their enthusiasm, combined with their spare cash, setting aside altogether the question of their ability to judge.

The improvement of the flute began about 1828, and to Captain Gordon, a retired French officer, is now generally assigned the merit due of the first step, by the invention of what is known as "ring keys," or more correctly, "the ability of closing two or more holes by one finger" at the same time, even if widely apart; and all subsequent improvements in key mechanism have sprung from this one invention, of which he made little use, as his flute was a very imperfect instrument. However, he at last in 1834 brought out his "Flûte Diatonique," which was not a success, and is now of no interest except as a matter of history. It was based on the idea that a method could be found having only eight keys for the thirteen holes, and to this idea he clung, although warned by Boehm that it was "not a practical solution of the imperfections" then required to be removed.

Theobald Boehm was a jeweller in Munich, a skilful worker in metals, and he made his first flute in 1810. He became first flute at the Royal Theatre of Munich in 1812, and played in Paris and London in 1831. While in the latter he heard "the Great Charles Nicholson," who was then at his best, but found he could not compare with him for largeness or loudness of tone, owing to the great difference of size between his sound-holes and those of Mr. Nicholson, who was peculiarly gifted with large, broad fingers. Boehm returned home disappointed; but resolved to make a new flute so as to surpass the volume and execution of Mr. Nicholson by mechanical improvements on the key mechanism and the use of larger holes. This he accomplished in 1832, and played with it successfully in London in 1833. It was exhibited at the Academy of Sciences, 1837, and adopted by very many players of repute throughout Europe. The improvements were as follows:

1. Large holes closed by keys instead of fingers.
2. Situated in their best positions acoustically.
3. The use of ring keys and an open G sharp.
4. The taper bore of the body brought to its best proportions.

Still he was not satisfied, and commenced to study acoustics and continue his experiments. Finally, in 1846, he investigated the theoretical positions of the sound-holes, decided to make them all of one size, established a definite proportion between their diameter and that of the flute tube, improved the key mechanism, discarded the taper body, and now completed the edifice by inventing the cylindrical [illegible] with the [illegible] or parabolic head. These changes [illegible] manufacture of all the [illegible] instruments [illegible] before that date were made without [illegible] or proportions.

May 9. [illegible]

SOME CONTINENTAL ORGANS — [illegible] ILLUSION DISPELLED.

[28748.]—DURING a short [illegible] extending over a fortnight, I have made a point of visiting as many of the organs [illegible] the various churches as it was possible to do. [illegible] the courtesy of the clergy, and still more that of the various organists, I was enabled not only to penetrate into the organ-lofts, but in many cases even to inspect the mechanism and to play on them myself. There is no need to trouble you with specifications, with one exception, as the majority of the instruments I saw are described in Hopkins's, and also in Hamilton's, "Catechism of the Organ."

Beginning with Antwerp. The organ in the cathedral is very old, hard and brassy in its full effect; touch very difficult, pedal organ very good, especially the reeds. The case is handsome, and it is well located over the west end in a gallery which it fills, but the front pipes are atrociously dirty. Nearly all the pipes are of lead with zinc feet. St. Paul's, Antwerp, possesses an instrument of first-class size, three manuals and excellent pedal, and a most imposing case; choir in front. St. Jacques has a small organ with plenty of reeds, and, strange to say, during the whole service the organist accompanied in but two parts, of which all the pedal reeds without variation formed the lower.

As the choir contained only boys the effect was execrable. The manual stop used was the mounted cornet, really a mixture in this instance, containing 8ft., 5⅓ft., 4ft., &c., producing a hideous effect of consecutive fifths.

Next as to Brussels. I here tried three instruments—the cathedral Notre Dame, De la Finis Terre, and St. Jacques. I append a description of this last, as it is a modern organ, and has many remarkable features. The console is reversed, the registers arranged in three circular rows on each side of the organist; the top row on each side contains the registers of the great, the second row of the swell, the bottom row of the pedal. All the foundation stops are to the organist's left, the reeds, mixtures, and solo stop to his right. Over the manuals are twelve registers of combination, and there are twelve couplers worked by pedals with a balanced swell pedal in centre. The pedal keys are covered with *lead* tipped with brass. The registers are not controlled by draw stops, but by japanned brass levers, which are pressed down and held by a catch. The specification is remarkable for the number of 16ft. registers, and for the pedal contents.

ORGAN IN ST. JACQUES, BRUSSELS.

PEDAL CCC—F.		*Contra Fagotto ...	16ft.
Contra Bass	16ft.	*Hautboy	8
Octave Bass	8	*Voix Humaine ...	8
Flute Bass	4	GREAT CC—*g*.	
*Bombarde	16	Double Diapason	16
*Trumpet	8	Contra Gamba ...	16
*Clarion...............	4	Bourdon	16
SWELL CC—*g*.		Open Diapason ...	8
Bourdon	16	Stopped Diapason	8
Unda Maris	16	*Flute Harmonic	8
*Voix Celestes......	8	Gamba	8
Salicional	8	*Principal............	4
Stopped Diapason	8	*Flute	4
Open Diapason ...	8	*Mixture VII. ranks	
Gedact	4	*Bombarde	16
*Principal............	4	*Harm. Trumpet...	8
*Flageolet............	2	*Clarion...............	4

Marked * to the performer's right; the others to his left.

Great	13	stops	1008	pipes
Swell	12	„	660	„
Pedal	6	„	180	„
Couplers	12	„	—	
Stops of Combination	12	„	—	
	55		1848	

The full organ is very majestic, and the organist after service played Bach's great Fugue in G minor in splendid style. I am bound to admit that the swell organ is rather a failure, the crescendo being of the faintest. The organ in the cathedral of St. Gudule is divided, so as not to obstruct the fine west window, and the pedal organ is laid horizontally on the floor of the organ gallery. It is not a satisfactory instrument. The other instruments are small. At Liége I played on the cathedral organ for half an hour. It has two manuals and a most inconvenient pedal board, the sharps and flats being brought far too much forward. The registers of this department include two magnificent reeds. The coupling action is old, and what is more, the organ is practically unplayable if it is used. I must hurry on to Cologne, where I expected to find the magnificent instrument described some time ago in your columns. It wasn't there, so I found a priest. As he did not know English and I knew no German, we talked in Latin, and I learnt from him that the aforesaid magnificent organ existed only in your correspondent's imagination, as no one had yet conceived the idea of replacing the small instrument they possess by a larger. This *was* a crushing blow, and I think your correspondent ought to pay my expenses for having caused me to make such a fruitless journey, unless he has some very satisfactory explanation. In fact, there is not a decent organ in the city, much less such a colossal instrument as you published the specification of. However, I recovered, sure that the ENGLISH MECHANIC was an innocent accomplice in the hoax, and I went to Rotterdam. In the church of St. Lawrence there is a first-class organ of more than 100 stops, the organist of which, however, declines to be approached with anything less than a guinea fee—reduction for a party. However, I heard it for nothing at a service, and was very much pleased with it. To-morrow I return to England, and I think, on the whole, we possess better organs, better organists, and infinitely better singing than I have yet heard or seen.

John T. Lawrence, M.A.

THE CONTINUOUS BRAKES RETURN.

[28749.]—THE continuous brakes return for the half-year ending 31st December, 1887, has recently been issued; and, like its predecessors, it furnishes evidence that for years past the companies have neglected to adopt efficient brakes; on the other hand, it is more satisfactory to find that the companies are becoming aware of the importance and advantages of employing automatic brakes which appear to fulfil the well-known conditions of the Board of Trade—in fact, the principal work done during the half-year consisted in removing or altering the inefficient systems and replacing them by efficient ones.

I have drawn up the following summary, showing the amount of stock fitted and unfitted on the 31st December, 1887.

	Engines.		Vehicles.
Total amount of stock returned as fitted with brakes complying with the conditions of Board of Trade ...	2,860	...	25,837
Total fitted with brakes which do not comply.........	1,569	...	12,836
Total fitted with continuous brakes	4,429	...	38,673
Total fitted with apparatus for working brakes, or with pipes or chains	3,654	...	8,108
Total not fitted with either brakes, apparatus, pipes, or chains	649	...	5,245
Total rolling stock therefore	8,732		52,026

From these figures it will be seen that out of a total of 8,732 engines and 52,026 carriages, &c., only 2,860 engines and 25,837 vehicles have brakes which even profess to fulfil the Board of Trade conditions, and from an examination of some of the brakes I am able to say that a considerable number of vehicles returned as efficient are not actually so in practice.

With reference to the failures of brakes, I find no case reported under Class No. 1 that is "failure or partial failure to act when required in case of an accident to a train, or a collision between trains being imminent." Under this heading the Hexthorpe disaster should have been recorded, for although, no doubt, the first cause of that accident was the suspension of the block system, there was ample evidence that the Smith's vacuum brake failed to stop the M.S. and L. train from 35 miles an hour in 359 yards.

Under Class No. 2, "failure or partial failure to act under ordinary circumstances to stop a train when required," I find no fewer than 94 cases, of which 91 occurred with vacuum brakes, as follows:—

Vacuum, automatic,	10	cases.
Vacuum, simple,	81	„
Westinghouse	3	„
	94	

The Vacuum Brake Company very naturally does not like the enormous number of actual failures of its systems, and has therefore issued a statement or comparison of the total faults and failures compared with the miles run. Such a way of overcoming the difficulty and managing the figures may do very well for a trade advertisement; but it is not the correct method of estimating the efficiency of a continuous brake, and clearly the Vacuum Company's system of comparison must be wrong, because, according to it, the best brake would be the old non-automatic air-pressure brake on the Metropolitan District Railway, which ran 754,062 miles without one single fault, and next would follow the chain brake on the London and North-Western, which ran 1,662,113 miles with only two faults.

It would be a very great advatange if the totals of failures and delays could be arranged in a summary or tabulated form, as at present the information extends over no fewer than 53 pp. of the return, whereas, the figures would be much more clear and convenient if given as under:—

Brake.	Railway.	Failures Class 1.	Failures Class 2.	Delays Class 3.	Miles run.
—	—	—	—	—	—

The London, Brighton, and South Coast Railway reports that during the half-year seven cases occurred in which accidents were prevented by the use of the Westinghouse automatic brake.

In conclusion, I think there can be no doubt from the facts given in the return and from the action that is being taken, that the present 14 systems of brakes will speedily be reduced to two—namely, Westinghouse Automatic and Automatic Vacuum, and that all vehicles intended for through traffic will be fitted with those two systems in duplicate.

Clement E. Stretton, Engineer,
Associated Society of Enginemen and Firemen.
Saxe-Coburg-street, Leicester, May 14.

CERTIFICATES FOR ENGINEMEN.

[28750.]—I HAVE read Mr. Stretton's letter on the above subject with much disappointment, because I was under the impression that he was on the side of progress and reforms which tend to ameliorate the railway service. However, that idea is now evaporated, and from the tone of his letter, and from what I am able to read between the lines, I take it he is opposed to enginemen receiving a Government certificate. So far so good, for it is satisfaction to know who are foes and who are true friends. I contend that a Government certificate is necessary to lift the enginemen up to a higher landing up there. I possess sufficient evidence in a pile of letters to convince me that the project in question is in the right direction, and therefore, like Longfellow's mountaineering standard-bearer ever scaling new heights, my motto to *friends* is "Forward!" The debate in the House of Commons has helped the good cause, and I am perfectly satisfied with the result; in fact, it exceeded my expectations, inasmuch as it engaged the attention of an ex-President of the Board of Trade who approved of the measure, and said sufficient to give us hope in the future. There is nothing tame and dull about that achievement, because it is enough to make the ground shake beneath the feet of our oppenents. As all things come to those who *wait*, we can devote ourselves with enthusiasm to the work of being prepared to assist Mr. Mundella when he again holds office. With respect to Mr. Stretton's fears that a Government certificate will enable enginemen on "strike" to hold the "fort," it is only a sly thrust into the editor of the *Railway Review*. He may owe the Amalgamated Society of Railway Servants a grudge; but I think it is best to allow an opponent a right to his opinions. For my part, I consider it would be a good thing *for the public* if it *were* impossible for railway companies to employ drivers unless they held a certificate, for it would make the officials think twice before they allowed things to come to such a climax as to disorganise the traffic. I have learned that railway strikes arise more often from bad or injudicious management than from love of fighting and "striking" on the part of the employés. The Midland strike in August last year, in my opinion, would not have occurred had an order been issued to the effect that the directors regretted that, owing to trade depression, drivers and firemen in future *may* have to work short time, but as far as possible the *time* shall be equally divided. Instead of this, they treated the men unfeelingly and without a word of sympathy for them. Human nature craves for sympathy. From my experience of railway working, *the* "time" could have been divided, and each man received according to his talent, and the arrangement would not only have given satisfaction, but secured the sympathy of men. The directors did that towards their drivers and firemen, *who earn the dividend*, which they would never dream of doing with the fitters' shops, and they would not do it with certificated enginemen. Certificates would *prevent* strikes and long hours. Why don't the companies work their office clerks, whose labour is non-productive, 12, 15, and 18 hours at a stretch? Why don't they find a uniform for the drivers and firemen, who do all the work, as well as guards and porters? Two gentlemen were looking at an oil-painting, and one said to the other, "What do you think of it, my friend?" "Why," said he, snapping his fingers, "it wants that." Let enginemen ask themselves what "that" is in their case, and I think they will find it is a "Government" certificate. **Michael Reynolds.**

Standeford, Wolverhampton, May 3.

TURRET CLOCKS.

[28751.]—I REGRET my inability to assist Mr. Carre (letter 28731, page 237), not being aware of any work specially devoted to clock-work, turret or otherwise. Reid's work has been long out of print—is now very scarce—and excellent though it was, did not enter more into the construction of clocks than the others. Even in the great work of Saunier, turret clocks are only just referred to, being mainly devoted to watch-work. The fact seems to be that all these works have been written chiefly for the *trade*, which presupposes a certain amount of technical knowledge on the part of the reader gained in the workshop; and there appears to be no work on horology specially for amateurs. Perhaps the want of such a work has not yet been felt.

To anyone having a good knowledge of the theory of time-keepers which is well obtainable from books, and possessed of the requisite mechanical ability, it seems to me that almost, if not quite, sufficient information might be gleaned from the works to which Mr. Carre refers to enable a small turret clock at any rate to be constructed.

Of course a tool must not be taken up until a working drawing has been prepared. This may be as much in skeleton as desired, but must be precise as regards dimensions, centres, &c., and forms a most beneficial exercise in the high-class work of designing. After all, a turret clock is only a larger house clock having the necessary changes in its construction to adapt it to its increased dimensions, weight, and difference of circumstances, the mechanical principles being alike in each. Moreover, owing to the very great improvements which have been made in turret clocks of late years, as old work on the subject would be almost worse than nothing, and simply misleading. An inspection of a clock of the modern form would render more assistance than a deal of description.

In my humble opinion the chief charm and glory of the attempts of the amateur in any branch of industry or science appears to consist in the consciousness of the difficulties to be overcome in his endeavours to equal, if not to surpass, the performance of the professional. **A. Marson.**

PICTORIAL COMPOSITION.

[28752.]—WRITING in reply to letter 25283, p. 245, perhaps you will allow a little space on the subject of composition and light and shade, as I am also of the opinion that a few letters on this would prove of some benefit, not only to the would-be critic of art, but also to the many photographic readers of the "E.M." For how often do we see the beautiful productions of the camera utterly destroyed by bad composition and ill-distribted light and shade, which might easily have been averted by a little previous knowledge. I know it is impossible for the photographer at all times to adhere to the principles of art; yet, when the prospect admits of various positions, the one most in accordance with the rules may be chosen.

Variety with unity is the grand principle upon which all good works of art are based. Although there are many more, yet this is the foundation of all principles. Repetition is an eyesore to be avoided as much as possible. The ill effect attending repetition may often be observed in photos of groups, where the trees or bushes forming the background describe the contour of those photographed; or in the picture of a few rustic figures, who seem, through the similarity of tint or badly-composed position of the objects, to be in the act of bearing on their head some distant spire or even church itself. This is a common occurrence, and looks ugly to the educated eye.

To secure unity, no prominent object in a picture should be entirely insulated, for one with an unbroken contour receives undue attention, and detracts considerably from the others. All lines should be broken, it matters not how little, and, when practicable, the round with the square, the rough with the smooth, the crooked with the straight, &c. In good pictures the masses of light are always well balanced by those of shade; but these two are never in equal proportion.

A dark line or shade crossing the mid-distance on sky and land has an admirable effect in throwing back the distance and giving brilliancy to the foreground.

Gradation should be everywhere in a picture. Every object should have a gradation, and never a monotonous tint. A tree may be graduated from the bottom to the top, and at the same time from the centre to the sides, the one gradation passing through the other. This is an important point in painting.

These are but a few detached remarks on the principles of art, from which perhaps the student of photography may derive a hint for the selection of a subject. Some other reader may favour us with a few more—perhaps on colour.

Avicula.

DYNAMO BRUSHES.

[28753.]—HAVING finished my trials of the above, to decide what materials and form was the best as a collector for dynamos, I have at last settled it to my satisfaction, and now give the result, as requested by "Engineer, Govan." I find, after trials of everything likely, that nothing is so good as a brush made of fine brass wire, say 28 B.W.G., about ¼in. thick and 2in. broad, for the following reasons:—It requires little pressure, collects more current for its size, sparks less than others, does not scratch the commutator, readily adapts itself to inequalities, takes less lubrication, and lasts longer than anything I tried. No. 36 copper foil 12-ply thick is good, but it is not so good as brass wires. The brushes must be free from vibration, but not screwed up tight; they should not be thicker than one segment of the commutator. Vaseline or blacklead is the best lubricant if any is required, and the commutator should be cleaned with sand-paper before starting. I also balance the armature by a spring, so as to allow it to oscillate sideways slowly. **Vulcanite.**

ECONOMICAL PRESS.

Fig. 1

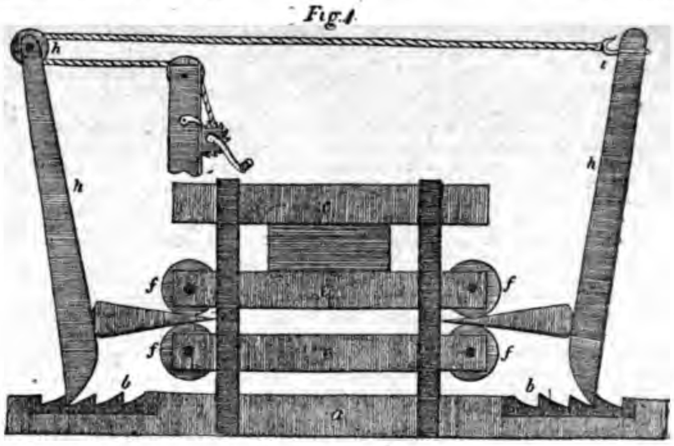
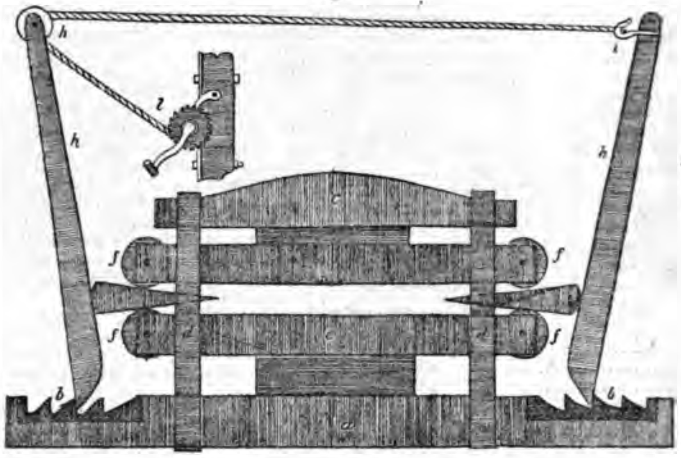


Fig 2



[28754.]—HERE is a description of a most ingenious, cheap, and effective press, in which all the other mechanical powers are brought into operation—viz., wheel, axle, lever, wedge, inclined plane, and pulley. It was one of the inventions of Mr. Ewings, a talented member of the London Mechanics' Institution, who obtained for it Dr. Fellowes's annual prize of £10. This was taken from "Hebert's Cyclopædia," published about 50 years ago. The press, which is applicable to the packing of goods, the expression of juice from fruits, oil from seeds, or other purposes to which the screw-press is applied, consists of a framework and two or more blocks or beams, between which the articles to be subjected to pressure are placed, and these vary in size, form, and material, according to the purposes for which they are intended. Mr. Ewings did not claim any novelty in the construction of these parts, but only in his method of producing the pressure, which is effected by bringing together the pieces that act on the articles to be pressed by wedges. These are forced in by levers (in the manner represented by Figs. 1 and 2), in both of which the same figures represent similar parts; *a* is the base of the press, furnished at each end with ratchet notches *b b*, which constitute the fulcrums of the levers *h h*; *c* is the top of the press, supported by the frames *d d*; and *e e* are the pieces acting on the goods, either downwards, upwards, or both, according as the pressure may be required. In Fig. 1 it is represented as acting upwards; in Fig. 2 as acting both ways; *f f f f* are friction rollers, between which the wedges *g g* are projected. A cord is fixed to a hook on one end of a lever, and passing over a pulley, *k*, on the end of the other lever, is attached to a small drum, *l*, furnished with a ratchet wheel and pawl, to be turned by a winch. There were other modifications of Mr. Ewings's press, but the present one is selected to show the principle of its action. The advantages of this press consist in the simplicity and economy of its construction, as it may be made by any person accustomed to handle carpenters' or smiths' tools, and of very cheap materials, and also the facility with which its power may be varied. It may be increased or diminished to any extent simply by changing the form of its wedges; but the drawings exhibit its various applications and modes of operation so obviously as to preclude the necessity of further remarks. I recommend a model of this appliance to all industrial establishments where juvenile mechanics are trained. **Eos.**

THE GLACIAL PERIOD AND ITS END.

[28755.]—MR. CANE holds that our earth has received (p. 235) an addition of water from without; and no such addition was possible without two thermal effects, a sudden heating of surface to a degree that would require some years, at least, to dissipate, and a permanent warming of all climates, or setting back the clock, as it were, of the planet's cooling, by some thousands or myriads of years. He will find, in the present state of physics, we can by no means escape these two consequences.

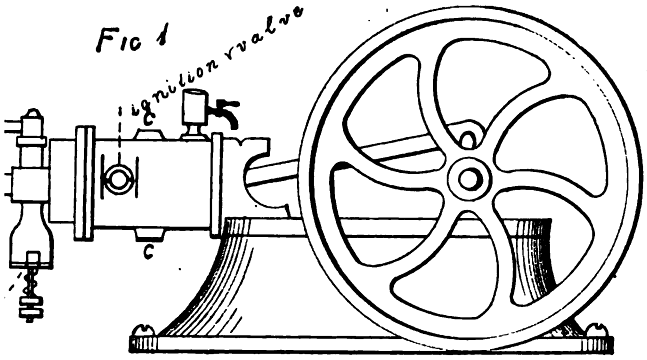
His main reason for the wetting seems to be the form soundings have disclosed in the sea-beds, indicating a former coast-line everywhere about 100 fathoms lower than the present. He hardly seems aware how fully such downpour solves the puzzles of surface geology, of the last extinct fauna, and of present biological distribution, provided we allow it to have fallen since the Glacial age. To put it back into that age or earlier, we have to fly in the teeth of most of the evidence, and instead of solving anything, create endless new difficulties quite gratuitous.

We have all heard of the smith's feat of taking a cold wire and hammering it hot enough to burn; but Mr. Cane must show us how to hammer a thing colder, and make the wire freeze something before we can believe in a fall of matter not bringing us heat. The grand difficulty is how to account for sufficient downpour without *boiling* "all flesh."

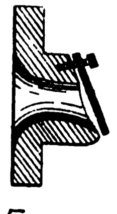
As for a "hydrogen comet" in the past, it is not possible, though quite probable in the future, if the spectroscopic results have as generally indicated hydrocarbons as "F.R.A.S." says. Such a comet would have exactly the effects described by St. Peter in 2nd Epistle, iii. 10, 12. All geologic appearances are against anything of that kind since the very earliest strata, so that the "hydrogen comet, whenever coming, will be unprecedented. Indeed, the positiveness of our "F.R.A.S." that no modern comet ever is, or can be, or shall be, watery, would go to confirm another remarkable prophecy, Genesis ix. 11, 17. I should not have lugged either in, only "F.R.A.S." insists on them.

When I said that whatever the state of the arriving cometary aqueous matter, its liquefaction would be the work of the last few seconds, these were, of course, meant to include all the contact with air or time during which velocity is checked and lost. In no meteor-falls do we see this exceed a few seconds, however many miles may be travelled therein. Mr. Cane seems to admit that in vacuo and far from the earth we can hardly suppose any portion liquid. Now, the resulting liquid might have any temperature between freezing and boiling, according to the relative quantities that had been in the two states of snow-mist or of invisible vapour. The latter would liquefy first, before any check to its speed, merely by its increasing weight: and then the snow-crystals would melt, and in so doing absorb or render latent some (but not all) of what ceased to be latent in the vapour now liquefied.

The Alpine waterfalls that Mr. Cane mentions are by no means dissipated into vapour, but into spray. And who or what on earth can have led him to reckon "more heat is received about the Poles than about the Equator annually"? But his paradoxes are endless—out-Hampdening Hampden. If ice-mist, at 20 miles high, "would rapidly become vapour," why does not the snow of Mount Everest? Instead of "rapidly," it seems



Fic 1



Fic. 2

aporate at all, though in the utmost power
ine possible at our distance from the sun.
amoth was ever found in ice of a berg, it
em to have been an unmelted relic of one
umerous antediluvian glaciers, and how
re the Flood this creature had been frozen
be impossible to say. But the commercial
h ivory comes, as a rule, from diluvium.
amusing is his question about glaciers.
ecession or shrinkage" is what I am to
"going on more or less steadily" from
cial epoch." Well, turning to De Luc's
on the Physical History of the Earth,"
nd that he and De Saussure (as well as
fter them) would have made glaciers one
chief geo-chronometers. Thus (Letter V.,
f these masses of ice had arrived at their
n, they would afford us no indication re-
the time of their commencement, nor
ntly respecting its cause; but if they are
ibly increasing, they must have originated
evolution of the globe which changed the
ure of the air at this level, and this altera-
t have been the less ancient, in proportion
eater rapidity of the progress which the
erved to have made. Now the extent of
-fields so sensibly increases, that the life
—of a chamois hunter, for instance—is
for him to observe the progress of it, in-
that generations transmit from one to
he dates when certain spots began to be
with permanent ice, and when certain
existing before, have been obstructed by
ess. This circumstance will not permit us
its origin back to a very remote epoch."
hich way are we to reckon their age? By
De Saussure and Cuvier held they had
sensibly increasing," or by the "recession
kage" of which Mr. Cane tells us?

E. L. G.

FLAT EARTH.

]—IN the "Christian Topography," by
Indicopleustes, who lived in the sixth
we find a description of the earth which,
to the true orthodox system of geo-
s a quadrangular plane extending 400
ney east and west, and exactly half as
th and south. It is inclosed by mountains
the sky rests—one, on the north side,
n the others, by intercepting the rays of
produces night. The plane of the earth
exactly horizontally, but with a little in-
from the north; hence, the Euphrates,
nd other rivers running southward, are
ut the Nile, having to run up-hill, has
ly a very slow current.
ld interest me to know if this description
with Mr. Hampden's views. **Sm.**

]—ALLOW me to ask Mr. Hampden (letter
look at Prov. viii. 27, new version. Will
at this means a circular pond? A circle
lirection describes a globe, and it is evi-
the words refer to the globular form of
ce of the sea, and they are incompatible
pancake" earth. "F. S. S." may also
ething from this verse, and be less hasty
demnation of references to Scripture.

Thomas May.

GEOMETRIC CHUCK.

]—I AM afraid that some of your readers
that I made a singular statement in my
713) in saying that the epicycloidal cutter
r to the geometric chuck. I must apolo-
carelessly leaving out a clause in the
which should read, "A most superior
it, which takes the place to some extent
ss of chucks, is the epicycloidal cutting

Amateur.

MODEL GAS-ENGINE.

—THE sketch here illustrated is from a
-engine I have made, and have had it driving an 8in. fan at an average speed of 1,000 revolutions per minute. The bore of cylinder is 2½in., the stroke is 3½in., speed when work is on, and it is giving out its full power, 110 revolutions per minute. The air is drawn by the suction of the piston through the valve A, which is self-acting, and is held down to valve face by a very weak spring. The gas enters at G, and is regulated by the handle R. The air and gas pass together through a self-acting valve in the end of cylinder, similar to the ignition valve, of which Fig. 2 is a full-size sectional drawing. I find that a smaller valve will not do; the ignition valve opens when the piston has travelled about one-third of its stroke. The exhaust valve is a mushroom valve closed by a spring and opened by a cam on the crank shaft and an anti-friction roller, which is on the other side of engine, not shown in the illustration. Length of connecting-rod is 9in., diameter of flywheel 11½in. The cylinder has a water-jacket round it which is connected at C C to a small cistern filled with water. I might mention that this engine will work equally well making its own gas from benzoline; the consumption of benzoline is about 1 gill per hour. I send these particulars hoping it will benefit other readers of the "E.M." who are making similar models. **J. Seal.**

67, Carthew-road, Hammersmith.

The Coal Fields of South Russia.—An important report from the British Consul at Taganrog on the coal industry of Southern Russia has just been laid before Parliament (Miscellaneous Series No. 87). The five coal basins of Russia are the Donetz, sub-Moscow, Dombrova (Poland), Ural, and Caucasus; of these the first is the one described in the present report. It stretches over a considerable portion of New Russia, between the Don and Dnieper, and includes many extensive seams of bituminous and anthracite coal, but it contains all kinds of coal suitable for manufactories and household purposes. The report goes *seriatim* through six groups of collieries producing different kinds of coal, and describes the mode of working and the results at the more important collieries in each group. There are in all 200 collieries in the Donetz basin, many being thoroughly equipped, but others being wholly unprovided with modern appliances. The recent rapid development of the coal industry in this region is said to owe much to the annual conferences of the representatives of the mining industries. The annual output at present exceeds 1,600,000 tons, of which about 1,300,000 tons are carried by railway; but it is calculated that nearly 3,000,000 tons will be available for transport during the present year, besides the quantity consumed in the neighbourhood. A long list is given (with a map) of the quantities sent away by the various railways, and consumed in different undertakings. The increased sale of Donetz coal is principally due to the duty on foreign coal. In spite of this, English coal successfully competed with it at Odessa; but Mr. Wagstaff fears that the recent depreciation in the value of the rouble must close South Russian markets to English coal. The prices of the Donetz coal in 1887 were unremunerative, owing to capricious railway rates, absence of shipping facilities, and the great expense of landing coal at such ports as Taganrog and Mariapol. Even if these were altered in favour of Russian coal, Mr. Wagstaff doubts whether it could oust English coal even from Constantinople, not to speak of markets to the west of this, and he thinks English colliery owners have no need to fear their Russian rivals in foreign markets.

Photographic Apparatus.—Messrs. Lancaster and Son, of Birmingham, have just issued one of the neatest printed catalogues we have seen. It contains illustrations of apparatus used in dry-plate photography, with a few enlarging lanterns and other accessories. Several forms of instantaneous shutters are shown, and we learn that some new forms of time shutters will be ready during the season. Amateur and other photographers should procure this catalogue, which is an excellent specimen of modern printing.

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[64602.]—**Evolution.**—"This query" was put by "Quis Est," not by "H. B. F.," and the remark I made has nothing to do with it, but was occasioned by a reply in which a correspondent (in effect) asked another (and deservedly respected) correspondent whether he was an atheist. I suppose it would not be considered the thing for a man to ask across the dinner-table whether one of his host's guests was an atheist; and as this paper may be described as a scientific dinner-table, where food for the mind is supplied, it seemed to me that such a question was "unmitigated impertinence," for matters of faith can have nothing whatever to do with matters of science. Anything that is not fact is not science; but if a statement is true the student of science holds to it. If it runs counter to some preconceived view, he must adapt his faith: he will not refuse to recognise the fact. "Si tibi vera videtur, dede manus; et si falsa est, accingere contra." The evolution hypothesis is now the evolution theory; and if we cannot argue the "points" without hinting a doubt as to the soundness of the orthodoxy (whatever that is) of our opponents, better taboo the subject altogether,—and that would be a pity. "Self-evolution" is a contradiction in terms; but if "E. L. G." can show us how self-evolution can exist, we should listen to him, as we should if he brought facts demolishing the evolution theory.

"What were the God who sat outside to scan
The spheres that 'neath his finger circling ran?
God dwells within, and moves the world and moulds;
Himself and Nature in one form enfolds."

See proem to Goethe's "Gott und Welt."—NUN. DOR.

[64895.]—**Indiarubber (Artificial).**—I think "Nun. Dor." is mistaken in supposing that every man takes his secret to the Patent Office and thereby lets all the world know it. If "Hammer" will advertise his address in the Address Column I will communicate with him, as I have a secret for producing it at 6d. a pound.—M. D.

[64911.]—**Electric Lighting.**—In the reply to this on p. 173 Messrs. Walker and Hyde state they used "12in. glazed drain-pipes" to stand the pressure of the 39ft. head of water. As I am about to put down a turbine for the same purpose, may I safely use them to that depth of fall?—or, if deeper, how much? And how are the joints made? They seem to be able to stand much more pressure than I thought.—J. O. R.

[64924.]—**Chiretta.**—If "Nun. Dor." perseveres with this infusion as a substitute for bitter ale, it will take him about six weeks to get atony of the stomach.—M. D.

[64946.]—**Railway Waggon Springs.**—They are tempered just the same as any other springs of steel. Heat to a red in the dark, quench, reheat on a hot plate, and smear with oil. When that blazes off, quench again. It is only practice that can teach the art of tempering.—E. G.

[64949.]—**Organ Swell.**—Up to time of writing this query has remained unanswered, although some correspondents seem never tired of airing their opinions about organ swells and puffing this or that person's work, including their own. How is this? Perhaps they are preparing to reply. If "Mechanic" will remind me, I will, in the event of no reply being forthcoming from those who pretend so much, see whether I can help him; but those who debate organ questions with so much vigour really ought to answer. Where is Mr. Audsley, Mr. Robinson, or, for that matter, "Uranium"?—OBOE.

[64954.]—**Fire-Doors.**—The fire-door is best hung from the top, so as to swing inwards towards the furnace, and it should be so balanced that it can be fixed at any angle, so as to admit only a thin stream of air when advisable, or the full amount. As to what extent smoke-consumption and steam-production can be attained, it is a matter for trial; but I think the arrangement in which heated air is delivered just by or beyond the bridge is most effective.—NUN. DOR.

[64955.]—**Chloride of Zinc Soldering Fluid.**—If, as Mr. Stanley says (p. 239), he "wrote for those needing the information," why did he not give the recipe of the "new German fluid" (p. 174) which he offers to send by post? He simply notices my "rather weak attempt at criticism," by quietly ignoring the subject, and going off on the "steel-welding" tack. It is the "new German fluid" that is wanted. We shall know whether it is stale when we get it.—T. MAUDSLEY.

[64992.]—**Ballast.**—Some little art is required in burning ballast; but this is the way. Start fire of wood or twigs with some breeze, and then lay on the clay in rather thin slices, taking care that they are so placed as to afford a passage for the flames. To get a good start, add some coal-oil or tar oil, and as the clay burns keep adding layers, with thin strata of breeze. The heap should not be too thick, so the fresh clay and breeze are added at the side of the burning heap rather than on the top.—NUN. DOR.

[65068.]—**Vertical Sundials.**—In reply to "Iliad's" query (p. 219), he can set out the hour lines of any vertical declining dial by adopting the method described on p. 133, Vol. XLV. He must note, however, that neither the latitude nor the co-latitude of his station will serve for the angle A B C, but the latitude of a place where a plane parallel to the dial is horizonal, which angle also gives the height of the style. He should also observe that the hour lines must be shifted round by the amount of the difference of longitude of the two places. The diagrams previously given for a horizontal dial are here repeated, with the variation necessary to suit a declining dial—say, the one described on p. 197. Perhaps "Iliad" will be kind enough to compare these diagrams with those referred to, when the following differences will be noted:—In getting the line of hours (Fig. 3) it is first necessary, in this case, to lay off an angle S F G equal to the above-mentioned longitude difference, which, in the given example, is 16° 28′. This gives the position on the hour line W S of noon, and from that position on the arc of the circle all the other hours can be set out by taking 15° spaces both right and left. Instead of one quadrant being divided and used for both sides of the dial, two must be set out as shown, the two sides of the style not being symmetrical. In other respects, the description of the diagrams given on p. 133, Vol. XLV., applies to those now given, and need not be repeated. The lettering has been kept the same to facilitate reference. Diagram 1, in the former case, has been here separated into Figs. 1 and 3 for the sake of clearness, more of the circle being used for the line of hours. The two must, of course, be drawn to exactly the same scale, and this should be as large as convenient, remembering that the line W S (Fig. 3) is equal to Y Z (Fig. 2), and has to be got on the face of the dial. The above presupposes that the lat. and long. of the place where the dial would be horizontal have been calculated in the way already described. Graphic methods of getting these can be adopted if desired; but they are so much less accurate than calculation, and as no labour is saved by their use, it is hardly worth while troubling about them. In fact, for my own part, I should much prefer the method of calculation altogether for this kind of work, and that not because I feel more at home with figures than with the drawing-board, for possibly it is the other way about. But draughtsmen know, perhaps, better than others that, while graphic methods are invaluable where calculations of the rough-and-ready kind are being used, there is of necessity a very low limit to their accuracy, even in well-trained hands. Where much precision is required, it is always better to use figures as far as they will go.—W. J. R.

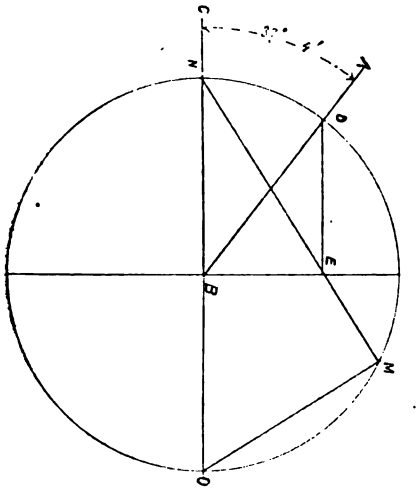


FIG. 1

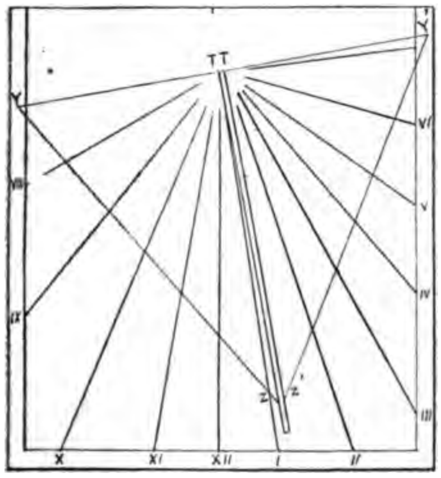


FIG. 2

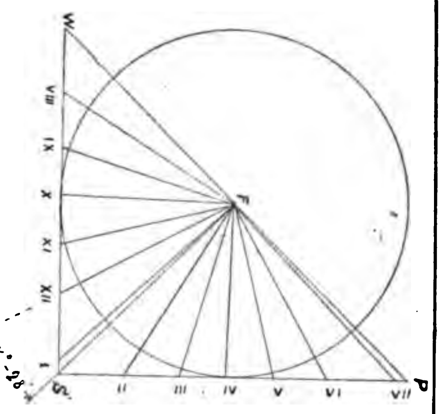


FIG. 3

[65113.]—**Shafting Rollers for Wringing Machines.**—"Dublin Subscriber" is in the same difficulty as I myself was a few weeks ago; but I overcame the difficulty by burning hole in roller with a square poker to suit the shaft, and getting a piece of steel, 1½in. thick and 3in. long, boring ⅜in. hole about 1¼in. deep in end, and then another hole 1in. deep, the size of the spindle. The reason I put a small hole in the bottom is not to damage the centre of the shaft. I use the piece of steel on as well for driving the shaft out of roller as far as it will go, and then I have a bar, with small hole drilled in end to drive them out, having a block of iron let in the floor, with a hole in the ground for the shaft to go in. With a few good blows with a large hammer, you can put them in without damaging spindle at all.—J. C., Hull.

[65126.]—**Harmony.**—TO "MAJOR.—Please notice errata in my last. In 4th line read "D F A flat, dim," and in 5th line "E G B, major." In your query, page 179, the chord on G (minor col.) is G B nat. D, and chord on B nat. (accidentally sharpened one semitone for a leading note) is B nat. D F, dim. (acc.) In further reply, the minor scale and chord formed on each note is more readily understood by comparing A min. (rel. min. of C maj.) with C maj., instead of comparing C maj. with C min. (C min. being related to E flat maj.) Below are chords on each note of scale of A min. and C maj.:—

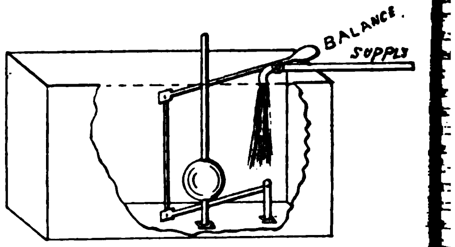
	Scale of A min.	= Maj. C + E − G 1 (8)
	‖	= dim. B − D − F 7
(8)	1 A − C + E min.	= min. A − C + E 6
(*a*)	7 Gsh. − B − D dim.	Maj. G + B − D 5
	6 F + A − C Maj.	= Maj. F + A − C 4
(*b*)	5 E + Gsh. − B Maj.	min. E − G + B 3
	4 D − F + A min.	= min. D − F + A 2
(*c*)	3 C + E − G Maj.	= Maj. C + E − G 1
	2 B − D − F dim.	= ‖
	1 A − C + E min.	= Scale of C Maj.

The chief difference in the two modes is that the interval between the 3rd and 4th and the 7th and 8th in major scale, both ascending and descending, is only one semitone; whereas in minor mode given, the semitone is between 2nd and 3rd, 7th and 8th, and 5th and 6th (ascending). In descending, the semitone is between 6th and 5th and 3rd and 2nd (scale descending as in C maj., without accidentals). On the piano, from any one note to the next is a semitone, as C Csh., E F, B C. (*a*) Notice G is raised a semitone to form leading note; sometimes F below is raised too, to make more euphonious scale. (Chord is then dim.) (*b*) Here G is raised, making maj. chord (sometimes minor chord E G B). (*c*) The G must not be raised here; it should remain a part 5th of C, the tonic of C major (rel. maj. of A min.)—W. H. S.

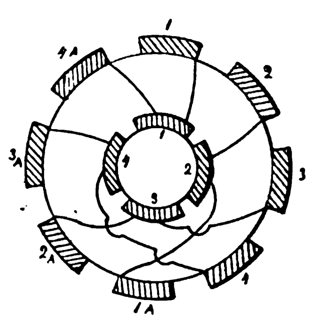
[65126.]—**Harmony.**—"Philomath's" assertion on page 289 that my reply to this query is "much too clever" for the querist is not very complimentary to "Major," for the reply in question was very elementary. There is, at least, ample room for difference of opinion concerning the exact nature of the triad on the dominant of a minor scale, because there are at least four forms of the said scale. In my reply I adopted the view of the writer of the articles in Vol. XIII. My authority for applying the term "diminished" to the triads consisting of a note, its minor third, and diminished fifth, is J. Stainer, M.A., Mus. Doc. I observe that "Philomath" uses the plural pronoun "we," and would like to know how many there are of him.—WM. JOHN GREY, F.C.S., Analytical Chemist, Newcastle-on-Tyne.

[65144.]—**Engine Query.**—What a "hash" the hasty "critics" have made of their "correction" of "T. C., Bristol's" reply to this query. What was the merest slip on the part of this obliging, educated, and practical engineer is rushed at in indecent haste; and with what results? Two out of the five correspondents or correctors making most egregious blunders, almost, but not quite, as bad as the "*side strain upon the indicator*" discovered and announced by one of them. What next?—W. M. J., Dublin.

[65145.]—**Automatic Tank-Filler.**—"Yarty" may find above suitable. It consists of a flotation ball sliding on a rod that is riveted to bottom of tank, and steadied by stay across top of same. The ball actuates two levers working through slots in rod. On the tank being nearly empty, the weight of the ball on lower lever opens the supply, and on the tank being full the pressure of the ball against the top lever shuts it off. Rod stay across top of tank not given in sketch.—E. R. BLAKE.

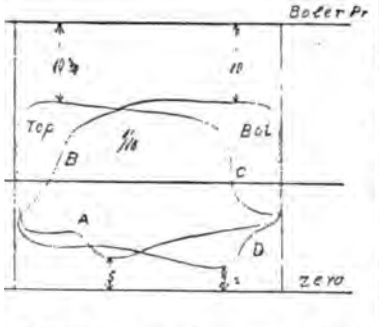


[65146.]—**Siemens Armature Winding.**—As I do not see a reply to this query from the gentleman to whom it was addressed, I send "Practicus" a sketch, showing the method of coupling the coils to the commutator. The Figs. 1 and 1A, &c., indicate the opposite ends of the same coil, which are connected to adjoining segments. The whole wire forms one circuit, as in the Gramme. The core should be of punchings, with narrow cogs just to form channels to receive the wire, as this greatly facilitates winding. When the core is built up it must be fixed securely on the spindle, with internal brass spiders or drums at each end. The coils are then wound on, and crossed at the ends at either side of the spindle, so as to keep it regular. When completed, it must be bound with two or three wire bands in the usual manner. The length of these armatures may conveniently be half as long again as the diameter.—W. A. WALTON.



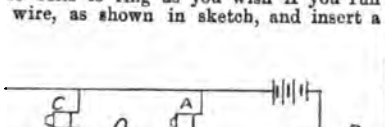
[65151.]—**Boot-Cleaning Machine.**—These are in general as described in last week's issue; but the best is "Edwards's patent," which cleans, applies the blacking, and polishes the boot or shoe far more efficiently than by hand, while a man can do seven times more work in same time than by hand. The principal features in this machine are that for polishing there are a pair of circular brushes running close together in opposite directions at great speed, and producing a brilliant polish. The cleaning or hard brush can be worked independently, and thrown out when polishing. Maker's address will be found in Sale Column last week.—L. A. S.

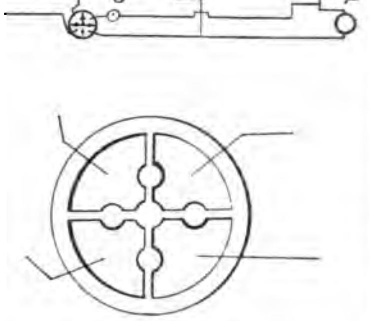
.]—**Beam Blowing-Engine.**—"Young
got his cards upside down somehow; be-
they are at present, they are next door to
le with a curve like that at B and C, as



all them the expansion curves. Next is
ful clearance, which can't be less than 20
., allowing 6in. of cylinder for piston.
m line is good on the whole; but there is a
l loss between the engine and boiler, which
will turn out to be that there is a long
ipe between engine and boiler; that alone
away with no end of coal. The cut-off is
, and the engine appears to be very much
ed under its present conditions. The
n line drops a great deal too fast, showing
early that there is a bad leak somewhere,
eveals itself when you come to the com-
curve at the other end of the cylinder,
ooner does the exhaust close at D than
a sudden rise in power, showing clearly
re is a very bad leak past the piston. It
me at the other end, so it is in the piston
the valves. Next, the exhaust is bad.
haust-pipe may be big enough, but no
loes the steam get away than a lot more
e other side of the piston leaks by and
he vacuum. The exhaust closes on the
l rather too soon; but the lead is good,
is the steam line. I should recommend
M." to see if his piston is tight in the
y; if he does not know how, write, and
ll him. (2) Lag his steam-pipe well; and
e his cut-off earlier. The I.H.P. = 183·3
ards, and the loss due to the bad vac. is
40I.H.P., and if the steam power were
nearer the boiler power, and with a cut-off
·5 stroke, he ought to get with the same
0I.H.P., whereas he is only getting 183·3, a
37H.P., say, and is burning nearly twice
coal as he should for a given power.—

.]—**Electric Bells.**—You cannot do
u want without additional wire at some
he circuit; but I think you will be able
he bells to ring as you wish if you run
wire, as shown in sketch, and insert a





switch with five holes (also shown separ-
you will only require two plugs. Five
experimenting will show in which holes to
lugs to ring any required bell. Write again
ear.—X.

1.]—**Elasticity.**—"M.I.C.E." is right
he stretch did not vary as the length the
of elasticity of any substance would be a
quantity. I forgot that for the purposes
lation I was dealing with only half the
LAG

7.]—**Methyl Orange Indicator.**—Phenol
n is quite applicable for your purpose.
I believe, is commonly used with oxalic
n this case it is very slow work, as your
must be boiled up after every addition of
lkali, as the case may be. I suppose you have special reason for using oxalic acid; but, I may say, for all ordinary purposes its use presents nothing but disadvantages over a mineral acid. It does not keep, and special indicators have to be used with it.—CHEMIST.

[65181.]—**Indian Jugglers.**—No doubt, as "Eos" says—and I have heard others mention it—that the sword being covered with blood or other red fluid would add very much to the effect of the basket trick; but I do not remember ever having observed it, though I have watched the whole performance very closely on several occasions. In my description last week, four lines from the bottom, "should now be omitted" should read "would have to be omitted."—G. G. B.

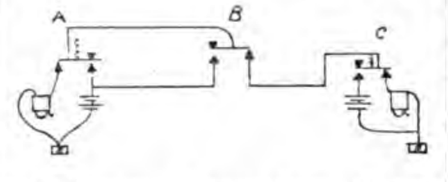
[65192.]—**Potassium.**—As "Chemist" (p. 242) appears to doubt my veracity, if he will take the trouble to look up the "Year-Book of Pharmacy and Transactions of the British Pharmaceutical Conference" for 1878, pp. 155—6, I believe he will find what he fails to see in other books; and if he reads French, perhaps the original is obtainable. I have not tried the process in question, but see no reason why it should not do.—PRINCIPIA.

[65195.]—**Corns on Horses' Feet.**—There is no permanent cure for corns in horses' feet, save the removal of the cause. As, however, the cause is often to be found in a deformity of the foot, in such cases palliative treatment is alone possible. But should the corn have arisen merely from the pressure of an ill-applied shoe, and there be no structural defect in the foot, a permanent cure ought to be effected by removing the diseased horn, encouraging the growth of healthy horn, and afterwards applying a proper shoe.—P. A. N.

[65201.]—**Bursting Pressure on Tanks.**—In my answer to this query π should read $\frac{1}{2}$.—ELAG.

[65211.]—**Logarithms.**—If l = latitude, h = hour-angle, θ = angle required, "Esne Caralita's" formula is: Log. sin. l + log. tan. $h - 10$ = log. tan. θ. Hence, if $h = 90°$, tan. h = infinity, and log. tan. h = infinity. Now as long as log. sin. l is not − infinity, the quantity (log. sin. $l - 10$) will not make any difference to log. tan. h, and may be neglected; consequently we have—Log. tan. h = infinity = log. tan. θ. Hence $\theta = h = 90°$. If l were = 0 (i.e., if the place were on the Equator), log. sin. l would = − infinity, and the above would not necessarily be true. But as in all probability "Esne Caralita" is not on the "Line," it does not affect his case.—G. F. C. SEARLE.

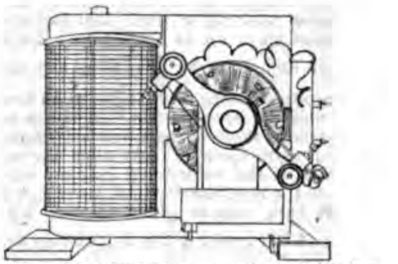
✓[65217.]—**Bells.**—If it is absolutely necessary to use the battery at A, an additional wire must be run from A to B. If a battery is used at B,



the fresh wire may be dispensed with My sketch is in accordance with the first conditions.—W. PERREN-MAYCOCK.

[65214.]—**Theodolite and Compass Surveying.**—In the theodolite compass and also the circumferentor the cardinal points are not reversed; but East is put where West should be in relation to N. and S.; also the numbering of the graduation into degrees, &c., proceeds in the contrary direction to that in which the bearing or magnetic azimuth is estimated, for the following reason. Assuming the north-seeking end of needle to coincide with marked N. in compass-box, then during observation the needle is regarded as stationary, and if the north of box be kept a head, it will be seen that when this point is carried westerly the (north end of) needle really at rest will travel relatively easterly, because it is the box that moves, and therefore E. and W. must be reversed that the reading may be right. The same thing would happen if the S. of box were ahead and the S. of needle read. A simple diagram may be used to assist in proving that the bearing—viz., the angle from the north of the needle to the forward point of box estimated in one direction is the same as the angle from N. of box to N. of needle read in the contrary direction. A moment's inspection of the instruments at work will show this, which is just a question of apparent motion of the needle, which is stationary. As to the true meridian, it must be found at the place of survey, and with an exactness of accuracy commensurate with the requirements of the case. It may be simply found for survey purposes by observations of sun at equal altitudes, or by a plumb-line intersecting the pole-star and the second one in tail of Great Bear, as pointed out by Mr. Butler Williams. The many small variations of declination are not considered in surveying because the compass is not graduated or required to be read to the accuracy of the limb of theodolite, and only used either as a check in the traversing, or when by itself as prismatic compass its operations are confined to where strict accuracy is not required. Of course, it is expected that local attraction will be guarded against.—H. J. CAMPBELL, Surveyor, Dublin.

[65219.]—**Dynamo.**—TO MR. BOTTONE.—Yes, a Pacinotti ring 6in. diameter, with twelve teeth, will be found very effective. A single wrought-iron core, 3in. diameter, 8in. long, wound with 8lb. No. 12 as the series, and 45lb. No. 20 as the shunt coil, fitted with massive pole-pieces cast in malleable iron, of the pattern shown in the cut, will give sufficient current to light eight 20's easily, and will absorb about 1H.P. To get 60 volts you would need about 6lb. No. 14 on the armature.—S. BOTTONE.



Dynamo, with 1 Field-Magnet Core and Ring Armature.

[65235.]—**Indians with Tails.**—I was in Paraguay between the years 1850 and 1870. There are no Indians in that country other than a small remnant of the once vast Pagey-a-gwar tribe. They were great drinkers of spirits, and are, therefore, probably now extinct, and their very guttural but beautifully expressive language lost. There was nothing remarkable about them other than that they had no hair on their skins, and that they were very truthful and honest. The story referred to by your correspondent I had heard before, with others of a similar nature. They are what "blue-jackets" call "cuffers"—yarns which carry their own refutation. For instance, Indians who go on a foraging expedition don't take encumbrances with them in the shape of young children. Again, who was there to understand the boy's language? Because that spoken by the Indians of the Gran Chaco is totally different to that spoken by the Paraguayans. Only their chiefs can converse in Spanish or Portuguese. Again, the boy was captured and taken to somebody somewhere or other (all new names to me); it was then discovered he had a tail. How was it that it was not discovered before, because children do not wear any clothes in those climates. I knew Mr. Lucas, who was the friend of Bonpland (the companion of Humboldt) in his captivity; Mr. Bliss, the famous Indian linguist; Dr. Ferres, the eminent surgeon (the same who amputated his own leg during the war); Lieut. Roubley, born of Indian parents—these all knew the interior of the continent well, and had never met with Indians with either flexible or inflexible tails. The owners of the latter were said to be obliged to carry a stick to make a hole in the ground before they could sit down. Said to me an Indian patriarchal chief (whom Capt. Page, of the U.S. Navy, estimated to be 126 years old), "My dear sir," said he, "Indians with tails could not ride on horseback as you see me do now; then how could they hold their own against us? And, as for Los Mansos, they would not be able to hold their own against even the jaguar, puma, or other wild beast. Then how could they all live?" Los Mansos were said to be a tribe of Indians so tame that if you put a drove of them in a corral or cattle-pen they would not have sense enough to get out! Many of the tribes are teetotalers; their chiefs will not allow their tiger-skins, &c., to be bartered except for calico, axes, knives, or other articles of utility. Hence, with a clear head and strong arm, they have held their own against all comers, though armed with weapons the most primitive. Their skill with the bow and arrow must be seen to be believed.—A CITIZEN OF PARAGUAY.

[65238.]—**Electric Bells.**—TO "F. C. A."—I have arranged with the Editor for, and will shortly send in the first of, a series of articles on the construction of electric bells, indicators, switches, &c., entitled "Electric Bell Construction," in which "New Subscriber" will, I think, find all he requires. As in "Practical Electric Bell Fitting," the articles will be accompanied with copious illustrations, and all the parts of the various apparatus will be shown in detail, each figure being either half or exact size.—F. C. ALLSOP, Brighton.

[65240.]—**Dynamical Problem.**—When the monkey starts climbing he causes an extra tension on the rope. This tension (which is the same at all points along the rope, since the rope is weightless and inextensible) acts on the counterpoise just the same as on the monkey, and, since they are of equal mass, will cause in each the same change of motion. Hence each will start moving upwards with the same velocity. The above argument clearly applies to the whole of the motion, and the monkey and counterpoise will always have the same velocity and acceleration. Hence they will always be at the same level. If v is the velocity of monkey relatively to the rope—i.e., the number of feet of rope which pass the monkey in one second, the rate of shortening of the rope between monkey and counterpoise will be v also. But monkey and counterpoise move up at same rate. Hence the velocity of each must be $\frac{v}{2}$. If at any time the monkey stops climbing and holds on to the rope, both he and the counterpoise will rise a certain distance (like a stone thrown vertically upwards), depending upon their velocity when the monkey stops. If u is the velocity of monkey when he holds on to the rope, the distance, h, through which they will both rise is given by $u^2 = 2gh$, or $h = \frac{u^2}{2g}$. After reaching this height they will fall again, still keeping always at the same level, until the rope becomes tight, when each will receive a sudden jerk and will be stopped. If in any case the rate at which the monkey climbs is given, the motion can be at once found from the above principles. I have written rather at length on this subject, but it is one at which very many people have come to grief.—G. F. C. SEARLE.

[65242.]—**Formula for Gradually Decreasing Scale.**—It would be impossible to find out the "law" of the series merely from the first and last term and the number of terms. If the law is known the sum of any number of terms of the series can be found in a great many cases; but some require very special treatment. If "Stepney" will explain more fully what he means, I will try to help him.—G. F. C. SEARLE.

[65243.]—**Lead Pipes.**—The deposit on the wall above the pipe is probably dust from the air. When warm, dusty air comes in contact with a cooler body, the dust (by a process not perfectly understood) deposits on the cooler body. For the same reason, all kinds of house-warming apparatus which act principally by warming the air first cause a deposit of dust, as well as moisture, on the cooler walls and furniture.—J. BROWN, Belfast.

[65243.]—**Lead Pipes.**—I never heard of lead pipes through which hot water flows giving off any fumes. What "Perplexed" complains of is really smoke, which follows the circulating pipes from the kitchen fire. The said pipes in their passage to the cylinder pass through one side of chimney, and the hole not being properly made up, the smoke gets through, and if the pipes are cased with timber it will follow them all the way to the cylinder. The remedy is to make good the wall where the pipes go through with good cement, and if there should be a small crevice show itself after a time, make it up with putty or mastic. And lastly, be sure the pipes are well hooked to the wall, as if not they are liable to vibrate and break the joint. —J. T. G.

[65262.]—**Inflammable Liquid.**—Phosphorus dissolved in carbon disulphide does this if the air is moderately warm, about 70° F.—AN OLD LEYSIAN.

[65262.]—**Inflammable Liquid.**—Querist may try solution of phosphorus in carbon bisulphide; but great care should be taken, and it is safest, after experimenting, either to burn or throw away the remains of the solution in a safe place.—J. BROWN, Belfast.

[65264.]—**Borax Toning Bath.**—I have never used any other toning bath than the borax one: I have every reason to be satisfied with it. I find it acts best if used directly it is made, and with a good vigorous print a splendid purple black may be obtained in about one minute; of course a brown black may be got by not keeping the print in so long. The following bath is the one I use:—Hot water, 10oz.; borax, 70gr.; gold chloride, 1gr. —AN OLD LEYSIAN.

[65266.]—**Leclanche Zincs.**—These wear and work much better amalgamated.—M.M.I.SC.S.

[65266.]—**Leclanche Zincs.**—It is not absolutely necessary; but it adds to the efficiency of the battery to do so.—X.

[65266.]—**Leclanche Zincs**—These are usually sent out by the various makers already amalgamated; and amalgamation, though not absolutely necessary, tends to greatly increase the lasting powers of the zincs.—F. C. ALLSOP, Brighton.

[65266.]—**Leclanche Zincs.**—If these are amalgamated, I think you will find that they will work much cleaner and last longer than the unamalgamated ones. I happen to know one or two makers of the above, and they say that they always amalgamate their zincs.—PRINCIPIA.

[65266.]—**Leclanche Zincs.**—Opinions are somewhat divided on this point. Practically, I do not find much difference. Still, beyond the additional expense, there is no harm in amalgamating the zincs; but it is doubtful whether amalgamation protects the zincs when a salt (like salammoniac) is used alone.—S. BOTTONE.

[65268.]—**Basic Sulphate of Mercury.**—Boil two parts of mercury (by weight) with three parts of sulphuric acid to dryness. Powder the mass, and treat it with successive portions of boiling water until it is all converted into a canary-yellow powder. Worth about 3s. to 3s. 6d. per lb., according to the price of mercury.—S. BOTTONE.

[65268.]—**Basic Sulphate of Mercury.**—According to the B.P. the preparation of this salt is conducted in the following manner:—"Heat mercury 20oz. and sulphuric acid 12fl.oz. in a porcelain vessel, stirring constantly until the mercury disappears; then heat further until a white dry salt remains—$Hg + 2H_2SO_4 = HgSO_4 + SO_2 + 2H_2O$" (this is the mercuric sulphate). "Rub together until no globules are visible. Moistened sulphate of mercury 10oz., and mercury 7oz.—Hg_2SO_4 is formed." Taking the price of mercury at 2s. 8d. per pound and sulphuric acid at 2d. per pound, the cost of the above materials would be 3s. 7d.—that is, for a product of about 30oz. of mercuric sulphate; then 10oz. of sulphate will cost 1s. 2d. and 7oz. of mercury 1s. 2d., thus making 2s. 4d. for 17oz., or about, say, 2s. 3d. per pound. Do not attempt to make it unless you have a proper place, as the sulphur dioxide which is evolved makes an awful smell.—PRINCIPIA.

[65269.]—**Piston Valves.**—These are not suitable for small sizes, because of the difficulty of getting them up, and of the very doubtful results obtained with them. Even in large engines they do not seem to make any progress. My experience of them is, however, confined to steam hammers.—W. M. J., Dublin.

[65271.]—**Steam-moved Engine Valves by a Subsidiary Cylinder.**—This was patented last year by Mr. Fredk. Thompson, of Sunderland. The valves of the subsidiary cylinders themselves are governed by extremely simple light gear, driven off crank shaft, and this light gear governs all the machinery. There is no liability to recoil.—FRANK CAWS, Sunderland.

[65271.]—**Steam-moved Engines Valves by a Subsidiary Cylinder.**—This is not new, as, if "T." looks up any of the steam-pump patents, he will find plenty of them. But I think they are dying out, as, with all their ingenuity and counter-cushioning, they had quite a way of sometimes making long strokes which knocked the covers, and short ones which did no work; then suddenly, when least expected, stop dead, &c., causing disappointment and bad language. "May they rest in peace." Commend me to a positive action by the good old crank and connecting rod, and a similar "push and pull" to any ordinary slide-valve.—W. M. J., Dublin.

[65272.]—**Soldering Fluid.**—Salammoniac and rosin, dissolved in alcohol. I do not know the proportions.—A. F. SHAKESPEAR, Lüttichaustr. 14, Dresden.

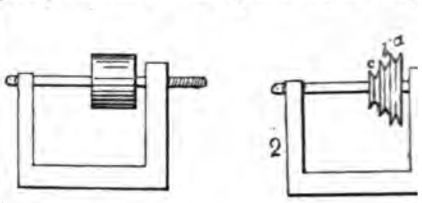
[65272.]—**Soldering Fluid.**—I cannot recommend any fluid, if zinc chloride be not admissible; but powdered rosin is an excellent flux for all tinned goods, and will work well with clean copper and brass. Salammoniac in powder is also very good, and will work with zinc, provided the zinc be previously well cleaned; but the flux for zinc is certainly hydrochloric acid; but this has an objectionable smell.—S. BOTTONE.

[65273.]—**Braiding Patterns.**—Will not the method in common use for ladies' fancy work answer your purpose? The design is drawn (or printed) on thin paper with coloured wax. A hot iron causes the wax to leave the paper, and be absorbed by the material.—SM.

[65273.]—**Braiding Patterns.**—I have seen some friends of mine marking out crewel-work patterns from tissue paper patterns, printed in a red, fusible kind of ink. A hot iron is passed over these while lying face downwards on the cloth to which the pattern is to be transferred. Various designs are sold in narrow slips at about a penny per yard. If you require a considerable quantity of any one pattern, it would pay to obtain a block and print off in ordinary ink. — CHARLES READER.

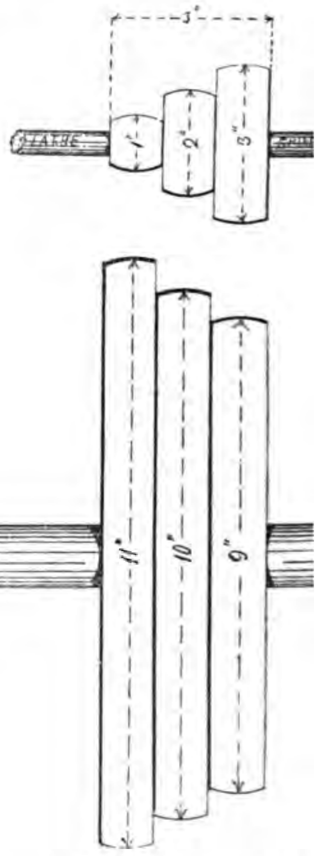
[65276.]—**Roofing Felt.**—Surely M. Smith knows that uncoated felt is the most commonly used kind, and, of course, requires to be coated when on the roof with tar, and over the tar, when hot, a good thick sprinkling of sand that has been dried, and I have known it (the sand) used hot. This keeps it together when under the sun's rays. Coated felt is also made, and is supposed to require nothing when on the roof. It is dearer, of course, and it is covered by a mixture of pitch and tar, which is very smooth and waterproof, but it is rather stiff, and not so handy for lapping ro
corners, &c. The fibre of felt is got from tow
the outer skin or covering of the flax plant. Af
retting, the flax is brought to a scutch mill, wh
it is held between a rounded edge and revolv
beaters, and along with the hard skin ther
beaten off this tow, which is afterwards put thro
special machines, somewhat like the paper proc
—W. M. J., Dublin.

[65226.]—**Lathe Alterations**—The lathe
be altered very easily by turning as many V groo
in the pulley as you may require. We will
pose three, as it is a small one. Procure a stri
untanned leather about ⅝in. wide and ⅛in. thic
few inches longer than present belt; twist t
and it will form a round strap; join same wit
hook and eye; fit it to lathe, and turn groov
You can keep the band over to the left by driv
a bradawl or long wire nail into the bed (a te
porary rest can be made by screwing on a strip



wood). Fit the band to groove *a* by unhooking
and screwing it up a turn or two; then turn groo
b and *c*. The three grooves turned in top pul
must not be any wider than driving-wheel, or
band will run off. By having a band to unh
and twist or untwist, you can make it do for
three speeds, and use the driving-wheel as it is.
have sent two rough sketches to make my expla
tion more clear to you. No. 1 as the head now
No. 2 the same altered.—BROSCENICUS.

[65226.]—**Lathe Query.**—You can work
lathe with 1in. belting; but if you would rat



use a round band put a V-groove on each of t
speeds, keeping to the above proportions.—J.
WELLWOOD.

[65277.]—**Carbons.**—Wash the carbons careful
dry thoroughly in a rather hot oven, melt off t
lead in a ladle, and make a plaster of Paris mou
of the shape desired, and re-cast the leads on t
carbons, adding a little antimony to the lead
insure tight contact.—S. BOTTONE.

[65278.]—**Water Colour.**—A saturated solut
of chloride of lime in water is the medium chie
used to remove colour from paper, &c. Arti
colourmen sell it in bottles for the purpose.—B.S
Plymouth.

65278.] — **Water-Colour.**—Small high lights oftenest put in with body colour. Chinese ite is much used. The knife is also sometimes d. A solution of chloride of lime removes nson lake. I do not think any suitable solution nown which can properly be employed to bleach every colour.—F. CAWS.

65278.] — **Water-Colour.** — "Chromo" must paper of a very porous and absorbent nature he ordinary methods of taking out lights with in water, after the colours have dried, fail in hands. I never heard of any preparation for purpose; but I think if he were to employ atman's best drawing paper, the difficulty he nplains of, unless due to his colours, would not se. Apart from scraping and then rubbing ooth, the colour can be removed by applying ter in the forms required with a brush, and owing it to remain undisturbed for a short time, excess being then carefully taken up with tting paper. This alone removes a great deal, d may be increased by rubbing the spot with y bread or indiarubber. Another plan is to use shield, which is a piece of stout paper, out of ich is cut with a knife the shape required, as e sail of a boat; this is placed upon the drawing, ld firm, and a damp, not wet, sponge applied to e opening until sufficient colour is removed. ll details on these points, and many others, are to found in Green's "Hints on Sketching from ature," Part III., published by Rowney and Co., ice 1s. I should recommend him to get the three rts, which are to be had bound in one volume.— . G. B.

[65279.]—**Electro-Motor.** — The motor starts mediately on being connected to the battery. A itch should be used to make and break contact. is not easy to regulate the speed of the motor. course it runs somewhat quicker as the battery wer rises; but the speed of the driven can be ulated by having different-sized drivers, as in a he wheel. The little arm at Fig. 6 is to shift brush holders round to the best point of comtation. Of course this disc can slide round on boss, but can be fixed at the best position by a screw. Leclanché would be no use for this tor. For best way of constructing plunging hromate, see my book "Electrical Instrument king for Amateurs."—S. BOTTONE.

5280.]—**Electric Bells.**—Add another cell— is not enough to work it unless it is exceptionwell made.—M.M.I.SC.S.

65280.]—**Electric Bells.**—I have a bell which some time behaved as you describe. I remedied y altering pressure of contact breaker, and by ling to the battery power. "Tamrai" does not which number his battery is. I used two No. 2 lanché cells.—FELIX HOLT.

65280.]—**Electric Bells.**—This is most probly defective push springs. Owing to the battery ver being small, unless good contact is made ween the two springs, the bell does not ring: accounts for its going on and off. Should the h be in proper order, look to the contact spring your bell, which does not perhaps make good tact with the adjusting screw. You will find it advantage to add another cell to your battery.— C. ALLSOP, Brighton.

65280.]—**Electric Bells.**—I have had the same uble, and found it was caused by the armature using to leave the contact-screw, and is probly caused by the magnetic field not being strong ugh—i.e., the armature is too far away from magnet. In order to ascertain if this is so, d an assistant to press the push, and the armae will move slightly towards the magnet, and it is touched it will then ring all right. Perps the magnet is not strong enough, or else the h does not make good contact. If it is due to former, on jerking the push smartly it will be nd to ring, probably through causing a sudden h of magnetism in the coils.—PRINCIPIA.

55280.]—**Electric Bells.**—Examine connecs in push, and see if they are likely to cause rmittent contact. Contact points may be dirty, only allow current to pass when pressed harder usual. Is it in the middle part of day that rings all right? If so, your wire is parted er by staple being driven in too far, or fault in ufacture, bad joint under insulation having n way when stretched in fitting up. A fall in perature would cause the ends to leave each r, whilst a rise would bring them together n, owing to expansion of the wire. Take two ing needles, and connect one at each end of a or two of small wire. Now, when push will ring the bell, fasten the button down tightly, go over your line wires with needles, sticking through the insulation into the wire about a or so apart; when the fault is bridged over, bell will ring, and you will know that it is een the needles.—X.

5282.]—**Magnetism.**—One of the essential itions of magnetism is that it magnetises steel iron without losing any of its own magnetism No fluid can propagate itself indefinitely without loss, thus magnetism is not a fluid.—FELIX HOLT.

[65282.]—**Magnetism.**—The attraction varies as the square of the distance from the magnet; thus —suppose a body to be attracted with a force of 1lb. at 1in. distance, then the force at 2in. would be 4oz., at 4in. 1oz., and so on.—PRINCIPIA.

[65283.]—**Pictures.**—To answer this question would occupy a great deal of space, and require many drawings and coloured prints to accompany the description. John Burnet's treatise on "Painting," in four parts (1, on the Education of the Eye, 25s.; 2, on Composition, 15s.; 3, on Light and Shade, 18s.; 4, on Colour, 31s. 6d., published in 1865 by Leighton, 40, Brewer-street, Golden-square), might assist "P."; but a good deal of information, perhaps sufficient for his present purpose, may be obtained from the "Sketcher's Manual," by Frank Howard, 4s.; and from Green's "Hints on Sketching from Nature," Part I., price 1s., published by Rowney and Co.—G. G. B.

[65283.]—**Pictures.**—"P." asks for what no genuine artist would think of affording him, knowing that no hard and fast rules can be given on a subject so utterly independent of what may be called grammar. "What do you mix your colours with?" said a young student to an eminent painter. "With brains, sir!" was the laconic reply. So I say to "P.," he must first possess a special talent for this special art, whether as a critic or an artist, which means a correct eye for colours, and, what is more essential still, be thoroughly familiar with the principles and practice of correct drawing or perspective. It is easy enough to know what constitutes a pleasing picture; but there is a vast difference between what is simply pleasing to the inexperienced eye and what would challenge the criticism of a judge of art. I would strongly advise "P." to try and attain proficiency in some less exacting art than that of painting, for he is sure to leave off no wiser than he began if he relies on what would be told him "in a letter or two." "Sound opinions on pictures" require many years' diligent study of the best masters to enable anyone to call himself a judge of what true art consists in. Many a person may be a good judge of true merit without being an artist. But, I say again, no rules can be given. —JOHN HAMPDEN.

[65283.]—**Pictures.**—It is thought by some that if photographs could be perfectly taken in colour, the occupation of the picture-painting artist would be gone. But the highest aim of the true artist is not merely to present on a flat canvas a "strictly correct" transcript of visual facts. Even the painter of fruits and flowers aims at something besides mere "naturalness." George Lance's fruit pieces, for example, possess a charm which is largely due to artistic qualities of grouping, composition, and chiaroscuro, over and above their mere naturalness. The true painter is a poet. He does not present to you a soulless report, by brush, of the beauty and life he has seen, any more than Tennyson presents to you the life of King Arthur in "dry-as-dust" antiquarian record. Some fondly "conscientious" critics urge that "an artist has no business to paint nature as he thinks it ought to be, but should paint it as it really is." But such critics forget that the artist does not see nature from their (merely literal) point of view. Scientific, practical, old Merlin was too wise to have demanded from the painter of rainbows a transcript correct merely from a geometric or spectroscopic point of study. "Sun, rain, and sun," he sang, "A rainbow on the lea, And truth is this to me, and that to thee." I find, by inquiry, that the stars of first magnitude appear to many persons "as pin's heads," to many others "as big as threepenny bits," and to others, "as sixpences." Likewise the moon appears to some "the size of a shilling," and to others "as big as a cart-wheel." Now, the actual perspective size of moon as seen coming out "above the tall white chimney tops" can be accurately determined by observation; but an artist who thinks his moon natural because it is drawn to correct size may not have succeeded nearly so well in conveying the moon's beautiful effect as another artist who has allowed his imagination to magnify his moon. When Mrs. Butler paints a horse in motion she expresses its motion, properly, by drawing the horse in an attitude he is, in point of fact, never in at any one moment. On the other hand, an instantaneous photograph gives us the correct momentary posture of the galloping animal, and he does not seem to be in motion at all; but in an ungainly, impossible attitude. Briton Riviere magnifies his lions. If the true proportions cannot be correctly observed without utter loss of life, motion, sublimity, and qualities which the imagination demands in a picture, and which only the imagination of both the artist and his critic can supply, then artists must be allowed reasonable license in such matters. There is a Berkleian element in the philosophy of vision. Our visual impressions are the resultants, so to speak, of component objective and subjective impressions. The photographic camera faithfully contributes its objective impression; which needs the addition of the subjective influence of the artist's mind to constitute a picture of nature as we perceive it in nature. It may be said that as the objective reflection from nature to the retina is sufficient to excite and stimulate the subjective, or imaginative, function of the spectator's mind, so ought a strictly accurate pictorial rendering of the objective reality itself likewise to awaken the same subjective faculty. And so it does, to some degree. But not sufficiently; for the instantaneous photo. of train in motion makes it appear to be standing still, the imagination notwithstanding. And here, where science fails, art comes to the rescue. I should like to add, lest I be misunderstood in the above observations, that I fully recognise that between the artist whose implement is the camera (rather than the brush), and the merely mechanical photographer, there is a wide gulf. One of the greatest qualities of art is "breadth," which may be described as the evidence supplied by the picture that its painter, taking a masterly grasp of the whole subject, has so treated it as to give due prominence to the leading features, making all the details and subordinate features accessory to the chief, and not conflicting therewith. This principle of "breadth" applies to the massing of, and grouping of, figures and objects, so as to have one group more prominent than other groups, and one figure or object in each group more pronounced than any other. "Breadth" should likewise be exercised by the artist in massing lights and shades, so that the central light, or central shadow, as the case may be, may have no rival in the field. Light running into corners is very distracting and to be avoided. Rembrandt, by exaggerating the "breadth" of his treatment in respect of lights and shades, originated a weird style of chiaroscuro, which will ever be known as "Rembrandtesque." Nature herself masses her lights and shadows in morning and evening effects, which are much more poetical and beautiful (as pictures) than noonday scenes, because of the "breadth" of Nature's own treatment when the sun is low and the mists are rising, and because of the mystery and splendour accompanying such conditions. Another great principle of composition is parallelism or refrain, which consists in repeating, with less and less emphasis, leading lines and features, which (if not too obviously done) produces a feeling in some degree akin to refrains in music, and contributes to the unity, breadth, and repose of effect generally. The greatest colourists, like Nature herself, can express colour without using it, or by using an infinitesimal degree of it. For example, I remember a large, powerful painting, by A. Gilbert, of a green mountain side by moonlight. It was as evident that it was a green hill side as it would have been in the actual scene. But, on closely examining the picture, I found the effect of green was most skilfully produced by gradations of grey, cunningly broken, no positive green being employed, so far as one could see.—F. C.

[65284.]—**Electrical.**—1. No. 16 is rather large wire for the core of such a coil. It will retain a certain amount of magnetism, hence the sticking of your clapper. 2. Your clapper spring is too weak; place a back-nut, so as to be able to regulate the tension. 3. The sliding tube, by removing the secondary further from the coil core, greatly weakens the effect. 4. Plain single-cell chromic acid, or bichromate batteries, are better than the form you are using for coil work. 5. Four chromic-acid cells with double carbons 2in. by 4in. will light an 8 volt 5c.p. lamp for three hours.—S. BOTTONE.

[65286.]—**Frosting Window Panes.**—I have tried the same plan with the same result as "A Christian Turk." But I have adopted a plan much better, and with a nice effect. I got some white tissue-paper and cut it into squares the size of the panes. I then cut the same size some stiff brown or blue paper. I then damp the stiff paper, and spread the tissue-paper on it, when it will adhere. Gum the pane over and bring the stiff paper against it with the white tissue against the pane, to which it will adhere; the stiff paper serves the same office for all. You can gum scraps on the pane first to suit taste. When dry this can be varnished, or will bear rubbing without.—TASTE.

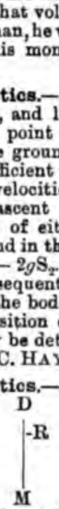
[65287.]—**Coil.**—See also my reply 65284. The probabilities are that the clapper spring is rather too weak. It is sometimes an advantage to have a rather stiff spring for the clapper, and to solder to it a thin, weak spring, to which the platinum contact piece is to be attached. If this latter spring is made to press lightly against the platinum screw, it insures a longer contact, and a more perfect magnetisation of the core before the "break" takes place. This conduces greatly to regularity and efficiency.—S. BOTTONE.

[65289.]—**Barometer.**—TO MR. BOTTONE.—You have done all correctly, except in the matter of filling the tube. I believe it is literally impossible to get the mercury dry and free from air without boiling it. The very act of pouring it in the tube carries air along with it. The proper way to manage the matter is to have the mercury in a perfectly clean iron ladle over a charcoal brazier, so as to keep it pretty warm. Pour a little into the inverted tube, boil it by a spirit-lamp, add more mercury, again boil, and so on until the tube is full. This is, I understand, the only way to get a trustworthy mercurial barometer, because, of course, if air and moisture find their way into the tube they falsify the readings.—S. BOTTONE.

[65292.]—**Noises in the Ears.**—This query is addressed to a correspondent direct, and perhaps I ought not to reply; but as the majority of the readers are scarcely likely to be interested in the reply asked for, might I refer the querist to the index of Vol. XLV.? He will see a good deal about noises in the ears in that volume; but if he should happen to be a wise man, he will seek skilled advice before parting with his money or doing anything else.—VIDEO.

[65295.] —**Kinematics.**—Let x be the point at which A and B meet, and let S_1 be the distance between the starting point of A, and x and S_2 the height of x above the ground; then as the initial velocity V of B is sufficient to carry it to the starting-point of A, the velocities of A and B at any point in the line of ascent and descent are equal. Let v be the velocity of either at x. Then in the case of A, $v^2 = 2gS_1$, and in that of B, $v^2 = V^2 - 2gS_2$. Therefore $2gS_1 = V^2 - 2gS_2$. The height $(S_1 + S_2)$ being known, and consequently the value of V, S_2 or the height at which the bodies meet may be easily determined. The position of x being known, the time of meeting may be determined from the formula $S = \frac{1}{2} f t^2$.—H. C. HAYCRAFT.

[65295.]—**Kinematics.**—Let D M represent the



line of fall, and R the point of meeting. Then body A takes same time to fall down D R as body B takes to rise M R. But body B takes same time to go up as to come down M R. Therefore, body A takes same time to fall down D R as down R M; therefore they meet at half the time. Now space varies directly as the square of the time; therefore, if body A falls down D M in t seconds, and down D R in $\frac{t}{2}$ seconds, D M is to D R as 4 : 1, or the bodies will meet at three-quarters the distance from the ground.—J. A. W. B.

[65295.]—**Kinematics.**—Let h = height, t = time, and x = height above the ground at which the bodies meet. Then, $h - x$ is the height through which the first body falls, and we have $h - x = \frac{1}{2}gt^2$. If V be the velocity of projection of the second body upwards, we have by the conditions of the problem, $V = \sqrt{2gh}$. And—

$$x = Vt - \tfrac{1}{2}gt^2 = t\sqrt{2gh} - \tfrac{1}{2}gt^2$$

Or— $$x = t\sqrt{2gh} - (h - x) = t\sqrt{2gh} - h + x$$

$$\therefore t\sqrt{2gh} = h$$

Whence—

$$t^2 = \frac{h}{2g} \text{ and } t = \sqrt{\frac{h}{2g}}$$

Again— $$h - x = \tfrac{1}{2}gt^2 = \tfrac{1}{2}g \cdot \frac{h}{2g} = \frac{h}{4}$$

Whence— $$x = \frac{3h}{4}$$

—J. E. GORE.

[65295.]—**Kinematics.**—The height of point whence A is dropped $= \frac{V^2}{2g}$. Let x = distance A passes through when it meets B. Then the time of passing through x is found from the following equation: $x = \frac{gt^2}{2}$; whence $t = \sqrt{\frac{2x}{g}}$. The distance B ascends till it meets $A = \frac{V^2}{2g} - x$, and the time of ascending that distance can be got from the equation: $\frac{V^2}{2g} - x = V\theta - \frac{g\theta}{2}$. But the times of ascent and descent are equal: therefore, substituting t for θ, we get from the last equation: $\frac{V^2}{2g} = V\sqrt{\frac{2x}{g}}$. Therefore $\frac{V^2}{4g^2} = \frac{2x}{g}$. Hence $V^2 = 8xg$. Therefore, $x = \frac{V^2}{8g}$. The distance B ascends till it meets $A = \frac{V^2}{2g} - \frac{V^2}{8g} = \frac{3V^2}{8g}$. The time of ascent $= \frac{V}{2g}$. Note.—The ratio of descent to ascent is 1 : 3.—TERRANOVA.

[65295.]—**Kinematics.**—The body B would take the same time to reach the point A is dropped from as A would take to reach the ground, and they would meet at half time, since they must both have been upon the journey an equal time. The height A is dropped from $= h \tfrac{1}{2} 32 t^2 = 16 t^2$, where t = time in seconds it takes A to reach the ground. In half the time A would fall $16\left(\frac{t}{2}\right)^2 = 4t^2$, or ¼ the total distance. Therefore they would meet at ¾ the height from the ground.—ELAG.

[65295.]—**Kinematics.**—
Let T = time of A's descent and of B's ascent.
S = space of " " " "
Then $\frac{T}{2}$ = time of A meeting B.
$\frac{S}{4}$ = space fallen through by A at moment of meeting B.
$S - \frac{S}{4}$ = space shot through by B at moment of meeting A.—FRANK CAWS.

[65297.]—**Tension in a Cord.**—The tension in the cord may be considered as the upward force acting on both P and Q. The pressure producing motion of P downwards will be P—T, and of Q upwards T—Q. As the acceleration f, which is the same in both cases, varies directly as the force and inversely as the mass, taking m and m_1 as the respective masses of P and Q, we get $f = \frac{P-T}{m}$ and also $f = \frac{T-Q}{m_1}$, therefore $\frac{P-T}{m} = \frac{T-Q}{m_1}$ or $\frac{P-T}{P} = \frac{T-Q}{Q}$, consequently $T = \frac{2PQ}{P+Q}$.—H. C. HAYCRAFT.

[65297.]—**Tension in a Cord.**—If the wheel were frictionless, the acceleration would be constant, steady speed would never be gained, and the stress on cord would be $= \frac{2PQ}{P+Q}$, as stated. But if the wheel were not frictionless, it would sooner (if rough) or later (if smooth) develop frictional resistance = P − Q. Then steady (i.e., uniform) speed would be attained, and so long as that speed continued the stress on cord would = P. It is only at the initial moment of motion that the stress on cord = Q.—FRANK CAWS, Sunderland.

[65297.]—**Tension in a Cord.**—$f = \frac{P}{W} g$. Let P be greater than Q; therefore P is descending. Now P − T is the force producing motion, and P is the weight. Therefore, $\frac{P-T}{P} = f$. As Q is ascending, T − Q is the force and Q the weight. Therefore, $\frac{T-Q}{Q} = f$. But the "f's" are the same. Therefore, $\frac{P-T}{P} = \frac{T-Q}{Q}$; $PQ - TQ = PT - PQ$; $TP + TQ = 2PQ$; $T(P+Q) = 2PQ$; $T = \frac{2PQ}{P+Q}$.— J. A. W. B.

[65297.]—**Tension in a Cord.**—Let T = tension in cord, and f = acceleration. Then we have—

$$f : g :: P - T : P \text{ and } f = g\,\frac{(P-T)}{P}$$

Also—

$$f : g :: T - Q : Q \text{ and } f = g\,\frac{(T-Q)}{Q}$$

$$\therefore g\,\frac{(P-T)}{P} = g\,\frac{(T-Q)}{Q}$$

And— $$PQ - TQ = PT - PQ$$
$$\therefore 2PQ = (P+Q)\,T$$

And— $$T = \frac{2PQ}{P+Q}$$

—J. E. G.

[65297.]—**Tension in a Cord.**—The actual moving force must be the difference of the two weights, or P − Q; this is usually called the pressure. Now the accelerating force is quite a different thing, and is usually measured by the velocity acquired at the end of a second; in the case of gravity it is 32·2ft. The accelerating force is found by dividing the pressure by the mass, the mass being the weight divided by g, or 32·2ft. This may be stated thus—

$$\text{Vel. at end of one second} = \frac{\text{pressure}}{\text{mass}}.$$

The mass in this case is the sum of the two weights divided by g. The above therefore becomes—

$$\text{Vel. at end of one sec.} = \frac{P-Q}{\frac{P+Q}{g}}$$

Now to find the tension on the string, we may suppose the two balls with string to be laid on a flat, smooth plane, and to be acted on by the above force horizontally; the two balls will acquire the above vel. in one second. If, then, we can find the pull on the string which will cause the vel. in Q alone, we have solved the problem. Let x = tension which we wish to find; by the above rule we get—

$$\text{Vel. at end of one second} = \frac{x}{\frac{Q}{g}}$$

But as the balls are tied together, the vel. must be the same as in the last equation; so we g equating the two values on the vel.—

$$x = \frac{PQ - Q^2}{P+Q}$$

Now, if instead of being on a flat plane the balls to hang over a pulley, the wei will have to be added to the above value tension of cord—

$$= \frac{PQ - Q^2}{P+Q} + Q = \frac{2PQ}{P+Q}$$

—M.I.C.E., Bath.

[65297.]—**Tension in a Cord.**—If with Q attached were attached station beam, the tension in the cord would be = if you cause Q to ascend or descend, th increases or decreases respectively, becau case Q goes against gravity, and in the o with it, just as a person may have power o enough in his arm to hold a weight stra but not to lift it higher. Example—If g = 32, and a weight of 12lb. be raised acceleration of 8ft. per second, as 8 fourth of 32, the tension will be 12 fourth of 12. Here is the proof in this Acceleration $= g\,\frac{(P-Q)}{(P+Q)}$; therefore, sion : Q :: $g + g\,\frac{(P-Q)}{(P+Q)} : g$; therefo sion $= \frac{2PQ}{P+Q}$.—TERRANOVA.

[65297.]—**Tension in Cord.**—It must membered here that since one weight P i than Q, that they will not remain at rest, move with a certain acceleration, so descends. Let this acceleration be f, and the tension of the cord; since the pulley is this is the same on both sides of the pull since the string is inextensible, the acceler Q upwards will be the same as P downwar

For P we have $f \cdot P/g = P - T$ ....
For Q we have $f \cdot Q/g = T - Q$ ....

Where g is the acceleration produced by Add these two equations, we get—

$$f(P+Q)/g = P - Q,$$
$$\therefore f = g\,\frac{P-Q}{P+Q}.$$

Substitute this value of f in (1) and we get

$$T = P - f \cdot P/g = P - \frac{P(P-Q)}{P+Q} =$$

—IGNOTUS.

[65298.]—**Science Exam.**—Victor Mey a glass vessel like a large thermometer elongated bulb; but having the end oppo bulb expanded into a thistle funnel, and having a capillary delivery-tube soldered this funnel. The funnel can be closed by a and the delivery-tube terminates under the a graduated vessel standing in a trough of In making an experiment, the bulbous encased in an outer and wider tube, at the of which is some water, aniline, oil, &c., sc to the temperature which is required. burner is placed beneath, and the liquid outer jacket brought to its boiling-point. in the bulb tube is now expanded, and through the side delivery-tube, the end of w immersed in the water of the trough. W more air-bubbles escape it is concluded t air in the bulb tube is at the same tempera the boiling liquid in the jacket. The sto quickly removed, a tube containing a quantity of the substance to be tested is d down into the bulb tube, and as quickly r As the introduced substance is volatilised, out the superincumbent air into the gr receiver. When the evolution of air is co the graduated receiver is transferred to vessel of water and the volume read off. perature and pressure are likewise asce Example.—0·1235grm. of a solid substance 43·4c.m. of air at a temperature of 15°. P = 743mm. (Press. aq. vap. = 1·27).

$$W = \cdot1235$$
$$V = 43\cdot4 \times \cdot001293 \times \frac{74\cdot3 - 1\cdot27}{760} \times \frac{273}{288}$$
$$D = \frac{W}{V} = \frac{0\cdot1235}{0\cdot0511} = 2\cdot416. \quad \text{Air} = 1.$$

If this description is not clear, I shall be to furnish a sketch of the apparatus.—SM.

[65299.]—**Nitrate of Silver.**—To reduc chloride, perhaps the best way is to put very weak sulphuric acid (1 : 20) or hydr acid (1 : 10) along with some scraps of zin few days take out any undissolved zinc a the silver with sulphuric acid (1 : 5). Di a few days, wash with hot water, and diss silver thus reduced in dilute nitric acid. wish to obtain, evaporate and crystallise tion.—PRINCIPIA.

[65299.]—**Nitrate of Silver from Sul** Mix the black sulphide of silver with one-its weight of nitrate of potash (saltpetre). Hessian crucible in your fire; when red-h ne teaspoonful of the mixture. It will fireworks. Go on adding a spoonful at l all is used up. Withdraw the crucible fire. When cold, soak the mass in cold water to remove the potash. What ure silver, which will dissolve easily in l.—S. Bottone.

]—**Nitrate of Silver.**—Put your silver e into a pot with some scrap zinc and lphuric acid. Allow to stand until all is thrown down as metal. Remove the zinc, if any, filter, and wash with pre- and dissolve it in nitric acid. Filter l to the clear solution add a solution of alt, to throw down the silver. Wash this e by decantation, and reduce again to zinc and a little acid. Filter off the silver, wash well, dissolve in nitric acid, to dryness, and heat to fusion. You can r it, when fused, on to a slab of porcelain plate), or recrystallise it from distilled ut the fused salt is pure enough for most hic purposes. You will find this a more ry method than fusion with sodæ carb., ecommended in books on photography.—

]—**Expansion of Brass Rod.**—It is treat expansion as proceeding in direct emperature.—F. Caws.

.]—**Base of Isosceles Triangle.**—Let
R = length of each side,
θ = included angle.
ain sin. and versin. of θ from a table of d proceed thus—

$$R\sqrt{\text{sin.}^2\theta + \text{versin.}^2\theta} = \text{Base.}$$

ws, Sunderland.

.]—**Lamps and Accumulators.**—To S. E.—A 10c.p. lamp may be anything be- and 25 ohms resistance. Allow 1 cell for hms resistance in your lamp. If your narked 12 volts, allow 6 cells; if 25 volts, A shunt-wound Gramme dynamo would hem; but if it is only 30c.p., it will take e to do it.—S. Bottone.

.]—**Repairing Meters.**—"B.Sc., Ply- asked for somewhat similar information e ago, but the query never was answered. I ertained that Bent and Son, Bell Barn- irmingham, are about the largest makers and dry meters. Probably the querist t the parts to: replace those defective from M.M.I.Sc.S.

.]—**Alcoholometry.**—A sample of the ne, or cordial should be measured into a receiver at 60° Fahr., and about two-thirds over into the same receiver, and made up riginal bulk with distilled water, at the nperature as when first measured, when it ested by the ordinary hydrometer. As to drinkable spirits, "Spirits" can make rum lasses; but it would require keeping for hree years before it would be fit to drink. t result would be obtained by mixing 150lb. sses with sufficient water to make it up to and adding 2gals. of good yeast, allowing it nt for three days, keeping it at a tempera- between 80° and 90° for the last two days, e liquor should be distilled, and the result be about 11gals. of proof spirit. But I arn "Spirits" that, unless he has a licence, d render himself liable to a fine of £500 g an illicit still if he should be found out.

2.]—**Alcoholometry.**—There are several of estimating the strength of alcoholic but the best is by distillation, and taking ific gravity of the distillate, from which entage of alcohol is found from tables. The e must be received in a flask fitted airtight ondenser, and provided with a safety-valve, se there will be a loss of alcohol. Tabarie's is to take the s.g. of the original liquid, oil till the alcohol is expelled; make riginal volume, and again take s.g., when

$$\frac{\text{iginal liquid}}{\text{boiled liquid}} = \text{s.g. of diluted alcohol boiled}$$

The results are usually too low. Geissler's eter shows the tension of the vapour of the as indicated by the height to which it raises n of liquid. The results are approximate t sufficiently accurate for technical pur- In all these methods no proof is given that tile substance is ethylic alcohol. If you prove that, you must oxidise it into acetic d estimate that. I expect this would be your powers.—Sm.

8.]—**Chloride of Gold** will probably be from the sides of bottle on which it has d by the use of hydrochloric acid.—B.Sc., th.

8.]—**Chloride of Gold.**—The question is biguous. If he means that the chloride the sides of the bottle, he should warm the bottle to dry it, or place water in to dissolve the chloride and evaporate.—A. J. T., Liverpool.

[65318.]—**Chloride of Gold.**—If it is gold chloride that is deposited on the bottle, a little water will remove it; if metallic gold, put a few drops of a mixture of three volumes of hydrochloric acid and one volume of nitric acid into the bottle and shake round; you will thus get a solution of gold chloride.—Principia.

[65318.]—**Chloride of Gold.**—Make a mixture of chloride of lime and water, say about ¼lb. to the pint; shake up in a bottle, cork, and let it stand till quite clear. Pour off the clear portion. This is an aqueous solution of chlorine, and if placed in the bottle on which the gold has been deposited will redissolve it, again forming chloride of gold solution.—S. Bottone.

[65319.]—**Edison's Three-Wire System.**—If "Student" will get the "E. M." for Sept. 30, 1887, and refer to letter 27909, he will find this system fully explained—i.e., to anyone with an elementary knowledge of electrical science.—Engineer, Govan.

[65319.]—**Edison's Three-Wire System.**—The simple multiple series is well adapted for installations where all the lights are required at the same time, such as for street lighting; the alternate lamps are taken off different circuits, so that if one circuit breaks down the lamps on the other circuit are not affected. The third, or compensating, wire renders each lamp independent of the extinguishing of the others, and provides that no lamp is exposed to a greater difference of potential than that of either dynamo. This wire is of same area as the other two, so that it can carry the whole of the current if one circuit breaks down. Edison makes his wire ¼ area, to make resistance 4 R in parallel system. The saving being 62·5 per cent. of cost by using Edison's system on conductors only, the saving being 77·8 per cent. disregarding extra cost of dynamo. I should have said that two dynamos are used in this system.—J. E. W. I.

[65320.]—**Gas-Engine Fitting.**—I have added to heading as above. Depends whether stone or brick in cement is cheapest. I should use brick as a rule—that is, if you require the engine raised a bit off floor; but if set level with floor, the matter is simple. Dig a pit on engine site—say, about 3ft., and bigger than engine base; line sides of pit with well-soaped planks; cover bottom with small pieces of brick, stone, &c., to depth of an inch or two; next, get some laths about ¼in. to ½in. thick by 4in. or 5in. broad; make a template from this to suit bottom of engine frame; get 4 or 5 cramps, and secure to underside of engine frame; then, with a scriber or pencil, mark through holes on to template; cut these through with centre-bit; get your concrete mixed, and also get your holding-down bolts ready (these must be about 3ft., + thickness of engine base and nut, long); get some pieces of iron plate ½in. to ¾in. thick, about 1ft. square more or less—shape or size is not particular; punch a hole through plates to fit bolts, and slip on to head; set these in hole, and put template over them, so that it keeps them in place, but don't let it fall to bottom, and see that bolts are about plumb, and also that centre line through bolts passes in required direction. This is essential if engine is to drive shafting, &c.; then fill in with concrete, level off, and your foundation is finished when dry. For a brick foundation concrete base need not be so thick; fill in as before and build round the bolts, and then fill in with fine concrete or cement grouting. In this case make the bricks round bolts approach nearer at top than bottom; the pull on bolts will then come on the brickwork, whilst if parallel the cement plugging would merely tend to pull out when strain came on it, and it would all come on the concrete bottoming. The object of the wood lining is for you to pull it out when concrete is dry, and then ram surrounding ground hard up; but unless ground is really loose it's not by any means necessary.—Engineer, Govan.

[65322.]—**Trigonometry.**—I am afraid that there is no general method of proving trigonometrical identities. The only way is to get up carefully the formulæ for the sines, cosines, tangents, &c., of the sum or differences of angles, and all similar formulæ, such as are given in all works on trigonometry, and to practise by their aid the class of problems mentioned. By "getting up," I do not mean learning off by heart without understanding; but to understand the formulæ so as to be able to prove them.—Ignotus.

[65322.]—**Trigonometry.**—Let h be the height from which the first body falls; its velocity on reaching the ground is $\sqrt{2gh}$, hence this is the velocity with which the second body must be projected upwards. Evidently this second body will, at any height above the ground, have the same velocity as the falling body at that height. Hence when the bodies meet their velocities must be the same. At any time t after it is released, the velocity of the first body will be gt, and that of the second at the same time will be $\sqrt{2gh} - gt$. Hence the time of meeting, since their velocities are the same, is given by $gt = \sqrt{2gh} - gt$ ∴ $2gt = \sqrt{2gh}$ ∴ $t = \sqrt{\frac{h}{2g}}$. To find the height of the point of meeting, we know that the height of the second body from the ground at time t is $\sqrt{2gh}\,t - \frac{1}{2}gt^2 = t(\sqrt{2gh} - \frac{1}{2}gt)$. Hence, given t, the value found above the required height is

$$\sqrt{\frac{h}{2g}}\left(\sqrt{2gh} - \frac{1}{2}g\sqrt{\frac{h}{2g}}\right) = h - \frac{h}{4} = \frac{3h}{4}.—$$

Ignotus.

[65322.]—**Trigonometry.**—In order to prove the identity of given trigonometrical quantities, all that is necessary is to express those quantities by means of the well-known imaginary exponential formulas for the sine, cosine, and tangent, with which all students should make themselves thoroughly familiar, as they are of the utmost importance in practice. When this transformation has been made, the remainder of the proof will consist entirely of simple algebraic operations, though it is to be observed that those imaginary expressions have no meaning in themselves, and can only be regarded as symbols of operation leading to correct results. The calculus can also be employed for this purpose, and though it is not generally so well adapted for proving the identity of given trigonometrical quantities, still it is the chief means of deriving those formulas one from another. To prove by the calculus such an identity as $\text{sin.}\,\frac{x}{2} = \sqrt{\frac{1 - \text{cos.}\,x}{2}}$, we would first have to put it under such a form that the quantities on one side would be an algebraic function of an assumed variable, as thus $\frac{x}{2} = \text{sin.}^{-1}\sqrt{\frac{1 - \text{cos.}\,x}{2}}$, and differentiating now for x, we see at once that the differential coefficient of the left-hand member of this equality is ½, and consequently—if the given identity be correct—the differential coefficient of right-hand member should also be ½, as in fact we would actually find it to be by trial. In this manner the given identity is proved except with regard to a constant quantity; but as the supposition $x = 0$ renders both sides of the identity = 0, the constant is therefore nothing. We would simplify the operation by substituting $\text{cos.}^{-1}\,x$ for x, so that the proposed identity would then become $\frac{\text{cos.}^{-1}\,x}{2} = \text{sin.}^{-1}\sqrt{\frac{1 - x}{2}}$, of which the differential coefficients being both algebraic functions of x are consequently quite easy of investigation. Otherwise we could equate the inverse function of each member of the given identity, and then the proposition would be reduced to proving that $2\,\text{sin.}^{-1}\,x = \text{cos.}^{-1}\,(1 - 2x^2)$, which is readily seen to be true by differentiation. The preceding principle is a fruitful source for arriving at trigonometrical identities, for let us suppose that casual inquiry has made us perceive that $2\,\text{sin.}^{-1}\,x$ produces the same differential coefficient as $\text{cos.}^{-1}\,(1 - 2x^2)$, since then we would know that these two quantities are equal to each other, we would only have to equate their inverse functions in order to deduce a trigonometrical formula as a necessary consequence. In the next place, as as example of employing the calculus for deriving one trigonometrical formula from another, let us start with the given identity $\text{sin.}\,x = 2\,\text{sin.}\,x\,\text{cos.}\,x$, and differentiating for x, we at once derive $\text{cos.}\,2x = (\text{cos.}\,x)^2 - (\text{sin.}\,x)^2$, which is a new and distinct formula in itself. Again, combining these two equations by multiplying together the left-hand members and right-hand members respectively, we find $\text{cos.}\,2x\,\text{sin.}\,2x = 2(\text{cos.}\,x)^3\,\text{sin.}\,x - 2(\text{sin.}\,x)^3\,\text{cos.}\,x$, and by integrating this, and correcting the integral, we obtain as another result $(\text{cos.}\,2x)^2 = 2(\text{cos.}\,x)^4 + 2(\text{sin.}\,x)^4 - 1$. All these results may easily be verified by means of the aforesaid exponential formulas. In these operations we have assumed that the arc x can be employed as an independent variable, which we are fully justified in doing, since x may denote any arc whatever, and it is also clear, as we have assumed, that if two functions are equal their inverse functions must also be equal. In dealing by this method with the differentiation of such an equality as $\text{sin.}\,(x + v) + \text{sin.}\,(x - v) = 2\,\text{sin.}\,x\,\text{cos.}\,v$, we would be at liberty either to assume x and v as two independent variables and the other to be a constant; or, again, we might substitute ax for v—where a being an arbitrary constant the formula would not be the less general by this substitution—and proceed then by differentiating for the one variable only. It would be an instructive exercise in this method to prove by differentiation the formula $\text{tan.}^{-1}\,x + \text{tan.}^{-1}\,v = \text{tan.}^{-1}\,\frac{x + v}{1 - xv}$, from which the whole science of trigonometry may be deduced. In proving it we would only have to consider this formula as an equation of comparison for the integral of $\frac{1}{1+x^2}$, and this consideration alone would enable us to deduce all the science of trigonometry without ever thinking of obtaining the integral of $\frac{1}{1+x^2}$, and even without ever regarding the circle as a known curve. This reveals to us the peculiar power of the calculus—namely, that it enables us to discover the properties of the integral of a function, without even having obtained that integral, provided only that an equation of comparison has been found for the integral. It is this principle which has supplied the foundation of the whole theory of elliptic functions, and has rendered these functions capable of being added or multiplied algebraically in a manner precisely analogous to circular arcs.—VLADIMIR.

[65324.]—**Fans.**—I find two important mistakes in "N. A. F.'s" calculation—$(R^4 - r^4)^2$ should be $R^4 - r^4$. He has got it right in one of the expressions and wrong in two others, and as it is wrong in the final result it becomes important. Again, the arithmetical coefficient in the final result is ten times too much, and this would give as much pressure in the fan as there is in a steam boiler. It should be ·000145. The group of R's and r's at the end of the final formula might be "boiled down" a little for practical purposes. After making the above correction, it may be written $(R^2 + r^2)\left(1 - \frac{r^2}{2R^2}\right)$, which will give a tolerably correct result. The formula will therefore be, pressure in oz. per square foot = ·000145 × (rev. per min.)² × $(R^2 + r^2)\left(1 - \frac{r^2}{2R^2}\right)$. If $R = 4$ and $r = 2$, the pressure on the square foot will be 627oz., or 39¼lb., the number of revs. per min. being 500.—M.I.C.E., Bath.

[65325.]—**Magnets.**—1st. You can magnetise these very well from the poles of a powerful electro-magnet, say 18in. of iron rod 1in. in diameter, bent into a U of about 7in. in length, and 4in. between the poles. Wind this with about 5lb. No. 16 wire. Excite with 3 cells chromic-acid battery, each exposing about 72in. of negative surface. Your steel and method of procedure are both right.—S. BOTTONE.

[65326.]—**Curve of Vessel.**—A given area may be inclosed by a variety of curves of the same maximum horizontal and vertical ordinates.—F. CAWS.

[65327.]—**Telegraph Needles.**—To magnetise the needles, lay them for an hour or two across the poles of a powerful horse-shoe magnet. They must be made of steel. Thin watch-spring is as good as any for this purpose. Half an ounce of No. 22 would be ample for the coil, unless it is very large. —S. BOTTONE.

[65327.]—**Telegraph Needles.**—These are of steel, and magnetised in the following manner:—Place the needle over the poles of a horse-shoe magnet, the end required to be the north pole over the south pole of the horse-shoe, and vice-versâ, rubbing them together once or twice in the direction of the needle's length. As you may fail to obtain good earth connection, join up as a metallic circuit.—F. BOURNE.

[65327.]—**Telegraph Needles.**—The simplest way to magnetise the needles will be to wind a few yards of s.c.c. wire, No. 22 or 23 B.W.G., round the needles, and send a current from a Bunsen or bichromate cell through it, which will magnetise the needles in a few minutes. Needles should be made out of cast steel annealed in boiling oil. If Felix Holt's model requires four wires and two sets of batteries to work it, I am afraid it will not be a practical success.—THE MILLOM.

[65328.]—**Evolution and Transmutation of Blood.**—There are many things asserted at lectures and even in sermons which are not true. I suppose they are minor sins, as the speakers believe their statements to be true; but, nevertheless, it is advisable to be careful—from their point of view. Will "C. H. T." kindly elucidate his expression "a very real barrier between man and monkey"? Surely he does not suppose that man has descended from a monkey, or that Darwinism or Evolution has ever said so? It is curious but true that in my experience the opponents of evolution are those who know nothing about it.—NUN. DOR.

[65328.]—**Evolution and Transmutation of Blood.**—Did the lecturer give any authority for the statement that monkey blood injected into the human body produced death? I do not believe it; but, supposing it was the case, it has nothing to do with the doctrine of evolution. "C. H. T." apparently thinks that evolutionists believe that man is evolved from man—this is the popular fallacy. What we think is this, that man and monkeys may have both evolved from some far-*back parent* stem which does not necessarily bear any resemblance to either man or monkeys.—B.SC., Plymouth.

[65328.]—**Evolution and Transmutation of Blood.**—"C. H. T." probably means "transfusion of blood," a ticklish operation at the best of times; but what has this to do with evolution? If evolution is true, the progression which the human monkey has made over his co-existent ape brother extends not only to his mental attributes, but also to his physical ones; and it is quite comprehensible that the blood globules of the ape may differ in size, chemical composition, &c., slightly, it is true, but still enough to decide the question, if the statement be true, which is doubtful.—S. BOTTONE.

[65328.]—**Evolution and Transmutation of Blood.**—The lecturer in this case stated a fact. The transfusion of blood from a monkey or any other animal into the human subject would bring on pyæmia and death. It is also true that the blood of the so-called lowest type of savage may be transfused into the European not only without injury but with benefit, because they are all human beings and of one nature and blood. The term savage is only a relative one, having various meanings and points of view, but from a medical point of view and in a medical sense it has no recognition. The assertion of some evolutionists "that there is much less difference between the lowest man and the highest ape than between the lowest and highest man" is simply an untruth, and has no foundation in fact, being only a part of the misty evolutionist metaphysics which they try to pass off as science, because all mankind in any and every part of the world are men and brethren, all without exception having the same human nature in essence and substance—in fact, one flesh and one blood.—DENS.

[65329.]—**Radius of Gyration.**—Square of the ring's radius of gyration = $\left(\frac{R + r}{2}\right)^2$.—FRANK CAWS.

[65329.]—**Radius of Gyration.**—Let r be the distance from the axis of the section, whose width is w, then—

$$w\,r = \text{constant} = c, \text{ say.}$$

Consider the volume of the body contained between concentric cylinders of radii r and $r + dr$, this is—

$$2\,\pi\,r\,dr\,.\,w = 2\,\pi\,c\,dr.$$

If we regard the mass of the body as constant and equal to ρ, the mass of this portion is—

$$2\,\pi\,\rho\,c\,dr.$$

Hence, if R² is the square of the radius of gyration,

$$R^2\,.\int_r^R 2\,\pi\,\rho\,c\,dr = \int_r^R 2\,\pi\,\rho\,c\,r^2\,dr\,;$$

$$\text{or, } R^2(R - r) = \tfrac{1}{3}(R^3 - r^3),$$
$$\therefore R^2 = \tfrac{1}{3}(R^2 + Rr + r^2).$$

—IGNOTUS.

[65329.]—**Radius of Gyration.**—Suppose the figure, page 246, to be divided by a horizontal line into two equal and symmetrical parts. If we find the square of the radius of gyration of the half, it will be the same as that of the whole. Where the horizontal line cuts the axis we will call the origin of co-ordinates, the horizontal line being the axis of x, the vertical line being the axis of y; then the equation to the curve must be xy = a constant. As this constant may be any quantity that may be chosen, and as besides, it will disappear in the working, we may call it unity, so that $xy = 1$, or $y = \frac{1}{x}$ is the equation to the curve. Now we may suppose the solid part of the wheel to be made up of a number of thin rings, of radius x and height y or $\frac{1}{x}$; draw two vertical lines on the figure at distance x from the centre or origin: these should be close together, and will represent the cross section of one of the rings. Then if the ring be considered infinitely thin, the thickness being represented by dx, the area of cross-section will be denoted by $y\,dx$, and its volume for the whole circle which it forms will be $2\,\pi\,x\,y\,d\,x$, or, substituting for y $\frac{1}{x}$, the volume will be $2\,\pi\,d\,x$; and if w be the weight of a unit of volume, its weight will be $2\,w\,\pi\,dx$, and the total weight of the solid will be the integral of this, taken between the limits of r and R, the integral of $d\,x$ is x, so the total weight or $W = 2\,w\,\pi\,(R - r)$. Now for the moment of inertia, or I. This moment for the ring whose weight is as above found will be weight × distance squared from axis; it will therefore be $2\,w\,\pi\,x^2\,d\,x$, the integral of which is $2\,w\,\pi\,\frac{x^3}{3}$, which, taken between r and R, gives $2\,w\,\pi\,\frac{R^3 - r^3}{3}$, which is the moment of inertia for the solid figure. Now the square of the radius of gyration is the last found expression divi
weight above found, the result being $\frac{R^3 -}{3(R -}$
$\frac{1}{3}(R^2 + Rr + r^2)$. This may be tested by
R and r to differ by an insensible quantity,
makes the expression R² or r^2, which we k
be correct from other sources.—M.I.C.E., B

UNANSWERED QUERI

The numbers and titles of queries which remai
swered for five weeks are inserted in this list, and
unanswered are repeated four weeks afterwards.
our readers will look over the list, and send what info
they can for the benefit of their fellow contributors.

64685. Cardew's Voltmeter, p. 42.
64688. Magic Squares, 42.
64697. Raising Air to High Temperatures, 42.
64703. Varnish, 42.
64713. Gas Engine, 43.
64717. Private Tutor, 43.
64722. Iron Casting, 43.
64723. Vanishing Lady, 43.
64729. Shiny Brown Leather, 43.
64738. Storage Battery, 43.

64948. Regilding, p. 135.
64953. Small Boiler, 135.
64959. To Mr. Lancaster, 135.
64977. Watch-Case Bottoms, 135.
64978. Electro-Motor, 135.
64990. Cycle Spokes, 135.
64994. Glass Beads, 135.

QUERIES.

[65330.]—**Plating Dynamo.**—To MR. BOTT
wish to make a good plating dynamo compact, str
one that will run some time without getting
require but very little attention, and to give a
amperes at 6 or 7 volts. Will you please furnish
type of machine, quantity, and size of wire to use,
of each coil, &c.? A sketch would be a great hel
you please say if the amperage of a dynamo is ca
by the square of the wire, or how?—M.

[65331.]—**Strontium Chloride.**—Can any
chemical readers furnish brief particulars
strontium chloride is made? What are its p
uses? Its price per ton, and the quantity annual
—LANKY.

[65332.]—**Filtering through Charcoal**
any reader inform me how large quantities
liquid may be filtered through charcoal?—A. E. F.

[65333.]—**Hydro-extractors.**—Can any rea
any information as to the respective merits of di
strap-driven hydro-extractors?—A. E. F.

[65334.]—**Organ Building.**—Will Mr. B
kindly tell me, if it is true that the bourdons sh
made larger in the centre, as I am told by one
they should, and by another "He is trying to
you"?—ANXIOUS AMATEUR.

[65335.]—**Indicating Air Pressure.**—Ple
if an instrument of any description is made to
a difference of pressure in the air of one-tenth of a
per square foot, giving name of such.—WIND.

[65336.]—**Worms in Parrots.**—Can any
readers give me any hints as to the best means of
rid of round white worms from a favourite parrot?
are of all lengths up to about 2in. or so?—C. E. M.

[65337.]—**Iron.**—Will some of your correspo
kindly give me a mixing of cast iron metal for all
of tool work and engine work?—A CONSTANT REA

[65338.]—**Colouring Gold-Fish.**—Will so
"ours" tell me how to recolour gold-fish skins tha
become dry and the colour all gone out? I have tw
do not want them to look like painted fish, but as n
as possible, so that I might put them in a case.—AMA

[65339.]—**Oxidised Silver.**—Can this be done
amateur, and how? For instance, can a silver
chain be made permanently dark?—ANTARES.

[65340.]—**Simple Weighing Machine.**—Ca
reader describe a small machine for weighing ma
for battery solutions (one without weights)?—W. H.

[65341.]—**Essences, Soluble.**—Would som
please to inform me how to make the above? I
tried pure spirits of wine, and the essence becomes
muddy when it comes in contact with water that is
with it.—SOLUBLE.

[65342.]—**Preventing Rust.**—Required a
varnish, or paint for iron, that will satisfactorily and
manently stand the alternate action of water, oil,
Most varnishes and paints are, in time, affected
and lacquer is by water.—S. O.

[65343.]—**S.N. Telegraph.**—Having made a p
these instruments (P.O pattern) I should be glad i
correspondent will be good enough to inform me w
needles are sometimes apt to stick. What are the m
above the coils on P.O. instruments for? Also
batteries are best suited to the above?—J. B.

[65344.]—**Bichromate Trough Battery.**—
some reader kindly give me instructions of the be
cheapest way to construct the above with six cell
able for electro-plating and gilding with some a
ment to regulate the strength of current for small
articles, and how to charge the same?—G. D.

[65345.]—**Engine Query.**—Many thanks to
Bristol," and "W. M. J., Dublin." Would they kin

ıcrease the power of this engine? It has been ı 6H.P. Can it be made to give this power? I can increase to 38lb.; but the pressure much, sometimes only having 15lb. when the a bit low.—ONE IN A FIX.

Chemical Gilding.—Would any of our aders assist me to gild the inside of crystal vases by the liquid process, or kindly refer me ı that would enlighten me? This process of ı common use in London and elsewhere for g and decorating, and is worked in something ay as the patent silvering process.—STUCK-

Alpha Paper.—Can any reader give me a good whites with this paper? All my prints ınish colour in the whites, which, when placed d acetic acid, is removed; but the picture developing until the prints are only black the ɛ out clearer; but the print will not tone then. d developer the colour is still worse and can- ›ved. I put my spent developer in a bottle in pour off the clear from the thick yellow de- ƷEORGE.

Mounting Photographs.—I have a ndiarubber sol. for mounting prints which gly of gas tar, and is very inflammable. The ave been scratched off the bottle, and all my use it have failed—the print refusing to stick. kind reader tell me how to use it, and is it mounting alpha prints?—H. GEORGE.

Antidote for Cyanide Vapours.—I ɩe some experiments by heating cyanides in a has not got a ventilation flue, and as some the cyanides will be given off, I should like to nonia in the room, or a cloth saturated with to be breathed through, would be of real use? ans use anything under the circumstances?—

Optical Query.—Will some of your o are well up in optics help me under the ircumstances? I am in the habit of observing ı a sextant in an artificial horizon. I find that ɛ the sun's lower limb my results are correct; rhen—e.g. in the afternoon—I take the upper r much experimentation to see what was the ınd that the image of the sun given me by the . reflected from the index glass—is not a true s, of course, satisfactorily enough explains the ı.m. sights do not come out But what I want , what is wrong? The sextant as tried by les (I have been using one for 30 years) is in ıstment. I am astigmatic, but I wear glasses ny defect, and I observe with them, and more, ɛ at a sixpence, or the clouded sun through the ıbe alone, I see a perfect circle. I also see the ɛd from the artificial horizon truly circular. your readers tell me which is wrong—my sex- ɛye?—ASTIGMATIC.

Greenhouse.—I have built a small green- by 7ft. The heating apparatus consists of an pper furnace, built in brickwork. The flue, ı. by 9in., runs all round inside of house. The erected close to side of fire-hole, the heated combustion having to pass all round before imney, which is 4ft. of brickwork, into which :. of 4in. stove-pipe. I find I can get no all. What is the cause? Are there any ı for calculating height and area of flues for rate surface?—T. G.

Creasote or Petroleum as Engine ll some one oblige me with directions for fit- aratus for burning either of the above to fire tubular boiler, which is set in brickwork arge furnace for burning wood, &c.? The indrical, having 12 2in. (outside) tubes. Is economy in the use of these substances over ? What would be the probable consumption them per day to maintain a pressure of, say, ıare inch?—A. F. P.

Engine.—Many thanks to "T. C., Bristol," ıberg' for kindly answering my question. I ıt I meant the absolute steam pressure to mean ›ressure above the atmosphere and pressure ısphere = 35 + 15 = 50. Would "T. C." or 's kindly show me by an example how to cal- diabatic curve of expansion; it falls below the ɔr isothermal curve—say, steam at 40lb. pres- quare inch cut off at ½ stroke? Pressure ɔr isothermal curve would be 40 = 20 = 13·3 steam was expanding. For adiabatic curve pressure have to be each multiplied by $\frac{9}{10}$ ld make them 36 = 18 = 11·97 = 9? Any T. C." would give me I should be very grate- ›VICE.

Steam.—Will "T.C., Bristol," "Marienberg" iend assist me to understand the following ? Rankine gives 1lb. coal = 14,500 units 11,194,000ft.-lb. and 1,980,000ft.-lb. = 1H.P. g" say, allow 25lb. water to 1H.P., and else- ɛ ½lb. per minute or 30lb. per hour, allowed ', which according to Rankine should be equal Why and where is this discrepancy, and how I can see that if 30lb. of steam (I want to lb. pres.) are wanted for 1H.P., and 1lb. coal b. of steam, the reason why 3lb. of coal go to I cannot reconcile these figures with Rankine's. coal = 10lb. steam, and 1lb. coal = 5H.P :o Rankine)—that is, 2lb. steam per H.P.; but ɣ is a misprint for 3. As I am about to have three-cylinder engine built of the inverted ner type, for screw steamer, to work at 120lb ıhould like to know what proportions ought ween length of stroke and the relative piston ı.p. cutting off at ⅓ stroke. What will be as for the cylinders 1, 2, and 3, the last being ndenser giving 3lb. back pressure, and what e friction to be calculated at in percentage of at an equal extra pressure may be used in ·n, and how far is expansion carried in such . want also to know what steam may be relied ıare foot of tube surface—(1) vertical tubes, al—as compared with fire surface, and lastly ıs coal will give as good result as hard coal or ɩLED ONE.

[65355.]—**Chiretta.**—In the "E. M." for March 16th, "Eos," in speaking of chiretta (64701), says that a piece of pure Stockholm tar about the size of a walnut put in water and mixed with an infusion of the above prevents fermentation and (the tar) will last for ever. Will he kindly say if pure Stockholm tar is in the solid or liquid state, as the writer is troubled with indigestion and has inquired for it at one of the principal chemists in Manchester, but was told it was in the liquid state?—DYSPEPSIA.

[65356.]—**Gas-Engine.**—I have lately bought the castings, partly finished, of a small horizontal gas-engine. Cylinder 4in. bore, 10in. long. It is something like Brotherhood's 12H.P. type. It is double web crank bearings on each side; but the valve chest is a 1½in. cylindrical form. Part cast on the side of the larger cylinder, and part on the cylinder cover. It is worked by an eccentric; but the valve is missing. I wish to know the length of the valve, and the shape of same. I am quite at a standstill as to know how to go on with the valve. If anyone would give me a few hints on this kind of engine would oblige.—A 20 YEARS' SUBSCRIBER.

[65357.]—**Cycle Making.**—I should be much obliged for information on the following matters? 1. The quickest way of removing the fins on the heads of spokes formed in the process of riveting in the dies. 2. How are rims trued that have been knocked out of round, say, egg-shaped, by collison or otherwise. 3. When chains break on the road, how are they best temporarily repaired. 4. Is there any way of proving that a wheel will carry one safely. I have a new process of fastening spokes and I don't want to be let down in the trial.—A. F. SHAKESPEAR, Lüttichaustr. 13, Dresden.

[65358.]—**Accumulators.**—I have a shunt-wound dynamo, 40 amps., 105 volts, driving at present 20 c.p. lamps. I wish to add 12 20c.p. lamps in another room, but to be available after engine has stopped, say, two hours each day or longer in case of a breakdown. I have an accumulator containing 19 plates, 9in. by 7in., 3-16in. thick, covered with red lead with unlimited material for the construction of others; but I am at a loss how to proceed when constructed. For instance, if I were to put in 48 volt lamps, could I light them direct from the dynamo through 25 cells of the above size whilst it is driving the 105 volt lamps, or should I have to charge cells in the day time? Would it do to charge the 25 cells from the dynamo without putting in a resistance? If not. what should it consist of? Any information on the subject, or as to any book treating fully on the matter will be thankfully received by—YOUNG NOVICE.

[65359.]—**Electric Tests.**—I have an ordinary detector with three terminals fixed on the top of the instrument. On the middle terminal there is a movable brass bar which will reach either of the outside terminals. What is this bar used for? In testing a battery of cells separately, on which terminals should the end of wire be attached?—to which terminals should the wires be attached in testing for continuity or earth? Is it possible to have a circuit S.N. of 30 miles length, the wires passing through a mountainous country, and free from all underwood, boughs, &c., perfectly clear—that is, without showing any degrees of earth when disconnected at one end on a detector of about 400 ohms resistance? Would cracked insulators cause any leakage? Would Mr. Bottone or some other contributor please answer this early? This circuit shows 5° on my detector in fine weather.—AMATEUR TESTER.

[65360.]—**Oil Painting.**—I have an oil painting of which I am desirous of obtaining information. It is 6ft. in length, and 3ft. 6in. deep (without frame). It represents Christ after the Crucifixion, with His head resting on the lap of a female, who, I suppose is the Virgin Mary. There is also another female at the head, while who I take to be Mary Magdalene is about to kiss Christ's toe. There are represented also three males looking on, one an old man, the other a middle-aged man, and the third a young man. The picture is, I think, an old one, although it is in an excellent state of preservation. It bears the following inscription in the left-hand corner, with two crests:—

CETTE PINTVR A ESTE
DNEE A, DANE BARBE
GERARDINE D'ARGENTEAN,
PAR LE MARQVIS
D'ASSCHE,
A° 1677.
LA, DICT, DAME, LAT
DONNE, A L'EGLISE
EN SA MEMOIRE.

This seems to read "This picture was given to Dame Barbe Geradine D'Argentean by the Marquis D'Assche, A.D. 1677. The said dame it has given to the church in his memory." Can anyone give any information as to the painter of this picture, and as to where it came from?—ART.

[65361.]—**Compensation Curb.**—A few weeks ago several gentlemen answered my query about compensation curb in Geneva watch. Since that time I have shown the watch to a working watchmaker belonging to a large firm in this town (Cardiff), and he told me the curb was merely an ornament. He did not speak satirically, but meant what he said. He had never heard of the watch compensation curb. Will the gentlemen who answered me in this paper kindly tell me if it is possible, with advantage, to have a compensation balance adjusted to the watch, and cost? It has gold cases, and is really a well-made article. Also will they say if the watch is very old. The maker's name is Arnaud, of Geneva. It seems to have had but little wear. The curb does not seem to be understood in this part of the world. Any explanation as to date also will be thankfully received by—GWENT.

[65362.]—**Piston, Crank, Pressure.**—1. In a slide-valve does it matter how long the piston rod is? 2. Does the connecting rod have to be a certain size for a certain cylinder? Does the throw of crank have to be half the stroke of piston rod? Does it matter what size the fly-wheel is? If I made an engine, say, cylinder ½ by 1, how should I know how much pressure I should want? What is the easiest way to find the length of eccentric rod, and would any kind friend explain the action of the reversing gear on locomotives?—A. D.

[65363.]—**New Battery.**—Would any of our readers kindly tell me what the solutions are of the new battery just out? It is said that a cell weighing only 1½lb. including solution gives a current of 5 ampères at an electrical pressure of 2 volts for about 12 hours, and costs only ½d. per c p for the whole time. This ideal battery, as I think one may call it, is even too much to be believed. I daresay it is one of the foreign bubbles, beautiful to look at, but won't bear touching without collapsing.—E.

[65364.]—**Bichromate Bottle.**—I am at a loss how to take the zinc out and put fresh in. If some of the readers would carefully explain how I must proceed they would do me a kindness. I cannot at present see how I must get the old one off. Also in ordering zinc plates do I give the size of the plates or the measure of the bottle? They are sold ready drilled and tapped, I believe.—A NEW BEGINNER.

[65365.]—**Bronze Medals.**—I have recently acquired a series of these of say 50 years old. They are French, and exquisitely modelled, and vary from 5in. to 2in. diam. Each is protected by a glass cover apparently gummed on. They have been lying by in their case unheeded for years, and I find that on most, but not on all of them, there is a quantity of fine dark powdery stuff, which runs about under the glass when shaken, and on some of them veins like veins in marble appear. What is the powder, and how should I set to work to clean the medals and using what?—H.

[65366.]—**Repainting Tricycle Black.**—Will some reader kindly inform me how to repaint a tricycle black, both wheels and framework? I have scraped all the old paint off, and would like to know what sort of paint or varnish to use, and how to apply it. I have applied some black japan with an ordinary painter's brush to a portion of the machine; but it appears rough and streaky; and the colour of the iron shows through the japan.—TRICYCLIST.

[65367.]—**Chiretta.**—Can "Eos" inform me whether there is likely to be any ill effects attending the drinking of the infusion of the above? Now the warm weather is coming, the liquid will sure to be swarming with infusoria. Have been accustomed to make at once sufficient for one week. Would "Eos" recommend only sufficient for one day to be made, and what mineral acid is most suitable in combination?—W. W. B.

[65368.]—**Tungstate Toning Bath.**—Will Mr. Walter Potter or others kindly give the formula for the above as it is recommended for the sample of paper which I have? I have a number of formulas, but this is not amongst them. I beg to thank "B. Sc." and others for their kind assistance—PRINCIPIA.

[65369.]—**Toning Bath.**—Will "B.Sc., Plymouth," kindly give formulæ of the lime bath he uses? I have used the borax bath successfully for some time, but do not like a warm tone. I have tried the lime bath as given in several photographic books; but have not got the black or grayish tone I should like.—W. S. CHESTER.

[65370.]—**Carbon Printing.**—Will some of your photographic experts kindly help me by giving their opinions of a particular trouble I have with carbon printing on smooth ground opal glass? After developing (sometimes during the operation) minute transparent blisters scarcely the size of a pin's head, appear all over the films. These dry down, but leave a rubbly surface and are rejected owing to the unreliability of the surface for working up. I may remark that Burton's, The Auto. Co.'s, and Max Bolter's explanations as to reticulations, frilling, &c., do not apply to this matter, nor is the trouble analogous. From careful experiments I have made I find the cause is in no way due to (1) too long or too short immersion in first soaking water; (2) to aëration of, or air-contained, water in which tissue is soaked; (3) to bubbles on the tissue or opal; (4) to squeezing insufficiently or violently in a way lkely to cause a slurring action; (5) to developing too soon; (6) to beginning developing with water of 112°, or beginning with cold and increasing up to that point. The prints develop in about five minutes and are lightly splashed with hot water, from which they are not taken till finished. The tissue is sensitised in bichro. of about 3 per cent, with no ammonia and lightly squeezed and dried in 8 or 10 hours. It is used a few hours later, as it becomes partially insoluble 24 hours afterwards. The trouble will show upon some plates, while on others, treated in identically the same way, nothing is seen of it.—ONE IN A FIX.

[65371.]—**Dialling Matters.**—In an old work on dialling (Leadbetter, 1773) I find the following remarkable statement. He is speaking about the restoration of old sundials that have become defaced by time and weather, and says (p. 141-2):—'Yet here take notice that I think it is not convenient at all to lay new colouring upon the old ground of a sundial (that is to draw the old lines and figures over again in the same posture wherein they where drawn before); but rather to take the declination anew, and according thereunto make a new draught of your dial, and proceed in the painting of it in all respects as if it were a new dial; for it is observed that dials which were made many years, as 30 or 40 years, ago (which we believe went true when first made) will not give the true hour now, but go very false, which is caused by some secret motion of the earth not hitherto taken notice of, which apparently alters the declination of all planes whatsoever. If anyone requires more satisfaction herein let him repair to some old dial that was made many years ago, and according to the distance of the substyle from the meridian let him find out the declination when first made, as any man that is an artist can easily do; then let him take the declination of the plane by the sun, and he shall find these two declinations to differ considerably, according to the number of years contained between your observation and the time of the dial's first making; so that a dial that stood full south 30, 40, or 60 years ago shall now decline some degrees either to the east or to the west according to the nature of the earth's motion, which is that which is called the variation of the compass, which is found by observation to differ much in the same country, in the space of 50 or 60 years, as all skilled in astronomy very well know." I have read about the variation of the compass; but I cannot understand how this can have any effect upon sundial securely fixed upon a firm pedestal or a strong stone wall on a good foundation. Has "Leadbetter" been lead into a mistake?—EMBRYO DIALLIST.

[65372.]—**Recovering Gold.**—Will some one kindly inform me how to obtain the gold from gilt watch plates? I have dissolved some plates in nitric acid (1·042); but I find a white powder at the bottom and some flakes of gold amongst it. Is the white powder zinc or gold? If it is zinc, how must I separate it from the gold? I have washed the powder and put some common muriatic acid with it to see if it would dissolve the white powder, but it did not make any difference.—WATCH FINISHER.

[65373.]—**Annealing Steel Strips.**—Having some tons of steel hoops, which are so hard that my stamping tools will not stand any time in using them in the stamping machine, I should be obliged if anyone could give me a plan to anneal or soften the temper of them. The hoops are put up in ½cwt. bundles.—STAMPER.

[65374.]—**Fireclay Testing.**—I should be glad if some reader would give a short outline of the processes involved in testing a sample of fireclay (chemically). I wish to apply it to estimating the value of bricks and retorts, with regard to amount of silica, &c., they contain.—EDEN.

[65375.]—**Calcium Chlorate.** — Will "Chemist" kindly inform me whether it is possible to convert the whole of the lime into calcium chlorate by passing chlorine in excess through milk of lime heated to a suitable temperature, such as is usually done in the manufacture of potassium chlorate? If not, is there any other way by which I may make calcium chlorate?—C.

[65376.]—**Flat Filing.**—I should deem it a great favour if you would give me a few hints for filing flat, especially regarding the manner in which a file should be held, and the proper method of disposing of the fingers.—A NEW READER.

[65377.]—**Gas for Blowpipe.**—I live far from gasworks, and I should like to know whether there is any simple apparatus for the conversion of oil into gas, so that it might be consumed in a Bunsen burner, and that I could pursue experiments with the blowpipe.—F. B.

[65378.]—**Model Gun.**—Have any of your readers constructed a block trail carriage gun, something similar to an Armstrong 12-pounder? If so, a description giving dimensions and general arrangement would be useful to —J. J.

[65379.]—**Dynamite.**—Give explanation of why, on exploding this, on, say, a rock, with but a slight covering of sand, its force strikes downwards on the rock, and not upwards.—H.

[65380.]—**Strains.**—A beam (16ft. span) shows weakness. If faced on either side with plates of iron, ⅜ thick, 7in. wide, bolted together, what strain or load would it carry on sound bearings?—H. BIBBY.

[65381.]—**Link Motion.** — I have ½H.P. engine, horizontal, and want to put the link motion to it. Will any correspondent give me a sketch to do it, and the size of it?—READER.

[65382.]—**Ruling Lines.** — Can anybody give me any information as to the best way to rule lines, as for a large lecture diagram, nearly ⅛in. wide, with Indian ink at one go?—DIAGRAM.

[65383.]—**Low Temperature.**—Is there any scientific explanation of the yearly increasing length of winter in central Europe?—A. F. SHAKESPEAR, Dresden.

[65384.]—**Carbons for Leclanche Cells.**—How are the lead tops put on to these? Are they pressed or simply cast on? Kindly describe kind of mould used?—CARBON TOYS.

[65385.]—**Switch.**—Can Mr. Bottone or any reader describe a switch for connecting a 4-cell chromic-acid battery either in series or parallel?—THALES.

[65386.]—**Hardening Parchment.**—Could any reader inform me of some method of hardening calf's skin parchment for banjoes, &c., without injuring it?—H. A.

[65387.]—**Duplex Telegraphy.**—Can the above system be adapted to needle instruments? If so, a sketch and particulars will oblige.—J. R. E.

[65388.]—**Tennis Shoes.**—Can any reader inform me how to clean buckskin tennis shoes, so that they may remain nice and white?—INQUIRER.

USEFUL AND SCIENTIFIC NOTES.

THE number of miles of streets containing water-pipes constantly charged in each water company's district within the metropolis is as follows:—Chelsea, 75½; East London, 185; Grand Junction, 83; Kent, 147; Lambeth, 135; New River, 281; Southwark and Vauxhall, 160; West Middlesex, 111¼; total, 1,177¾ miles. Throughout this extent of streets hydrants for fire purposes can be fixed.

A LIMIT to the rapidity of filtration has been generally adopted by the London water companies; it is represented by the passage of about 540 gallons of water through each square yard of the upper surface area of the filter in 24 hours, or 2½ gallons through each square foot of surface per hour. Water passed through well-constructed filter-beds at a rate not exceeding this becomes under ordinary conditions bright and clear.

SOME very long runs have been made with the Westinghouse engine used for driving the dynamos employed for alternate-current lighting in America. Some months ago it was reported that one of these engines had run for eleven months at a speed of 800 revolutions without a stop. This record has, however, been beaten by another engine of the same type belonging to the Pittsburg Gas Light Company, where a 10 horse-power engine has now run for upwards of thirteen months without stopping at a speed of 500 revolutions per minute, and is still running. These engines are of the single-acting closed-in type, and it is to this, no doubt, that the possibility of making such long runs must be ascribed.

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to Hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, May 16, and unacknowledged elsewhere:—

J. AND H. GRACE.—Rev. Canon Jones.—H. H. Holt.—J. Ratigan.—W. H. S. and Son.—J. W.—Oasis.—Tilemaker.—L. Gubbins.—V. E. L.—Anxious.—Mona.—Stepney.—W. H. Shrubsole.—A Young Chemist.—L. S.—E. L. G.—W. H.—Tuebor.—Beginner.—W. A. S. B.—Appendix.—U. O. G. T.—J. T. P.—Rosicrucian.—C. L. Baker.—Composition.—F. C. Allsop.—W. H. Taylor.—W. H. Kingdon.—G. Macbeth.—X.—J. R. C.—Satire.—T. E. Espin.

LEX. (All particulars in connection with scientific, learned, or other societies can be obtained from the secretaries respectively, and the addresses can be found in the Directory, as a rule. The address of the Society for Psychical Research is 14, Dean's Yard, Westminster, S.W., and the secretary is, we think, Mr. E. Gurney.)—SCHOOLMASTER. (Certainly not. The lantern will illuminate the blackboard just the same as it lights up the screen.)—STEEL. (Soak the canvas in water until thoroughly wet; hang up to drain, but whilst still damp dip in linseed oil. Hang up again to drain and dry, and repeat until a sufficient quantity of oil has dried on to render it waterproof. 2. Simply wash in soap and warm water; rinse in cold water, and let it dry in the air. The strings may be just wiped over with a rag moistened with olive oil.)—S. J. T. (China riveting is done by drilling holes with diamond sparks and inserting little bits of wire. The method of doing the work was fully described and illustrated in No. 908. There is a useful description also in No. 343.)—JORJE MAKBETH. (Any pewterer would set you up, as he could make one to suit. If you can see all the Vols. in the reference library, can't you search the indices as well as we can?—better, we should think.)—M. SLOWOUTSKY. (Certainly not. Friction steps in.)—H. E. S. H. (It would help to preserve it, if the air is excluded.)—GREEN. (For bronzing metallic articles, see p. 54, No. 1147, and the indices. One part perchloride of iron to two parts of water gives a green bronze on brass, as does nitric acid saturated with copper.)—T. C. (Mix the required pigments with size water.)—A. W. B. (Starch paste is the usual medium for mounting photographs. Rub some starch down with cold water into the consistency of paste, and then pour boiling water on. The starch will swell, and it is then diluted to the required consistency with more boiling water. Make it as you want it; but if it must be kept, add a few drops of essence of cloves.)—SH'ON-Y-GOF. (It is impossible to say what a "specialist" could or could not find out with the patient before him; but it is quite certain that no one can find out anything as to the cause of the noises in the ear without personal examination. Nine times out of ten it is caused by hard wax; but see pp. 341, 392, 420, 441, 461, 485, Vol. XLV.)—R. M. G. (Leaves of the dandelion make a most excellent salad, especially when the large-leaved variety is bleached. You can roast the root, pound it up, and use as coffee, or you can make a decoction of the fresh roots and drink that. One ounce of roots, a pint and a half of water. Boil to a pint, and strain. 2. Deal is not suited for boiler lagging.)—BLACKSMITH. (It is quite certain that there is no food more nutritious than oatmeal, and it ought to suit any one following an active occupation, or with plenty of exercise in the open air. See last week's *Weekly Times and Echo*, or read Dr. Edmunds's directions for cooking oatmeal in Nos. 848, 852.)—W. H. G. (Yes, it is an optical illusion, and has been frequently explained in these columns.)—AMBER. (A nicely-mixed query. You should have consulted your back numbers. The scent of flowers can be extracted by placing them in pure fat or wax, and afterwards extracting the odorous principle from the fat by means of alcohol. 2. You can conserve fruits by boiling them in a strong solution of sugar. 3. The bichromate solution for batteries has been frequently given. Try 3oz. of bichromate of potash, 9oz. of sulphuric acid, and 20oz. of water. Dissolve the bichromate in the water, and add the acid by degrees. Bichromate and prussiate are not the same.)—C. H. (Almost any back volume contains directions for making such coils—even recent back numbers.)—ARMOURER. (Why use a signature adopted by another correspondent? If you mean an induction coil, the secondary is not joined to the primary. But see indices.)—SUBSCRIBER, A. S. (Guttapercha, Chatterton's compound, white-lead—according to the purpose it is to serve. See indices. 2. "The Amateur Workshop" appeared in Vols. XL. to XLV. The numbers are out of print.)—YOURS A CONSTANT READER. (Sulphur can be dissolved in boiling linseed oil. 2. By using anodes of brass and a solution containing 2 parts of sodium bisulphite, 5 potassium cyanide, 10 sodium carbonate, in 80 parts distilled water, to which add one part fused chloride of zinc and 1½ part of acetate of copper, dissolved in 20 parts of water.)—J. MORCOMBE. (Please see indices, or procure the catalogues of the booksellers. Guthrie's works are good, so are Silvanus Thompson's. A student going up for Honours ought to know which books will suit him.)—APPRENTICE. (We do not know of any work devoted to the designing of triple expansion engines. The prospectus of the Whitworth scholarships can be procured by "any bookseller," or direct from the Secretary, Department of Science and Art, London, S.W., price 3d.)—SCIPIO. (There is no work giving "practical instructions for the manufacture of all kinds of galvanometers, electric bells, &c., &c." Mr. Bottone has published in book form the articles which appeared in this paper, and we are now giving a series on Electric Bells.)—B.SC., Plymouth. (David Nutt, Strand, W.C., will supply you with *La Nature*. The subscription, however, must be half-yearly, commencing June or December.)—W. WILSON. (We do not think such a patent would be worth anything; for we much doubt if the idea is novel. Thin leather has been used for the purpose for years.)—METEOR. (If you will say what sized electric clock you would like, we will endeavour to find one to suit in the back volumes. Or perhaps you will look yourself in the indices. There is one in the last volume.)—J. A. S. (The fourth wheel drives the escape pinion, and its arbor carries the second hand. The third wheel is between the centre and fourth wheels. 2. Saunier's "Watchmaker's Handbook," Crosby Lockwood and Son, Stationers' Hall Court, E.C.)—A. S. M. (There is plenty of room in the engineering trade, as in all others, *near the top*. The stupid grumblers who croak are of the usual lazy sort that like to stay down in the crowd. Work hard, and leave them behind you.)

Every Man or Woman suffering from any form of nervous derangement, loss of power, debility, or functional disorder, should send at once for "Electropathy; or, Harness's Guide to Health" (copiously illustrated). It will cost you nothing, and if, after perusal of the astounding facts it will bring to your notice, you should be persuaded to stop physicking and try rational treatment, you will assuredly be numbered among the ever-increasing multitude who daily express their gratitude for the priceless benefits derived from mild, continuous currents of electricity generated by wearing Harness's Electropathic Belt. Don't hesitate a moment, but sit down at once, lest you forget it, and write for the treatise, which will be sent you free by post.—Address Mr. C. B. Harness, Consulting Electrician, the Medical Battery Company, Limited, 52, Oxford-street, London, W. (corner of Rathbone-place.

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Epps's Cocoa.—Grateful and Comforting.—"By a thorough knowledge of the natural laws which govern the operations of digestion and nutrition, and by a careful application of the fine properties of well-selected COCOA, Mr. Epps has provided our breakfast tables with a delicately flavoured beverage which may save us many heavy doctor's bills. It is by the judicious use of such articles of diet that a constitution may be gradually built up until strong enough to resist every tendency to disease. Hundreds of subtle maladies are floating around us ready to attack wherever there is a weak point. We may escape many a fatal shaft by keeping ourselves well fortified with pure blood and a properly nourished frame."—*Civil Service Gazette.* Made simply with boiling water or milk. Sold only in packets, by Grocers, labelled—"JAMES EPPS and CO., Homœopathic Chemists, London."—Also makers of Epps's Afternoon Chocolate Essence.

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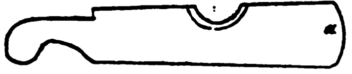
he English Mechanic
D WORLD OF SCIENCE AND ART.
FRIDAY, MAY 25, 1888.

TRACTS FROM BERGERON.—VI.

Description of the Chuck Lathe.

HAT which they call a chuck lathe is the kind of lathe which we are about describe, since, in contradistinction to the ceding one, on which the work is supted between two centre points, this work carried by an iron mandrel arranged to ld it by the aid of a chuck by one of its tremities. This lathe is undoubtedly the ul of the workshop, being intended to ceive all the apparatus, of which we ll speak in due order. We therefore trust r readers will excuse us if we enter into rtain details of this affair. There are in istence several kinds of chuck lathe: those the clockmaker, mounted on an iron bar d put in motion by a bow; those which e called bench lathes, both with and without ew-guides; and lastly, that with screwides of which we are about to speak. A and Fig. 1, Plate III., are two poppets, in the ickness of which are two mortices which re passage to the mandrel D *d*. As the stance between these poppets ought to be nstant and unvariable, it is insured by two nds of wood, *c*, which are glued to each side, and sometimes attached to the poppets by strong wood screws, and in order that nothing may shift these poppets, these two bonds have a shoulder against which the poppets rest, which adds to their stability. Fig. 2 is an iron mandrel turned in the lathe, and upon the truth of which depends that of all the work to be done in a chuck lathe. A *a* are two necks, perfectly round and cylindrical, which revolve in bearings, of which we shall speak presently; *b* is an angular groove made on the mandrel on which a brass key takes a hold, called a stop key, which readily allows the mandrel to rotate upon its axis, but does not permit it to advance or retreat; *c*, *d*, *e*, *f*, *g*, *h*, *i* are screw threads of different pitches, according as it may be necessary to make them more or less coarse upon the work; *l* is an hexagonal part about six or eight lines in length, upon which is placed a pulley secured by a nut, which is mounted on a screwed part adjacent to the pulley. Then comes a shoulder, *m*, which forms an abutment against the pulley, and serves as the inner flange of the bobbin *n*, upon which the cord is wrapped. Beyond it is a flange, *o*, similar to the latter; then a neck, A, larger than that at the other end *a*; and lastly a flange, *p*, very accurately turned, against which the chucks rest. The whole is terminated by a screw or nose, *q*, upon which these same chucks are mounted. At the other extremity of the mandrel is a smaller shoulder, followed by a screw, *r*, on which are mounted all apparatus which it is desired to add at the hinder end. At the ends of the poppets two mortices are formed sufficiently wide and deep to afford ample strength and to contain split collars of a soft material in which the mandrel revolves. Upon these collars a screw presses, which prevents the mandrel, and consequently the work, from shaking. *b*, *d*, *c*, Fig. 1, Plate III., is a bridle of iron in one piece, or hinged at *c*, which is mounted upon the poppet, and of which the ends enter into the thickness of the wood, or they are secured in a different manner, which we shall have occasion to explain. In the length of the poppit behind A., Fig. 1, are seven mortices of different sizes, which receive the keys, whose use is of the utmost importance. These mortices must be made with great accuracy, and their keys must fit exactly, without being tight or loose. Of these nine keys, the first, called the stop key, *e*, Fig. 1, is of brass, and has a double bevel at the part where it meets the mandrel, so as to enter the groove of the same shape on the mandrel, which we have already referred to. This key, like the six others, of which the form can be seen in Fig. 4, has power to move up and down in the mortice, which is so high as to allow the key to touch the mandrel when it is raised, but to escape it when lowered; and to provide for this movement all the keys are pierced at *a* towards the back part of the poppet, and are threaded upon a pivot which passes along the entire length of this poppet. It is understood that when the mandrel is within its collars it can rotate upon its own axis, and advance or retreat. If

FIG. 4



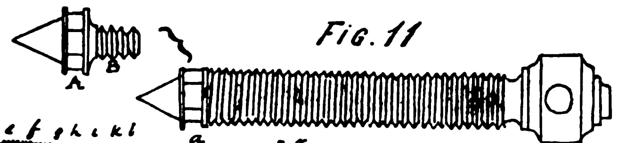


FIG. 11

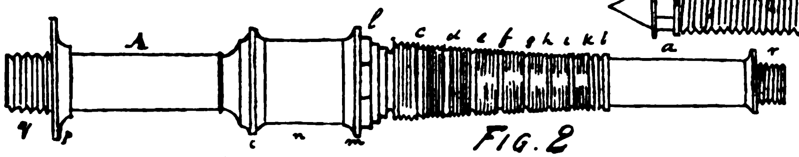


FIG. 2

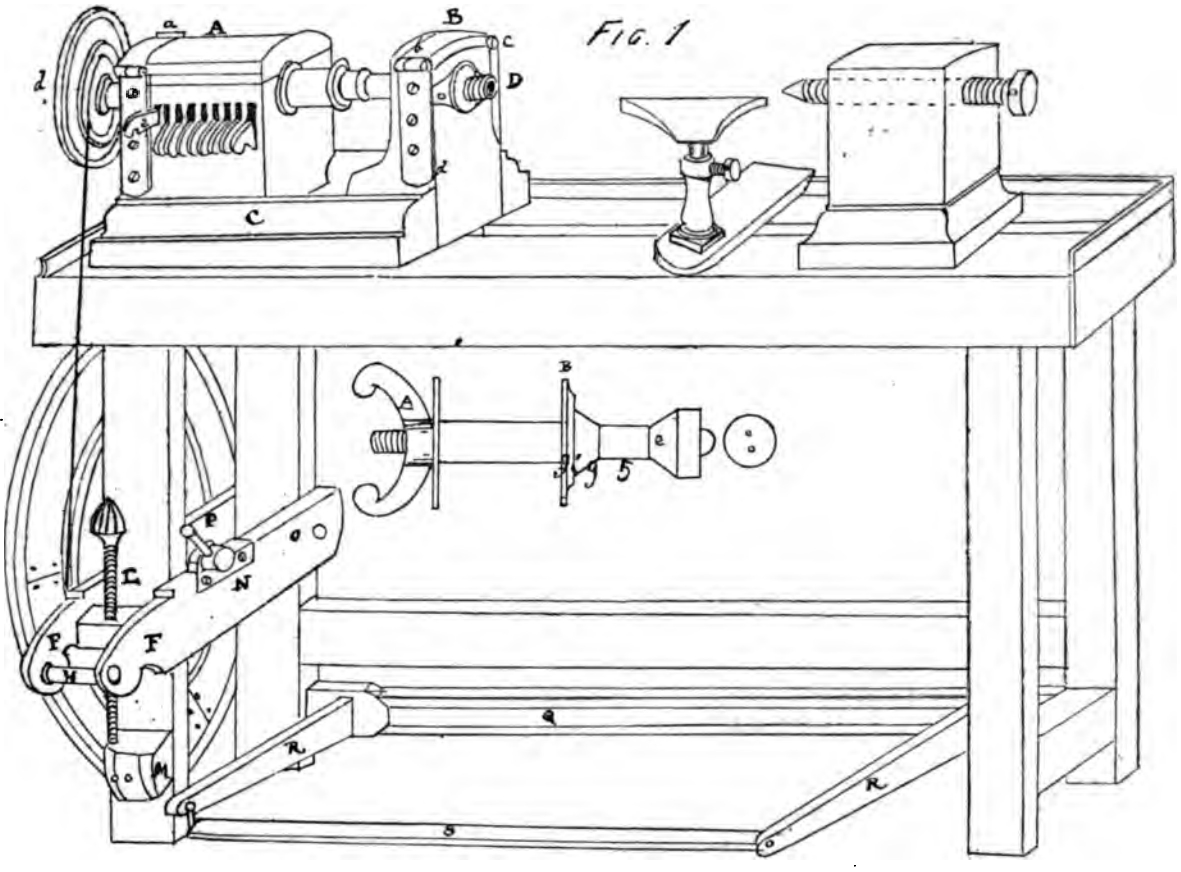


FIG. 1

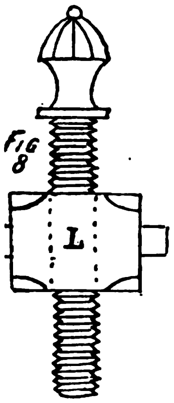


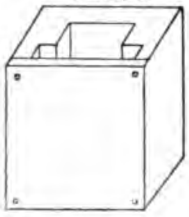
FIG 8

the brass key is compelled to take into the groove, which is on the mandrel, the said mandrel can only turn round; if, on the contrary, this key is lowered, and one of the other six is raised, it will press on the threads of the screw which corresponds with it, and as it is immovable it will compel the mandrel to advance and retreat in accordance with the pitch of the screw, and it is easy to conceive that a point or pencil fixed on some kind of rest opposite to the work will describe on its circumference a helix similar to the screw which determined the transverse of the mandrel. The mandrel being intended to revolve in its collars, in which it can traverse to and fro, it is easy to understand of what importance it is that the necks shall be perfectly cylindrical and true. It is of equal importance that all the screws shall be perfectly concentric with the necks, and especially with the screw of the nose of the mandrel. It is by this movement of the mandrel that it becomes possible to execute the more curious and interesting work on the lathe, such as Rose-engine work, swash plate turning, twists, and profiles. We shall give in due order the method of ascertaining the greater or less perfection of the mandrel of a chuck lathe. As it is often necessary to remove the mandrel out of its collars, and as, nevertheless, it ought to be held firmly and without shake by means of the bridle-piece and its pressure-screw, the first idea was to make the bridle with a hinge, *a a*, Fig. 3, and to put a pin with a head which could be removed at pleasure in the front part of the hinge, so as to be able to remove and replace at pleasure the mandrel and its collars. But as it is difficult and expensive to get the hinges accurately made, one generally procures a bridle of one piece, without a hinge, which is fixed to the poppet by means of a long bolt with a flat head, which passes through the tail part in front, traverses the thickness of the poppit, and is screwed into the further tail of the bridle.

As regards the pressure screw *f*, its form varies considerably. Originally nothing was used but a flat-headed screw. Then one was substituted in the form of a vase, of which the threaded end effected the pressure, whilst the upper part formed an ornament. Subsequently the vase-shaped part was extended. Instead of applying the oil by means of a small funnel arranged on the outside of the two bearings, the vases themselves have been hollowed out and drilled through the entire length of their tail-piece. The upper collar is also pierced with a corresponding hole, by means of which the oil descends to the inside of the bearings. As the screw by pressing directly on the brasses would soon bruise it, it is usual to put between the two a little plate of iron of the same form as the collar. The constant motion of the mandrel may tend to unscrew the pressure screw and give too much play, and even cause the mandrel to shake about. To prevent this nuisance it has been planned to put between the bridle and vase a clamping nut or movable nut upon the tail-piece of the vase, which, pressing against the bridle, does not allow the screw to free itself so easily.

Lastly, it has been noticed that by an indiscretion common to all persons unfamiliar with machinery they cannot see the least article in which there is a screw without amusing themselves by screwing and unscrewing it constantly—an amusement of which the least evil is that it gives too much play to the screw, which, in any case, is too speedily worn. These same persons, entering a workshop and standing beside a person who is turning, amuse themselves by tightening or unscrewing the screws of the lathe in an absent-minded sort of way, to the despair of *the workman, whose* work may be spoiled *hereby. Hence the screw heads* have sometimes been done away with, and the hole in their centre giving vent to the oil made square. They are set down to the proper degree of pressure with a square key, and once fixed, there is no further fear of the inadvertence or mischief of those who handle everything at the risk of disarranging it. There is scarce an amateur who has not remarked with amusement that the majority of those who get near a bench on which there are compasses set to a gauge which it is very important to preserve on account of the divisions for which they are intended, take these compasses and open and close them without ceasing, under the same absent-mindedness with which women flirt their fans. As collars wear out rapidly, and as it is impossible to keep them in stock lest they get damaged, we think that we shall gratify amateurs by giving them directions for making their own. The best are made of three parts tin and one part zinc; they are also made of two parts tin and one antimony; lastly, the zinc and antimony may be replaced by brass. But this last composition is only suitable for large lathes and other machines. In order to cast them a mould in the form of Fig. A in the margin must be made of wood of the size of the collars; then in a crucible or iron ladle the material is to be melted by commencing with the zinc, the antimony, or the brass. These metals must be in a state of fusion before adding the tin. The mixture must be stirred with a bit of wood in order thoroughly to incorporate the different materials. All must be left to cool to such a degree that a piece of paper only becomes singed to a brown colour when it is poured into it. The material is then poured into the mould. If hotter it would burn it, and the collars would be full of blowholes, which they call honeycombs.

FIG. A



It is specially in the chuck lathe that they use the rest Fig. B (in the margin). Nothing is so serviceable for making a piece inside and out, such as a box, a case, &c. Toymakers use another kind of rest, represented in the margin by Fig. C. The bar *a* that is seen there rises and falls on a hinge, so that the upright side serves for turning the outside of a piece, which, as can be seen, can

FIG. B

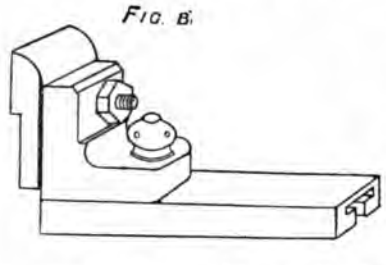
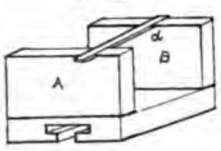


FIG. C



pass into the interval between the u
A B, and when it is to be hollowed c
rest is not disturbed. It suffices to
the bar upon which the tool rests.
addition to this rest being very hea
clumsy, the iron bar on which the
placed being smooth does not afford su
grip to the tool, which slips, and may
sequence cause damage just when
tention is relaxed, because the tool w
escaped control.

This rest has not the inconvenience
other, which must be constantly shi
order to turn its tool support to wh
side is necessary; but this inconvenie
be partly remedied by placing th
diagonally to the square of the sole.
way means will nearly always be pr
for presenting the T to the face of th
which is to be turned by merely lo
the holding-down bolt underneath.
theless, after working for some len
time, one gets accustomed to shift the
a moment's notice almost unconsc
Another advantage which the rest ha
that of the toymakers is the faci
raising or lowering it by altering the
of the T-piece. There is yet a third l
rest, represented in Fig. D. The T

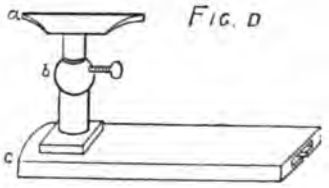


FIG. D

a resembles that of the bow lathe.
placed in a socket *b*, attached to the
by a tenon, which can turn in all dire
and be raised and lowered at pleasure.
clamping screw retains the T at a conv
height. This, which is called the Englis
is very handy when turning delicate
because angles of the T can be
to approach the narrowest mo
as closely as may be necessary. We sha
end our description of the chuck lat
serving to ourselves power to speak
when describing its various fitting
suffices to make known that M. H
Bergeron constructs them in his work
the simplest or most elaborate kind
perfect as to truth, and finished wi
utmost accuracy. If, however, certai
teurs desire to have a lathe built unde
eye, we advise them to take the
care in the adjustment of the parts
compose it. Very frequently a lathe
or is difficult to work, which proves
that the collars are not true in their be
or that they are bored too large, or th
are not in alignment with each oth
lastly, that the key shakes in its morti
does not embrace the mandrel acc
Suppose now that a good chuck lath
solid bed has been obtained, we sho
trouble ourselves for a single momen
whether it has a flywheel above or bel
stand: but when we have occasion to
of it we will show the best way of arr
it. The question is how to use it.

GERARD'S NEW TEXTILE THR

IMPROVEMENTS in the manufac
textile threads from viscous or pasty
have been recently patented in this cou
behalf of M. Gerard, of 11, Rue Louis le
Paris. Threads or filaments of gelati
other viscous, pasty, or glutinous matte
under certain conditions of liquidity a
perature, be formed by drawing the m
composing them out from the mass, by
of a brush for example. Glass has been
or "spun" into threads; but the obje

Occultations of Fixed Stars by the Moon.

Day of Month.	Name of Star.	Magnitude.	Disappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.	Reappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.
			h. m.		°	°	h. m.		°	°
24	50 Sagittarii	6	10 6 p.m.	Bright	91	65	11 16 p.m.	Dark	267	250
28	50 Aquarii	6	2 28 a.m.	Bright	177	163	2 59 a.m.	Dark	224	215

A description of the construction and use of the above table, illustrated by a diagram, will be found on p. 403 of Vol. XLVI.

Jupiter's Satellites.

Day of Month.	Satellite.	Phenomenon.	H.	M.	S.	Day of Month.	Satellite.	Phenomenon.	H.	M.	S.	Day of Month.	Satellite.	Phenomenon.	H.	M.	S.
1	I	Tr I	1	34	A.M.	9	I	Sh E	12	23	P.M.	18	III	Oc R	10	25	P.M.
1	III	Tr E	1	47	„	10	I	Ec R	9	40	31„	18	III	Ec D	11	15	38„
1	I	Sh I	1	47	„	11	*III*	*Ec R*	9	0	20„	18	*III*	*Ec R*	12	59	40„
1	*III*	*Sh E*	2	55	„	13	II	Oc D	12	53	„	22	II	Tr I	10	6	„
1	I	Oc D	10	52	P.M.	15	*II*	*Sh I*	8	59	„	22	II	Sh I	11	33	„
2	I	Ec R	1	17	45AM	15	II	Tr E	10	18	„	22	II	Tr E	12	35	„
2	*I*	*Sh I*	8	16	P.M.	15	II	Sh E	11	29	„	24	*I*	*Tr I*	1	16	A.M.
2	I	Tr E	10	12	„	16	*I*	*Oc D*	2	22	A.M.	24	*II*	*Ec R*	8	20	24PM
2	I	Sh E	10	29	„	16	I	Tr I	11	30	P.M.	24	I	Oc D	10	34	„
6	II	Oc D	10	36	„	16	I	Sh I	12	5	„	25	*I*	*Ec R*	1	29	17AM
7	II	Ec R	1	48	23AM	17	*I*	*Tr E*	1	42	A.M	25	*I*	*Sh I*	8	29	P.M.
8	*II*	*Sh E*	8	54	P.M.	17	*I*	*Sh E*	2	18	„	25	I	Tr E	9	55	„
8	I	Oc D	12	37	„	17	*I*	*Oc D*	8	48	P.M	25	I	Sh E	10	42	„
9	I	Tr I	9	44	„	17	I	Ec R	11	34	51„	25	III	Oc D	12	4	„
9	I	Sh I	10	11	„	18	*III*	*Oc D*	8	41	„	29	*II*	*Tr I*	12	24	„
9	I	Tr E	11	56	„	18	*I*	*Sh E*	8	47	„						

Ec Eclipse; Oc Occultation; Tr Transit of Satellite; Sh Transit of Shadow; D Disappearance; R Reappearance; I Ingress; E Egress. The printing of a phenomenon in *italics* indicates that its visibility is rendered doubtful, either by the brightness of the twilight, or by Jupiter's proximity to the horizon.

of his pale bluish disc remains constant at 3·8" throughout the month.

Day of Month.	Right Ascension.	Declination South.	Souths.
	h. m.	° ′	h. m.
1	12 49·9	4 37·3	8 7·0 p.m.
6	12 49·6	4 35·9	7 47·0 „
11	12 49·4	4 35·0	7 27·2 „
16	12 49·3	4 34·6	7 7·5 „
21	12 49·3	4 34·6	6 47·8 „
26	12 49·4	4 35·2	6 28·2 „

From which it will be seen that Uranus will remain almost stationary on a line joining Spica and γ Virginis. His conjunction with Mars at 6 a.m. on the 7th has been referred to under the head of that planet.

Neptune

Is invisible.

Shooting Stars

Are not common in June, but may be looked for from the 4th to the 13th (especially on the 6th), and between the 10th and the 28th, notably on the 20th.

Greenwich Mean Time of Southing of Eight of the Principal Fixed Stars on the Night of June 1st, 1888.

Star.	Souths. h. m. s.
η Ursæ Majoris	9 0 4·41 p.m.
Arcturus	9 27 25·44 „
α Libræ	10 1 28·03 „
α Coronæ	10 46 36·34 „
α Serpentis	10 55 23·24 „
Antares...	11 39 3·79 „
α¹ Herculis	12 25 55·75 „
α Ophiuchi	12 46 4·10 „

The method of finding the Greenwich Mean Time of Southing of either of the stars in the above list for any other night in June, as also that of determining the local instant of its Transit at any other station, will be found on *p. 404 of Vol. XLVI.*

GEARING.—XV.

Helical Wheels.

SINCE helical bevels appear to many to present greater difficulties than the spur wheels, I will conclude the subject of these gears in this article by explaining the method of their construction, which, though slightly more difficult in practice, is not so, in principle, than that of the spur gears.

If we consider a moment we see that bevel gears might be stepped with the same results as the spurs, the difference being that the distances between the contiguous steps will diminish as the common centre of the wheels is approached. Then evidently these steps can be merged into helical lines. The basis, therefore, of helical bevels is the development of screw lines on a *cone* instead of on a *cylinder*.

In Figs. 103, 104, let A represent the diameter of the base of a cone, B its slant height, and C its vertical height. Divide A and C into the same number of equal parts, in this case 18. To save confusion take only the divisions 3, 6, 9, 12, 15, 18 in Fig. 104, and project each of the 18 radial divisions in Fig. 104, which cut the lines 3, 6, 9, 12, 15, 18 in that figure, down to Fig. 103. Then the successive points of intersection *a*, *b*, *c*, *d*, *e*, *f*, and *a′*, *b′*, *c′*, *d′*, *e′*, *f′*, will give the curve of right and left-handed helical lines on the cone. The combination of the two curves to form double helical teeth is then quite apparent from the lines filled in in both figures.

In Fig. 105 is shown the complete development of a double helical bevel wheel. It is seen that we do not carry the development of Figs. 103, 104, into actual practice any more than we did in the case of the spur wheel, Figs. 101, 102, p. 207. But we take a sectional elevation of the wheel, Fig. 105, A′, and obtain the tooth shapes as in ordinary bevel gear, with this addition—that the tooth shapes on the middle section O O are also required. For the method by which projections of bevel-wheel teeth are obtained see Art. IX., Vol. XXXVII., p. 500. The larger, middle, and lesser diameters, with their appropriate tooth shapes, are projected at A B C, D E F, G H I, respectively, and their projection again to the wheel shown in elevation above is abundantly clear, the same reference letters indicating the tooth points, pitch lines, and roots.

Now, it is quite evident, without further illustration, that precisely the same principles of construction are involved here as in the case of helical spur wheels. When making patterns, therefore, we have only to determine the angle of teeth according to the condition stated in

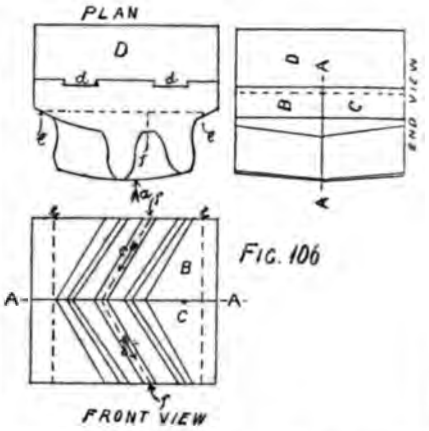


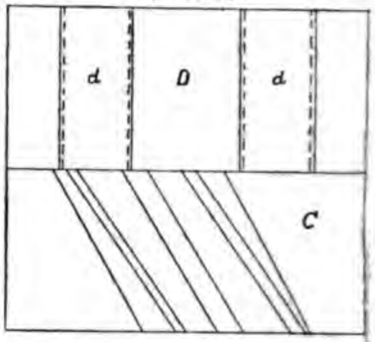
FIG. 106

our last—namely, that the contact of one pair of teeth shall commence as the previous pair are leaving, and that the centre lines of the teeth in any section shall be radial. The teeth are therefore marked out on the planes A B C, D E F, G H I, and the flanks worked across from one set of lines to the other, the twist peculiar to the screw outline being developed during the working through,

In no instances, so far as I am aware, are complete patterns made for helical bevel-wheels, whether their bevel is little or much, but always, I believe, such wheels are made by machine. As they have never, to my knowledge, been described, I purpose showing in what manner the tooth blocks for helical wheels, both for spur and bevel gears, are constructed.

Looking at Figs. 106 and 107, which represent the tooth block for a spur helical wheel,

FIG. 107



we note, in reference to the ramming-up of the inter-tooth space, that the ramming must either be done from the front, as at *a*, or the rammer must follow the oblique direction of the arrow *b*, and afterwards that of *c*. Actually, it does not follow precisely either line of direction, but is held somewhere between the two. Still, in the main it is desirable that the rammer should be able to follow the directions *b* and *c*. It is then clear that when ramming *b*, that portion of the tooth on the left flanking *c* would be so much in the way as to interfere with the action of the rammer. Hence, the blocks are often, though not always, divided along the line A A. So that helical tooth-blocks consist usually of three portions at least, B, C, and a backing D, and B is rem while C is being rammed, as shown in Fi . To some extent this practice deper the custom of the shops; partly, howe is dependent on the angle of the tee coarse pitch, and therefore, of spaces, and of shallow depth, rammed without dividing the b parts. But the division of the b not necessary, in any case, Figs. 106 and 107 show how

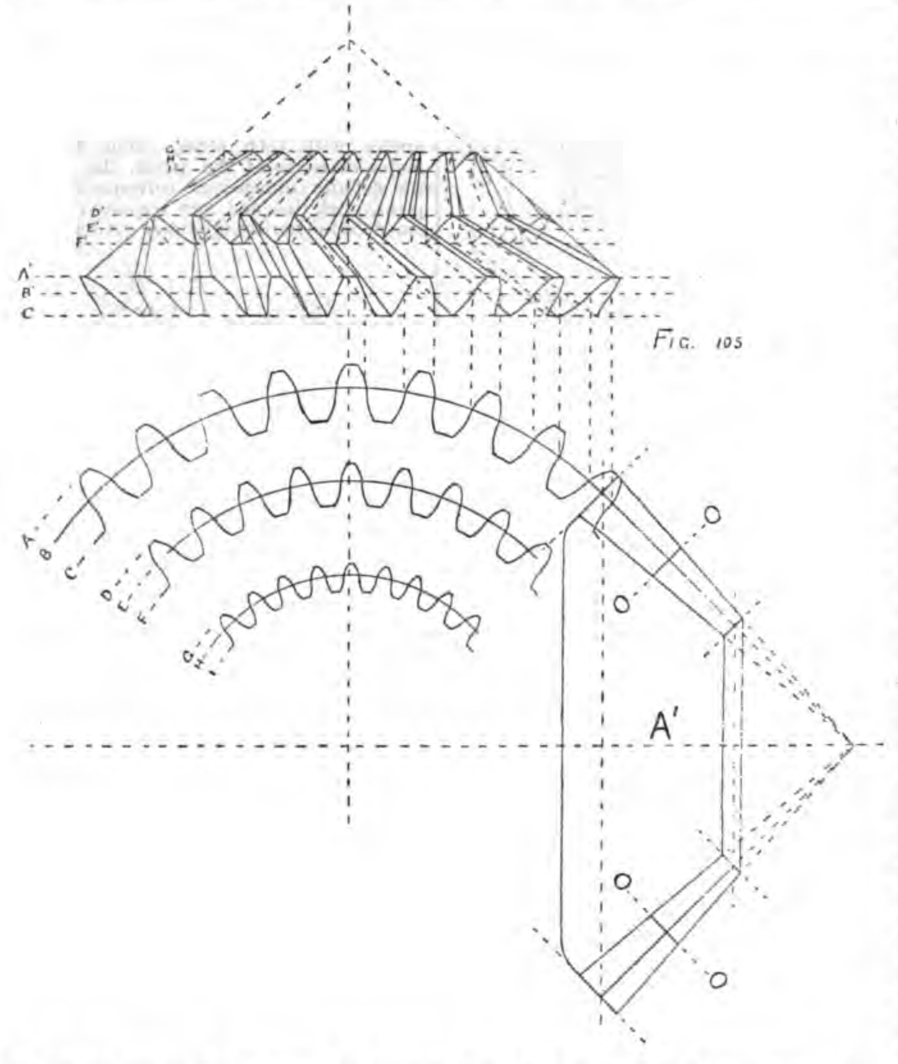


FIG. 105

then the line C' gauged, afterwards the bevels K c' and i c' are worked. Thus we get an exact section of the wheel face corresponding with the tooth roots, and to this we can attach teeth in any suitable way.

Fig. 110, then, illustrates the marking out of the body of a block, which would be equally applicable to an ordinary or to a helical bevel. Fig. 111 carries us further, showing the actual jointing of a helical block. The fitting of the dovetails and the joint through the middle line would be done before the bevels were cut, so that this is clear enough. Passing to the teeth, and comparing the lines in Fig. 111 with those in Fig. 109, the coincidence between the two is seen. Therefore, having fitted and glued rough blocks for the teeth on the worked block, whose outline and mode of jointing is that of Fig. 111, we can obtain all the points indicated by the reference letters corresponding with the pitch, point, and root lines upon the three diameters of the wheel. Here the jointing of the block in the middle line facilitates the marking out, by furnishing faces upon which the middle dimensions can be marked directly. We have a centre line on the block, and knowing the angle to be given to the teeth it is quite easy to take off the tooth centres, their angle, and their profiles from Fig. 109, and transfer them to the block. Working the profiles from one face to another, such amount of twist as will be natural to the wheel will be developed in working them through with gouge and chisel—that is, if we bear in mind to make the centres of the teeth on each section truly radial. J. H.

MR. BOYS' EXPERIMENTS WITH SOAP BUBBLES.

THE paper in which Mr. C. V. Boys, A.R.S.M., demonstrator of physics at the Science Schools, South Kensington, described his experiments with soap-bubbles before the Physical Society, has been published in the *Philosophical Magazine*, and we make the following extracts:—

Everyone is familiar with the fact that a soap-bubble may be supported or even struck by a piece of baize or wool without coming into real contact with the material; it is also well known that two bubbles supported on the pipes from which they are blown, or on rings, may be pressed or knocked together with such violence as to materially alter their shape, and yet they do not come into real contact; there is a film of air between them which they are unable to squeeze out. This film, though thin to ordinary tests, is so thick that the colours of Newton's rings are only seen when one of the bubbles is very small, so that the air is squeezed out the more readily. If the pressure is increased so as to make a real contact, the bubbles both instantly burst. That this pressure may be made great before the true contact takes place will be shown in a variety of ways hereafter; but the following simple experiment makes it very evident that the air-film will prevent the contact of two soap-films that are pressed together.

Exp. 1.—Blow a bubble about 9cm. (3·5in.) in diameter, and place it on a ring with a diameter of about 7cm. (2¾in.) This bubble may be pulled or pushed through the ring by means of a smaller wire ring which serves as a handle. It may be so adjusted that the weight of the ring will not pull it through. Then a ring larger than the bubble, carrying a plane film, can be used to push it up and down through the ring, and yet the two films do not touch (Fig. 1).

Exp. 2.—Blow a bubble on the lower side of the same ring that was used in Exp. 1, and if a large drop does not remain hanging to the bubble slowly apply solution to any part until as great a drop as can safely be carried has accumulated. Then pass the end of the pipe through the upper side of the bubble, and blow another inside, but take care in this case to have no excess of liquid. When the inner bubble is about twice as large as the outer one was at first, remove the pipe with a rapid movement. The inner one will now fall gently and rest within the outer one, the heavy drop pulling the thick part of the outer bubble out of reach of the inner one. The air of the outer bubble may then be withdrawn until the space between the highest point of the two bubbles is no more than two or three millimètres (Fig. 2).

The great pressure which the air-film will carry is well shown by the next experiment, which, moreover, is more easily carried out than the last.

Exp. 3.—Proceed as in the last experiment, but instead of making a large drop on the first bubble, hang on a moistened ring of wire rather smaller than the fixed ring. This ring should be weighted until it pulls the bubble so much out of shape that a tangent to the curve at the points where the film meets the hanging ring makes an angle of 20° or 30° with the plane of the ring (Fig. 3). A bubble may then be blown inside and allowed to drop, when it will be found to rest on the conical seat provided by the outer bubble, while the heavy drops of liquid are kept apart, and thus there is no fear of contact (Fig. 4). These drops may now be both removed with the end of the blowpipe; then, if the lower ring is pulled down slowly, it will be found that the inner bubble is being squeezed out of shape until it becomes a beautiful oval, while the outer bubble shows the effect of the pressure by a corresponding enlargement (Fig. 5). If the lower ring is pulled down still further, the outer bubble is simply pulled in half, and the inner one, often unbroken, gently floats away. This shows that contact was not made, as in that case both would be immediately broken. If, however, instead of pulling the ring too far, it is held in the position shown in Fig. 5, it will be found that it is possible to swing the pair of bubbles round and round, and yet in spite of this violent treatment the bubbles refuse to touch one another. Or, if the lower ring is cautiously inclined and pulled away, the outer bubble will peal off it and remain attached to the upper one only. The two bubbles will now be spherical again, but there will be no heavy drop as in Fig. 2. The air of the outer bubble may be withdrawn as before, until the two bubbles are barely separate.

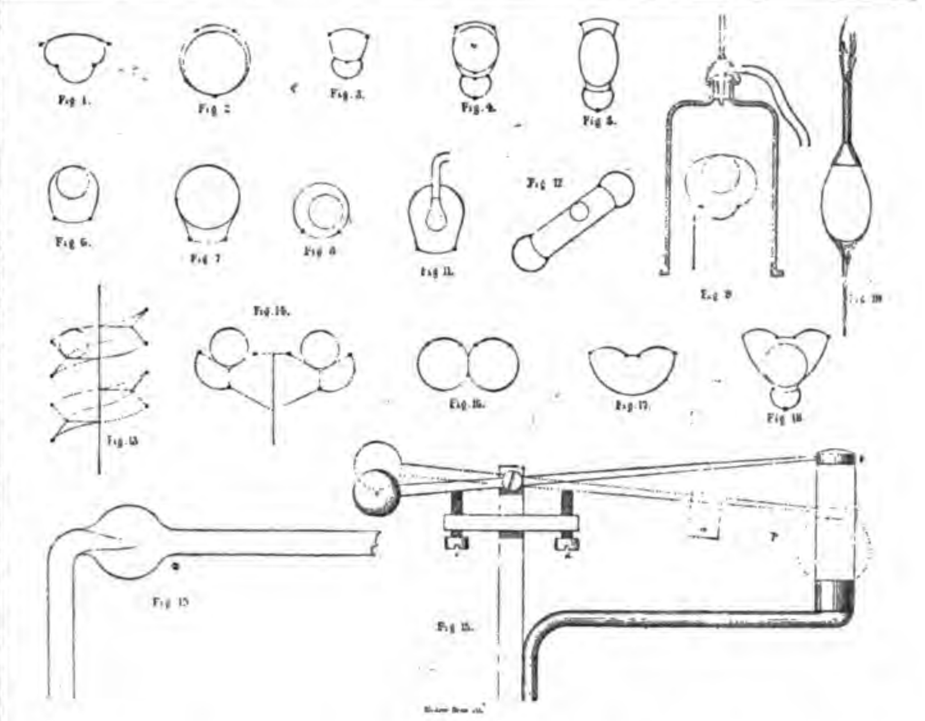
This experiment, and many of those that follow, may be made more beautiful by using for the inner bubble a solution strongly coloured by fluorescine, or still better by uranine (for the knowledge of which I am indebted to Mr. Madan); then, if sunlight, electric, or magnesium light is thrown on to the bubbles, the inner one appears a brilliant green, while the outer one remains clear as before.

The power of the surface-tension to do work is demonstrated by blowing a large bubble below the ring and hanging on the weighted ring. If now a very small ring, a centimètre or more in diameter, is placed on that part of the bubble which is stretched across either ring, and then the part within the small ring is made to burst, the air will escape through the small hole, and the heavy ring will be lifted until it comes in contact with the upper one. If the film over the whole of the heavy ring is burst instead, the ring is pulled up so suddenly that it is difficult to follow it with the eye, and it strikes the upper ring with such violence that the noise is loud enough to be heard across a large room.

A suspended ring affords a simple and accurate means of measuring the surface-tension of the soap-film. A plane film is formed across a fixed horizontal ring and a light smaller ring is attached to the plane film, which is then broken within the smaller ring so as to leave an annular film only. Weights are then hung on to the suspended ring until the angle between the film and the plane of this ring approaches 90°. At this point equilibrium becomes unstable, and the lower ring falls away, but now both rings will be found to carry plane films, though the moment before neither did. On repeating the experiment a few times it will often be found possible to use such a weight that the ring will hang for some time, but will gradually sink, while the angle referred to above will approach more and more nearly to 90° as the surface-tension of the film diminishes; and thus the exact surface-tension at the particular moment of separation may be found by dividing weight of the ring and attached moisture by twice its circumference.

Exp. 4.—Bubbles blown with coal-gas are lighter than air, and rise. If, therefore, an inner bubble is blown with such a mixture of air and gas as to rise, it will rest against the upper side of the outer bubble, where there are no heavy drops, but where the films are thinnest and clearest (Fig. 6). A pair of bubbles blown in this way will sometimes last an hour when exposed to the air of the room. The inner bubble may be gradually enlarged by blowing in gas until the outer one can barely withstand the pull. The forms assumed under these circumstances are extremely graceful, and their beauty is increased by the play of colours on the two bubbles which the multiple reflexions seem to intensify. If, when the inner bubble is not too large, as in Fig. 6, a little gas is gently let into the outer bubble, it is possible to so adjust the mixture of gas and air that the inner will float either near the top or near the bottom of the outer bubble, or about the middle, as may be desired (Fig. 8). If under these conditions the bubbles are left undisturbed, the richer gas above the inner bubble will diffuse into the poorer and heavier gas below, and the bubble will slowly rise or fall, according to the relative quantities of gas and air. The diffusion through the film is well shown in the next experiment.

Exp. 5.—Blow a pair of bubbles, as shown in



out make the inner bubble only just light to rest against the top of the outer one. bell-jar over all, and pass a stream of gas bell-jar by means of a tube passing through As the air is gradually driven down, the ubble begins to feel the want of buoyancy, dually settles down, as shown in Fig. 9. short time the effect of the diffusion both bubbles tending to enrich the gas of er bubble is made evident by the gentle of the inner bubble.

6.—Into a large inverted bell-jar pour a uantity of ether, or to fill the jar with the quickly wet a piece of blotting paper with nd stand it on edge in the jar. Remove the hen blow a bubble and drop it into the jar. bble will rest on the ether vapour as on c anhydride, and while floating the most agitation of the colours of the film will be The bubble does not remain floating long at e level; it gradually sinks into denser and ayers of vapour until it reaches the bottom ks on the way.

7.—At the end of a wide tube, which has larged at the lower end, blow a large and lower it gently into the vapour of olding the finger at the mouth of the tube. few seconds it will be found difficult to the bubble by means of the tube, because ht may have become sufficient to tear it hen buoyed up by the air only. If it is d successfully it will hang like a heavy hen, on removing the finger, a light may be the issuing vapour, which will burn like a burner. If, moreover, the bubble full of pour is held in a brilliant light, the shadow w the ether vapour oozing through the film ing away in a heavy stream (Fig. 10).

8.—Blew a bubble with oxygen gas in a jar filled with ether vapour; on taking the out of the vapour and carrying it to a light xplode with a loud report. Sufficient vapour etrate the bubble, even whilst it is being to make the mixture violently explosive.

9.—The weight of the air is well shown by a bubble with gas on a ring and then try- low an air-bubble within it (Fig. 11). The ubble is then pulled out in a pear shape, and n breaks away from the pipe on account of t weight.

10.—If Exp. 4 be repeated, but instead of a ixed ring a light aluminium one be used to which is tied a long piece of thread nay have a sheet of paper at the end, then le combination will float and rise in the n though, as in Fig. 7, practically the whole buoyancy is due to the gas in the inner In this case the inner bubble is the bag loon, the outer bubble is the netting, and e and the things carried by it are the car. case the power of the air-film to resist con- the two films is more evident than ever. If the former figures 6, 7, or 8 are carrying a g and thread, as described, it is possible table pull at the thread to release the pair les, which float away, one inside the other, e ceiling brings the experiment to a con-

11.—If the inner bubble of Fig. 6 is made than the ring, then the corresponding ex- t to that represented in Fig. 5 is shown in The small sphere will always roll to the nd of the outer bubble, which may be ut to the cylindrical form and be inclined way. This modification of the other ex- t was suggested by Mr. Newth, to whom I wn the previous combinations.

12.—An experiment which is easily per- shows in a striking way how the air-film being broken. If a pair of bubbles are as shown in Fig. 4, and the vibrating of a large tuning-fork are brought quite the line where one bubble rests upon the oth films will take up the movement of the nd a point of light reflected by the two seen spread out into a pair of rings, so is the motion—yet the films do not touch. rdly possible to suppose that the two films as close together where the movement s in other parts of the line of support; if d to separate they form an exception to the rule that a vibrating body attracts an n the immediate neighbourhood. In this inner bubble is heavier than the air in the e, both because of the weight of the film compression of the air within due to its But if the same experiment is tried when er bubble is lighter than the air in the ne, as it may be by holding one of the close to the highest point of the bubbles in Fig. 6, or when either bubble is heavier er than air, the same result will be found ubbles will refuse to touch one another.

13.—A spherical bubble may be dropped of these troughs and rolled from end to may be taken out of one trough and dropped ther, or the frame may be held with its tical, when the bubble may be dropped into the triangular pit, where, however, it will not remain long.

Exp. 14.—If, instead of a single helix of wire, two helices are fixed to the same axis, but not quite symmetrically, so that in any part the wire of one helix is nearer that above it than the one below, two helical films will not be formed, but there will be a single one in an intermediate position, which will be joined to the two wire screws by a pair of conical screw-surfaces, these forming with the true screw-surface a screw-shaped trough down which bubbles may be rolled or up which they may be wound, as water is wound up by a screw-pump (Fig. 13). Further, if a series of small bubbles are blown along the helical edge in which the three films meet at angles of 120°, a spiral staircase is made of soap-film, down which a bubble will run one or two steps at a time, and from which it will escape uninjured when it reaches the bottom. Of course, bubbles lighter than air, in the same way, will rest against the lower sides of a trough, or roll up instead of down the screw-surface.

Exp. 15.—One more experiment in which the rolling of bubbles is the chief feature is worth describing. Three rings of wire, seen in section in Fig. 14, are joined together by wires, shown dotted, and are carried by a central axis, which may be made to rotate. After this frame has been dipped in the solution of soap, and the three radial planes broken, it is found to carry a circular trough, into which a series of bubbles may be dropped, while at the same time the frame may be kept rotating, so that the bubbles are rolling round and round like marbles on the rim of a solitaire-board. A corresponding frame might possibly be made of light wire, which after dipping would rest on the bubbles in the first frame, thus forming a working model of the ball-bearing. I have not, however, succeeded.

Fig. 15 shows a convenient apparatus for producing, as often as may be desired, a cylindrical bubble of any degree of stability. The short tube *a* is in connection with a supply of oxygen which is employed to blow the spherical bubble shown by the dotted circle. According to the position of the screw *d* this bubble will be larger or smaller before it comes in contact with the ring *b*, which is held down by the loose weight *w*. The gas-tap is then immediately turned off, and the ring *b* raised by the action of the weight *c*, until the screw *e* brings the movement to a stop. Thus the length of the cylinder depends on the screw *e*, while its volume is determined by the screw *d*, and so whatever degree of stability is found suitable can be reproduced as often as may be required. The poles of the magnet should be placed at about the level of the line *p p*.

There is one other property of a pair of soap-films resting against one another, but not in contact, to which I have not referred. In a lecture at the Royal Institution a few years ago Lord Rayleigh showed that two water jets if perfectly clean will, if directed so as to meet one another at a small angle, be reflected again and fall as two separate jets, never really coming into contact at all. If the water is not perfectly clean, the experiment will not succeed. He showed that such a pair of mutually reflected jets form a very delicate electroscope, so that if a piece of excited sealing-wax is held even at a considerable distance they instantly coalesce. As the two jets in his experiments and the two bubbles in those which I am about to describe are in each case kept apart by a thin film of air, I expected to find a pair of bubbles attached to two rings in the same way act as a delicate electroscope.

Exp. 16.—If a pair of bubbles are blown on rings, which must be insulated from one another, as shown in Fig. 16, and the cover of a small electrophorus is raised even at some yards distance, instantly the two bubbles coalesce, as seen in Fig. 17, but do not burst, as they have hitherto been found to do. Or if the two rings are connected with a key and a single bichromate cell so that when the key is not preesed the rings are connected together, but when depressed they form the terminals of the cell, then at the moment of making the contact the bubbles unite because the electrostatic attraction between surfaces so very close together is able to squeeze out the air, which mere pressure had hitherto failed to do.

Exp. 17.—Bearing in mind how exceedingly delicate this is as a test of difference of potential, the following experiment seems the more decisive. The cover of the electrophorus may be brought so close to the side of the bubbles, shown in Fig. 4, as to pull them completely out of shape, and yet the outer film so completely screens the inner from the electrical action, even though the inner one is to all appearance in contact with the outer one, that there is no difference of potential between them, and so the film of air is not destroyed. I do not know any experiment which so clearly shows as this that electrical force is confined to the absolute surface of a conductor, and is not felt at any depth within it, however small.

Exp. 18.—One more experiment, which is a combination of these two, is worth performing. If one of the bubbles of Fig. 16 is replaced by the combination shown in Fig. 4 while the other remains as before, and if the cover of the electrophorus is raised anywhere in the neighbourhood, immediately the two outer films join and become one, while the inner bubble, undamaged, and the heavy ring slide down to the bottom of the now enlarged single bubble, and give rise to the form shown in Fig. 18.

I am perfectly sensible of the fact that these experiments lie very closely on that ill-defined border-line which separates scientific work from scientific play, but I trust that the beautiful way in which they illustrate the action of certain forces may be sufficient excuse for my showing members of the Physical Society what cannot fail to remind some of them of their nursery days.

The following particulars may be of service to those who wish to repeat any of these experiments.

The solution that I have used is composed of 1 part by weight oleate of soda and 40 parts of distilled water. These, when solution is complete, are well mixed with one-third the volume of glycerine and left for a week to settle in stoppered bottles. The liquid is then siphoned off from the impurities which have risen to the surface and clarified with a few drops of ammonia. The thick wire rings and frames are made of tinned iron wire 1½ millim. (No. 17 B.W.G) in diameter, well cleaned with emery-cloth. The thin wire rings may be made of any thin wire, but aluminium about ½ millim. (No. 25 B.W.G.) in diameter does well. I have found it necessary to make a blowpipe with a trap, as shown in Fig. 19, to catch condensed moisture, which is apt to cause a failure if it mixes with the bubble. The diameter of the mouth is 7 millim. (0 28in.). For detaching small light bubbles, a pipe with a smaller mouth should be used. When both gas and air are used in any experiment, and it is necessary to regulate the proportions very carefully, it is well to have a T-piece attached to the blowpipe, so that either gas or air may be blown or stopped at pleasure.

THE CRANK'S STORY.

I WAS never anything but a crank, and although the world is not yet ready to do without me, I never had credit for all the help I have given it, one reason being that no two persons ever agreed as to how much I did help. Because, although I was most willing to work, I was never two seconds at a time in the same mind, and if I did come round to the same point pretty often, I did not stay there long enough for my friends to agree as to just what I was doing. I was so uncertain in my movements that some gave me up and tried to get around without me. But they generally came back and asked my help again.

I am of a very old family, although I did not set up a family name until a century or so ago, when somebody tried to tie me to a steam-engine with a patent, which so disgusted my friend Watt that he sought help from a sun and planet. But, dear me, I turned a potter's wheel or pulled water out of a well ages before. Of late years, by going into partnership with steam, we jointly do more work than all the rest of the world put together. I suppose steam, being younger and more pushing than I am, is the reason he gets all the credit for what we jointly do.

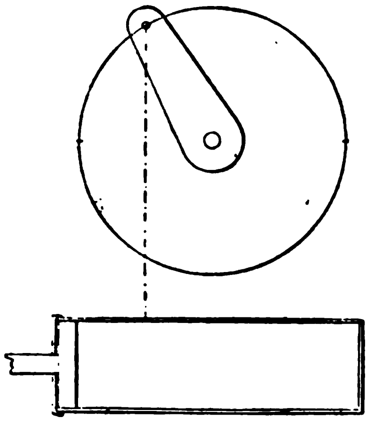


FIG. 1.

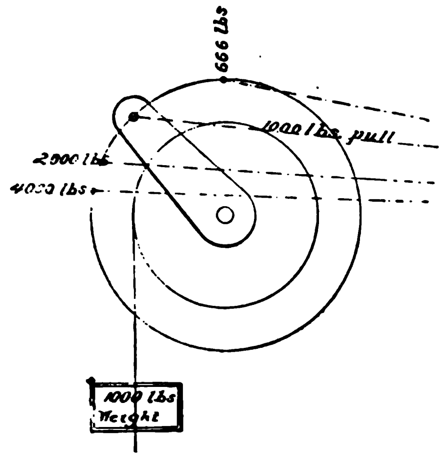


FIG. 2.

Time was not long ago when it took me and steam and 10lb. of coal to get a horse-power per hour. Latterly I and steam have succeeded in getting a horse-power per hour out of less than 2lb. of coal. I propose to show where I think my help came in, and will try to explain on a line of general averages, leaving out fractions, and will argue my case by comparison of leverages.

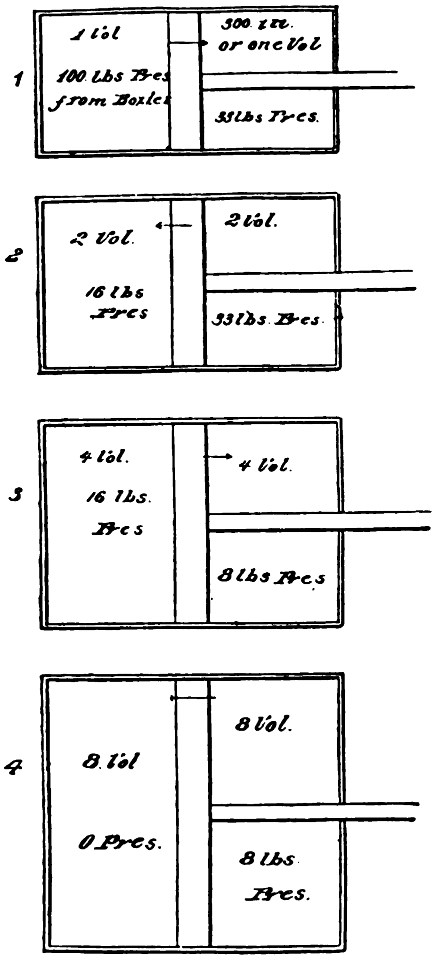
Argument.

There are those who claim that steam can be *expanded* in a single cylinder with the same good results as it can be in three or four cylinders. But as experience shows to the contrary, and as a single-cylinder engine with one crank and a four-cylinder engine with four cranks, both using the same weight of steam, and both supplied from the same boiler, show different results, it looks as if the cranks had something to do with it. In the following diagrams, Fig. 1 shows a crank supposed to be 6in. throw, beneath which is a cylinder in which the piston moves back and forth 12in. each way, to suit the crank-pin; while the piston travels 2ft., the crank-pin travels 8ft.

Fig. 2 shows a crank-pin advanced one-third of its travel from one dead centre to the other.

In about this position a 1,000lb. pull on the piston by the steam will balance a 1,000lb. weight hung on a pulley whose circumference is equal to the two strokes of the engine—in other words, a pulley on whose rim a belt would travel as many feet in a given time as the piston did. This I term the par line. It is the line where the leverage of the crank is equal to the power of the engine.

The diagram also shows that about ½ the pull of the piston is expended on ⅓ the travel of the crank pin, and this when the power of the crank pin is above par. The crank pin has to pull the same load, the ⅔ of its travel below par as it has when it is above par, and only has half the steam to do ⅔ of the work, and that half when it has the least power to help.



Let us compare a single-cylinder engine used expansively with one of four cylinders, using the same weight of steam in each and getting the same expansion. Say the four cylinders have piston areas of 50in., 100in., 200in., and 400in.

We arrange the cranks alternately opposite each other (and use flywheel in both engines). Thus in both engines when the crank-pin is at its best, or at right angles, the pistons will all be about in the centre of the cylinders, as in diagram No. 3.

As cylinder No. 4 with its 400in. has eight times the volume of No. 1 with its 50, we get eight expansions, or sixteen if we cut off No. 1 at half stroke, which we propose to do; and, starting from the boiler with 300in. of steam at 100lb. pressure, we will follow it through its different stages in each cylinder and see the result, and refer to diagram No. 3.

In the back end of No. 1 the steam is 100lb. on the 50in., and is one volume. In the second stage the same inches of steam fill half No. 1 and half No. 2, equal to three volumes and 33lb. pressure, which is back on No. 1 and forward on the 100in. of No. 2.

So the net power from No. 1 is 100 less 33 = 66 on 50in. = 3,300lb. push on crank.

The same steam in next stage fills half of No. 2 and half of No. 3 with six volumes and 16lb. pressure. This is sixteen back on the 100in. of No. 2 and sixteen forward on the 200in. of No. 3, giving a pull to the good from No. 2 of 1,600lb.

The same steam then goes into the half of No. 3 and half of No. 4, having twelve volumes and 8lb. pressure.

This is 8lb. back on the 200in. of No. 3, which has sixteen forward on it, so there is 8 on 200 = 1,600lb. to the good from No. 3.

As there is no back pressure on No. 4, it has the good of the whole 8lb. on the 400in. = 3,200lb.

This is a total force above back pressure of 3,300 + 1,600 + 1,600 × 3,200 = 9,700 applied to the four cranks when they are at their best point of leverage.

To get the same expansions in a single cylinder, it must have 400in. of piston area same as No. 4 in the multicylinder, and the steam must be cut off at $\frac{1}{16}$ of the stroke. This would be when the piston has advanced ¾in.

Put in the 300in. and cut off at ¾in. Then at 1½in. it would be 50lb., at 3in. advance it is 25lb., at 6in. advance it is 12½lb., and the crank is at best point.

This 12½lb. on the 400in. of piston is but 5,000lb. of push on the crank at right angles against the 9,700lb. of push on the cranks in same position in the other engine.

Such multicylinder engines are not generally made with cranks opposite each other and with flywheels; but it is the fair way to compare the two systems. All questions of varying temperature and mechanical arrangements of valves are also in favour of the four or more cylinder engines for 150lb. boiler pressure, and more cylinders would give better results still.—G. H. EDWARDS, C.E., in *Scientific American Supplement.*

HOW TO CATCH AND PRESERVE MOTHS AND BUTTERFLIES.

THERE is no part of our country in which one cannot form a beautiful local collection, and any young person who wants amusement, instruction, and benefit for two, three, or more weeks in the country can find all in catching butterflies and moths, arranging them, and studying them up.

Provide yourself first with two tools, a net and a poison bottle. The net may be made of any light material. I find the thinnest Swiss muslin best. Get a piece of iron wire, not as heavy as telegraph wire, bend it in a circle of about 10in. diameter, with the ends projecting from the circle 2in. or 3in.; lash this net frame to the end of a light stick 4ft. or 5ft. long. Sew the net on to the wire. The net must be a bag whose depth is not quite the length of your arm—so deep that when you hold the wire in one hand you can easily reach the bottom with the bottle (to be described) in the other hand. Never touch wing of moth or butterfly with your fingers. The colours are in the dusty down (as you call it), which comes off at a touch. Get a glass bottle or vial, with large, open mouth, and cork which you can easily put in and take out. The bottles in which druggists usually get quinine are the most convenient. It should not be so large that you cannot easily carry it in your pocket. Let the druggist put in the bottle ½oz. of cyanide of potassium; on this pour water to the depth of ¾in., and then sprinkle in and mix gently and evenly enough plaster of Paris to form a thick cream, which will set in a cake in the bottom of the vial. Let it stand open an hour to set and dry, then wipe out the inside of the vial above the cake and keep it corked. This is the regular entomological poison bottle, used elsewhere. An insect put in it dies quietly at once. It will last several months.

These two tools, the net and the poison bottle, are your catching and killing instruments. You know where to look for butterflies. Moths are vastly more numerous, and while equally beautiful, present more varieties of beauty than butterflies. They can be found by daylight in all kinds of weather, in the grass fields, in brush, in dark woods, sometimes on flowers. Many spend the daytime spread out, others with close shut wings on the trunks of trees in dark woods. The night moths are more numerous and of great variety. They come around lamps, set out on verandahs in the night, in great numbers. A European fashion is to spread on tree trunks a strip made of brown sugar and rum, and visit them once in a while at night with net and lantern. Catch your moth in the net, take him out of it by cornering him with the open mouth of your poison bottle, so that you secure him unrubbed.

Now comes the work of stretching your moths. This is easy, but must be done carefully. Provide your own stretching boards. These can be made anywhere with hammer and nail and strips of wood. You want two flat strips of wood about

$\frac{3}{8}$in. to $\frac{3}{4}$in. thick and 8in. to 14in. long, nailed parallel to each other on another strip, so as to leave a narrow, open space between the two parallel strips. Make two or three or more of these, with the slit or space between the strips of various widths, for large and small moths and butterflies. Make as many of them, with as various widths of slit, as your catches may demand. Take your moth by the feet gently in your fingers, put a long pin down through his body, set the pin down in the slit of the stretching board, so that the body of the moth will be at the top of the slit and the wings can be laid out flat on the boards on each side. Have ready narrow slips of white paper. Lay out one *upper* wing flat, raising it gently and carefully by using the point of a pin to draw it with, until the lower edge of this upper wing is nearly at a right angle with the body. Pin it there temporarily with one pin carefully while you draw up the *under* wing to a natural position, and pin that. Put a slip of paper over both wings, pinning one end above the upper and the other below the under wing, thus holding both wings flat on the stretching board. Take out the pins, first put in the wings, and let the paper do the holding. Treat the opposite wings in the same way. Put as many moths or butterflies on your stretching board as it will hold, and let them remain in a dry room for two, three, or more days, according to size of moths and dampness of climate. Put them in sunshine or near a stove to hasten drying. When dry, take off the slips of paper, lift the moth out by the pin through the body, and place him permanently in your collection.—WM. C. PRIME, in *N. Y. Jour. of Commerce.*

DETAILS OF BLACKSMITHING.*

Guard Bows—Swivels—Breech-Frames—Refining Iron in Forging.

WHENEVER there is much stock to be reduced and got into definite different sizes, the operation is easiest performed by getting it into round shapes, for reasons already explained; but it must be provided that these shapes can be converted into the forms demanded. Instances of this kind may be often met with. The guard bow of the last model of the Springfield musket is a case in point. This was drawn round, with a swell in the middle, at a trip-hammer, and was afterwards flattened in proper dies with the drop to form the bow, and the right amount of stock was also placed to form the swivel hinge. After forging, this piece was finished before it was bent. The swivel was made similarly, the wire for the ring was drawn under a small trip-hammer which struck about one thousand blows per minute, and the stock for the ends, being cut of the right length, was headed in a foot-vice, and the piece wedged or upset to the right length, if it needed it, which it seldom needed, as a stop was set in the vice at the last heading which it drove down upon and got gauged. The swivel was also finished before bending. The wire was clamp-milled.

The process of clamp-milling is used to great advantage in finishing many things which are round and of small diameter, too flimsy to turn or grind, and not of such shape as to be wire-drawn or rolled. "Bosses" on the ends of braces which are either to be drilled or punched to receive bolts are made by forming balls, which, being flattened, assume the required shape.

In the piece represented by Fig. 2 this principle was carried about to the extremity of its safe limits. This piece is the breech-frame of a breech-loading rifle, similar to the Snider, but hinged on the other side, the cap of this turning over to the left as shown in Figs. 3 and 4. Fig. 3 represents the side view of the frame, with the cap which hinges over it, and Fig. 4 shows an end view of the same. To make it, a piece was blocked out with the trip-hammer from a 1½in. round bar of good iron, into the shape shown in Fig. 1.

It was not necessary to the procurement of this iron that anyone should invade a foreign country and steal the process, as the secret of cast steel was filched from Huntsman; for iron of very excellent quality—unsurpassable iron—has been made in this country for many years.

One great advantage that this method of working the stock possesses, moreover, was that a good sound welding heat could be taken on the bar at the very beginning, and work put on it to weld it solidly. Those who are but little acquainted with working hot iron have but a vague conception of its nature and consistence, when, as at a welding heat, it is in the pasty condition of partial disintegration. The particles of incandescent iron, which form the fibre of this spongy mass, hold, in its interstices, all the foreign matter which may be present, diffused in a gaseous or liquid form, which may also, perhaps, float or submerge some solid grains.

FIG. 1.

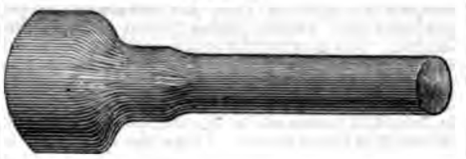


FIG. 4.

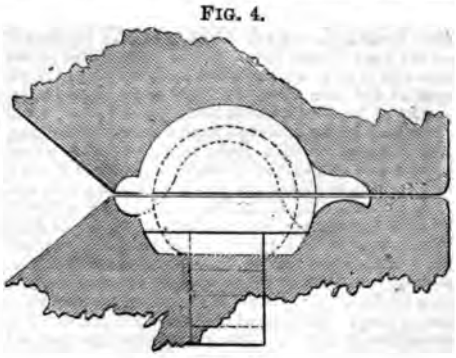


FIG. 3.

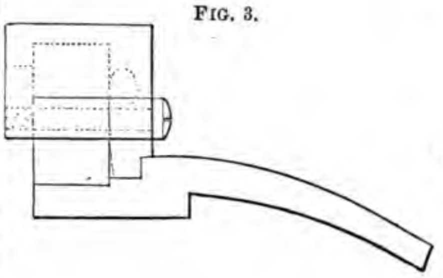


FIG. 2.

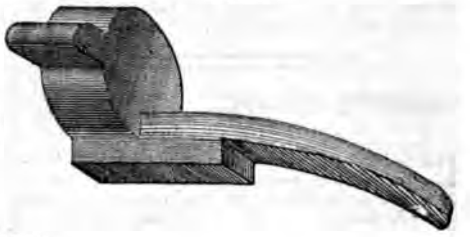
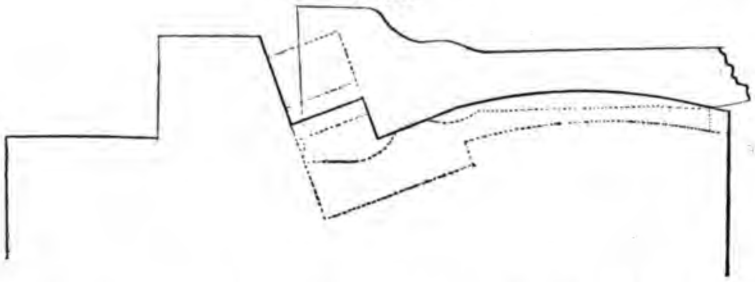


FIG. 5.



A sponge full of water may be squeezed nearly dry with one pressure of the hand; but it is not probable that all the moisture could be pressed out of it if it was submitted to the pressure of a powerful hydraulic press until its integrity was destroyed; but if put in a dry place the moisture would rapidly disappear by the action of the laws of equilibrium, the wet going to the dry. In order to get out, the water in the centre has to trace its way through a very intricate labyrinth among the fibres of the sponge, and as these are pressed closer together the portals of the passage ways are narrowed up, and the exit becomes more and more difficult.

There is not a perfect analogy between the sponge and the hot iron, for there is something in the hot iron that no power can prevent from forcing itself out, which is the heat, and while this remains in up to a certain degree, if the fibres of iron are pressed near enough together to touch, they will unite. As the liquid impurities are trying to get through the interstices, the iron cannot unite at every point, on account of the presence of the impurity; but that iron which unites at the greatest number of points is the best of its kind, and the kind is determined by the quality of its impurities. It does no good to take soft, soaking heats, unless force can be employed to drive out any such gross impurities as can be expelled by mechanical means, and to bring the particles of iron into close proximity to each other, for the promotion of coherence. By turning the iron, and bringing the pressure to bear in different directions, it is kept open, and the slag has a better chance to escape.

As gun-barrels were formerly welded under the trip-hammer, all these advantages were obtained, and the welding heats that were taken were sometimes so soft that in putting them under the hammer, on the mandrel on which they were to be welded, the rod would go through the side of the "skelp," instead of through the hole, and the workman would draw it back, and get it into the right place, and weld up a sound barrel. If at any stage the barrel was found defective through the fault of the welder, he was charged one dollar, and a new hand has been known to work a month and come out forty dollars in debt. As this was found to occur from the nature of the work, and not for want of intelligence, painstaking and ordinary trip-hammer skill, this injustice was speedily remedied, and measures were taken to prevent it recurrence, and subsequently gun barrels were welded with rolls.

The remarks upon the refining of iron have been made in this place, not only for their bearing upon this particular case, but for their general bearing and for future reference.

The breaking down dies used in making the piece shown at Fig. 1, which struck the first blows upon the hot iron, were so shaped as not to confine the stock too closely at the sides to prevent the expulsion of slag, and this process had a refining effect upon the iron. The amount of stock in each part of the piece was calculated, and its equivalent size was determined in round shape. The head required to make it a cylinder 1$\frac{3}{8}$in. in diameter and $\frac{7}{8}$in. long, the body $\frac{13}{16}$in. diameter and $\frac{7}{8}$in. long, and the tang $\frac{19}{32}$in. diameter and 3$\frac{3}{4}$in. long. The stock descended from one size to another with very round shoulders, as any squareness or sharp corners would have been productive of cold shuts or places where one part of the stock shut down over another part, while it might have been too cold to weld. These corners we made so rounding that there was no chance whatever for one part to shut over another, cold or hot, for if this had been allowed there would have been a presumption, amounting to certainty, that in making great numbers there would be some which would get through the processes unobserved, which would not be welded, and would, therefore, have cold shuts. When a man who thinks life is worth living holds the breech of a gun to his shoulder, he wants to be tolerably well satisfied that the force of the coming explosion will be spent in a forward direction; hence no cold shuts were tolerated.

After the stock was formed in the shape shown in Fig. 1, another good heat was taken on it, and it was dropped in the die shown in Fig. 5. This die was made in the form which is represented, for the purpose of getting the force of the blow on it in every direction, except sidewise, for the purpose of giving to it the shape and dimensions which would allow it to enter the finishing die. A good deal of dependence was put upon what is called the flow of the metal, to bring it to this form, and especially to bring out the hinge lug at the side, and it did, in fact, come to shape as well as if the stock had been melted and poured in. A part of the configuration of the faces was designed in the form exhibited, to prevent the dies from moving endwise in the drop, as they had a part of their work to do by a compression which tended to move the dies in that direction, or to force them apart. They were close dies—that is, the stock was restrained within certain limits sidewise, in order to force up the corners of the work, and this caused a fin to be produced. After this was trimmed off they were dropped in a pair of finishing dies, which were made to take them in sidewise. The impression for the hinge lug was made in the upper die, for the convenience of keeping it free from scale. When the frames had been dropped in this die, and again trimmed, the forging was complete.

The complement of this breech frame was a "cap," which was hinged to it, and could be opened to allow the insertion of the cartridge, and when shut formed the breech block. It was supported at the back by the notch in the frame, and at the front by a ledge on the inside, which reached down a short distance over the front end of the frame. A part of the stock, which had to be cut away, could have been easily removed in the process of forging, but this was one of a great many instances where a piece can be finished to better advantage if stock is left on it to allow the tools to make a full cut. It is rather a difficult matter to drill three-quarters of a hole in a piece, and the job can better be done if sufficient stock is given to drill the other quarter. This piece was blocked out solid from a bar 1½in. square, into correct shape, in one impression, in a pair of dies. They were struck two blows with a heavy drop. Sections of the dies, top and bottom, are shown in Fig. 4. The blacksmith who dropped them was able to gauge the stock so closely that they did not form much fin. When this was trimmed off, the forging was completed by re-dropping them at a light heat.

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* By B. F. SPALDING, in the *American Machinist.*

SUBSTITUTES FOR GUM AND RUBBER.

THE high price of gum acacia has led Trojanowski to seek for a substitute. This he believes may be found in the mucilage of flax seed. By boiling the seed with water and precipitating the strained decoction with twice its volume of alcohol, he obtained a substance which, after drying, consisted of opaque, yellowish-brown irregular fragments, somewhat brittle, but not easily reduced to powder, dissolving in water to a turbid mucilaginous solution. Of this five grains were sufficient to emulsionise an ounce of cod-liver oil. The large quantity of alcohol required for the precipitation and the difficulty of drying the adhesive product are, however, serious objections to this product. The author, therefore, pursued his study of the subject further, and believes that he has satisfactorily solved the problem. He still employs flax seed as the source of the mucilage, but by treatment with sulphuric acid he converts this into a gum more resembling acacia. He directs to boil one part of flax seed with eight of dilute sulphuric acid and eight parts of water until the mixture, which at first thickens, becomes quite fluid. The mixture is then strained through muslin, and to the strained fluid is added four times its volume of strong alcohol. The precipitate is collected on a filter, washed with alcohol, and dried. The alcohol, after neutralising with chalk, may be recovered by distillation, or it may be used for many purposes without distillation. The gum thus obtained is in the form of translucent, greyish-brown, brittle fragments, easily pulverised, and without odour or taste. Thirty grains of this gum will emulsionise an ounce of cod-liver oil, and the product resembles exactly that made by the use of acacia.

Another substitute for acacia, made from starch, has been recently patented in Germany by Schumann. Two hundred parts of starch are boiled under a pressure of two to three atmospheres with 1,000 parts of water and 1 part of sulphuric or nitric acid, until the mixture begins to be fluid. The acid is then neutralised, and the mixture is again treated under a pressure of three to four atmospheres until the starch is completely converted into gum-like substances. After filtering through animal charcoal the solution is evaporated at a low temperature. The product is a transparent colourless substance, which is non-hygroscopic, and has essentially the same useful properties as gum arabic.—*Pharm. Era.*

Under the various names of "almadina," "potato gum," "euphorbia gum," or, more shortly, "E. G.," a peculiar resin of African origin has been of late years gradually finding its way to the European drug markets in steadily-increasing quantities. Hitherto its chief, if not its only, use in the arts has been as a "substitute" for, or addition to, indiarubber, and we learn it is not only much cheaper than caoutchouc, but actually improves the latter when added to it in certain proportions. Among the advantages over pure caoutchouc which mixtures thereof with "E. G." are said to possess, not the least are diminished porosity and greater durability.

THE NEW HYDROCARBON ENGINE.

IN the Scientific News, March 30, we referred briefly to the new launch propelled by means of a highly volatile product of petroleum which was described at the March meeting of the Institute of Naval Architects by Mr. Yarrow. Last week a party of engineers and others interested paid a visit to Mr. Yarrow's works, and inspected four launches he has fitted with improved apparatus. Three of these launches are 36ft. long by 6ft. beam, the fourth being 30ft. long; two of them are steel built and two teak. The propelling machinery consists of an ordinary engine of any well-known compact type, the generator which produces the vapour being placed close to the engine. The generator is small and light, consisting simply of a coil of copper pipe, into which spirit is pumped continuously, and, being converted into vapour in its passage through this coil, which is heated, it passes on to the engine cylinder, and drives it as steam would. Below the vaporiser is a smaller coil, one end of which terminates in a burner, the other end being connected with an air-tight tank containing the petroleum of commerce. In order to start the engine, air is pumped by hand into this tank at a pressure of about 5lb. per square inch, which forces the petroleum into the lower coil. Beneath this petroleum coil is the burner. On turning on a small tap the pressure in the tank forces the petroleum through the coil into the burner below, where it issues forth and is lighted by a taper. A ring of flame is at once produced, which heats the two coils, producing vapour from the lower one, which is burned as fuel, and vaporising the spirit in the upper one, which vapour passes on to the engine. Having done its work there, it passes away by the exhaust to a condensing pipe placed beneath the boat, thence in a liquid form to the tank whence it was originally drawn. It will thus be seen that the spirit is used over and over again, and, being utilised in a closed circuit, there is no loss, and consequently no danger, provided the various connections are kept perfectly tight. The only loss is that due to the consumption of petroleum by the burner, which is put at 1½ gallon per hour for a 4H.P. engine, and this at 6½d. per gallon is not a serious item when the advantages presented by the system are considered. On these boats, with which some very successful runs were made upon the occasion in question, provision is made for a supply of the liquid fuel sufficient for a 24 hours' run. As regards the advantages offered by spirit-vapour propulsion, these launches can be started from a state of rest in about five minutes, or even less in warm weather. The fuel used being the ordinary petroleum of commerce, it can be obtained anywhere, and in some cases even more easily than the coal required for a steam launch. The central portion of the boat being unhampered by machinery, is available for passengers, while there is neither dirt nor smoke. The whole of the machinery, moreover, is self-acting, so that the boat can be taken in charge by anyone of moderate intelligence when once accustomed to the working arrangements. It is stated that about double the power from the same quantity of heat is obtained as compared with steam.

SCIENTIFIC SOCIETIES.

ROYAL METEOROLOGICAL SOCIETY.

THE usual monthly meeting of this Society was held on Wednesday evening, the 16th instant, at the Institution of Civil Engineers, 25, Great George-street, Westminster, Dr. W. Marcet, F.R.S., president, in the chair.

Mr. L. W. Gatward and Mr. N. Simmons were elected Fellows, and Prof. D. Colladon an Honorary Member of the Society.

The following communications were read:—

(1) "Report of the Wind Force Committee on Experiments with Anemometers conducted at Hersham," by Mr. G. M. Whipple, B.Sc., and Mr. W. H. Dines, B.A. A whirling apparatus, with arms 29ft. radius, was rotated by means of a small steam-engine. On the arms of the whirler four different anemometers were placed. Each experiment lasted fifteen minutes, the steam pressure remaining constant during the run. For the Kew Standard Anemometer, with arms 2ft. long, the experiments give a mean value for Robinson's factor of 2·15, and for two smaller instruments the factor is 2·51 and 2·96. Mr. Dines's helicoid anemometer gave very satisfactory results, the mean factor being 0·996.

(2) "On the Measurement of the Increase of Humidity in Rooms by the Emission of Steam from the socalled Bronchitis Kettle," by Dr. W. Marcet, F.R.S. The author described a number of experiments which he had made by steaming a room with a bronchitis kettle, and ascertaining the rise and fall of the relative humidity from readings of the dry- and wet-bulb thermometers. He found that the air in the room could not be saturated, the relative humidity not exceeding 85 per cent.

A TORPEDO range at Horsea Island, Portsmouth, costing £100,000, has just been completed and taken over by the Vernon Torpedo School. The range, some half-mile in length, has been constructed for experimental purposes in connection with the discharge and flight of torpedoes, and with its canal, lock, keys, wharves, tramways, firing pier, and offices, forms a prominent feature in the view of Portsmouth Harbour as seen from the surrounding heights.

SCIENTIFIC NEWS.

THE death is announced of Mr. W. M. Kerr, one of the explorers of Africa, and a traveller in the Far West and Mexico. His "The Far Interior" contained the account of a journey from the Cape of Good Hope to Lake Nyassa and down the Shiré and the Zambesi to the sea.

Small planet No. 274, discovered by Dr. J. Palisa, of Vienna, on April 3, has been named Philagoria.

Last Friday, at the Royal Institution, M. A. Renard, Curator of the Royal Museum, Brussels, delivered a lecture on "La Réproduction Artificielle des Roches Volcaniques," in the course of which numerous illustrations of the progress of crystallisation in vitreous rocks were thrown upon the screen, showing the curious forms they assume according to the temperature. The lecturer explained the means by which Sir James Hall, Gregory Watt, Fouqué, Michel Levy, and other experimenters were able to develop all the required degrees of temperature, from dark red to blinding white, and to maintain the temperatures for indefinite periods. In spite, he said, of the splendid achievements of synthetical geology, success was still incomplete. Rocks containing mica, quartz, hornblende, and the acid rocks in general, so far defied their efforts; but he expressed the opinion that the time would come when the rocks which were at present proof against the efforts of science would be reconstituted. Thus would be crowned the work of which Leibnitz had already, two centuries ago, obtained a view, for he wrote, "The man who will compare carefully the products wrenched from the depths of the earth with those of the laboratory will do a great work."

To-night, at the Royal Institution, Mr. Francis Galton lectures on "Personal Identification and Description"; and next Friday, Prof. J. A. Ewing is to lecture on "Earthquakes and How to Measure Them."

At the recent meeting at Washington of the National Academy of Sciences, Prof. H. A. Newton read a paper on the orbits of aërolites in which he submitted two propositions—first, that the meteorites which we have in our collections, and which have been seen to fall, were originally (as a class, and with a very small number of exceptions) moving about the sun in orbits that had inclinations to the Ecliptic of less than 90°—that is, their motions in the solar system were direct and not retrograde. Secondly, that the reason why we have only this class of stones in our collections is not a reason wholly, or even mainly, dependent on the habits of men; nor on the times when men are out of doors, nor on the places where men live; nor on any other principle of selection acting at or after the arrival of the stones at the ground. Either the stones, which are moving across the earth's orbit in the solar system move in general in direct orbits, or else, for some reason, the stones which have retrograde orbits do not in general come through the air to the ground in solid form. The Lawrence Smith gold medal was presented to Prof. Newton for his study of meteors, and the Henry Draper gold medal to Prof. E. C. Pickering for his researches in stellar photography.

The "interesting surgical operation" referred to on p. 233 turns out to have been a case of nerve transplantation—from a rabbit to a man,—Prof. Fleischl, the distinguished occupant of the chair of physiology in the University of Vienna, and the operation was performed by Dr. Gersung on March 4th last. Dr. Gersung postponed publication of the case until reasonably assured of its success. Sixteen years ago Prof. Fleischl accidentally wounded himself while conducting a *post-mortem* examination, and severe inflammation of the whole right upper limb ensued. During the course of the disease the terminal phalanx of the thumb became gangrenous. The stump thus left was painful, and later on re-amputation was performed. This was followed by the formation of neuromata (little tumours on or between the fasciculi of a nerve). From time to time various operations have been performed without success, and latterly, the pain having become severe, the patient wished to undergo another operation. The Vienna correspondent of the *British Medical Journal* sends the following verbal account, which he has received from Dr. Gerung: The patient was put under the influence of chloroform, and the neuroma, which was situated behind the volar carpel ligament, was excised, the nerve being cut through behind the neuroma. The peripheral nerve stumps of the two digital branches were then sought for. A rabbit was now killed, and as long a piece as possible of the schiadic nerve of the animal, with the two branches into which it becomes divided, was dissected from it (the animal still presenting voluntary contractions). The schiadic nerve was afterwards inserted into the space between the central stump of the median nerve and its digital branches; the central end of the schiadic nerve was sutured to the connective tissue which covered the median nerve, and the two branches were sutured to the digital branches of the median nerve; the portion of nerve, measuring about six centimètres, which was deficient, was thus made up. After the operation severe pain persisted for some hours, but then entirely subsided. Healing took place by first intention.

The use of drying apparatus for the preservation of hay and other crops in wet weather does not seem to have much extended; but the inventor of some of the most valuable of those appliances has lately turned his attention to the production of pure hot air, mainly for use in the tea-growing districts. In pursuit of this object, Mr. Gibbs, of Chingford, Essex, has, it is stated, succeeded in producing pure hot air from the combustion of coal. His apparatus consists of a brick chamber, about 5ft. long by ft. wide and 2ft. high. At one end is a feed chamber and a fuel chamber, and at the other powerful exhaust and blast fan. Placed intermediately between the chamber and the fan are baffle plates, splitting plates, a standing bridge with perforations at the back, and a hanging bridge with perforations at the front. There are also several carefully-proportioned inlets to supply the exact quantity of air requisite for perfect combustion. Another point is the exact relative proportion of the fuel chamber to the feed chamber and of both to the volume of air drawn per minute by the fan. Issuing from a fan mouth 12in. in diameter comes rushing a column of hot air, marking on the pyrometer at its exit a steady uniform temperature of 500° Fahr. Not a trace of smoke or fume was visible to the eye; but when the fan was stopped, a dense cloud of thick smoke rose up from the coal in the feed chamber, charged with suffocating fumes. On restarting the fan it was quietly drawn in again, but not a sign of smoke appeared at the exit from the fan. Mr. Gibbs suggests as an explanation that the water contained in the coal is decomposed into oxygen and hydrogen, and that the hydrogen in burning adds to the heat of the resultant air, while the oxygen, reinforced as it is by that obtained from the large volume of fresh air admitted at the various inlets, decomposes and purifies all the products of combustion. It is not easy to understand, though, what becomes of the sulphur, which is usually present in ordinary coal.

A number of members of the Civil and Mechanical Engineers' Society went to Wolverton recently to inspect the steam tramway between that place and Stony Stratford and Deanshanger, a distance of about four and a half miles. The regulations of the Board of Trade prevent the construction of light railways at a cheap rate, and railway companies must look to steam tramways as feeders. The success of the Wolverton branch seems to be assured.

The French War Office includes among the new defensive measures contemplated a system narrow-gauge railways to connect five of the x forts round Belfort. The roadways of these nes are to be sunk sufficiently below the surface to protect the trains from an enemy's fire.

The first railway in the Holy Land is about be constructed from Jerusalem to Jaffa.

A neat bit of doubtless unintentional sarcasm has been perpetrated by an American inventor, who has patented an "improved passenger railway car" with detachable and buoyant side panels, so that in the event of a bridge breaking and precipitating the coaches into a river, the passengers can readily detach the panels and use them as life-rafts.

A paper "On a New System of Telephonic Communication between Trains in Motion and Neighbouring Stations," by M. P. Germain, was read at a recent meeting of the Paris Academy of Sciences. A series of electric measurements effected on rails from the standpoint of their resistance, insulation, and diffusive electric power, has satisfied the author that the two metallic parts of the same line connected together constitute an excellent conductor, provided the circuit and battery are insulated from earth. He has established curves of resistance for the rails according to the variations caused by the temperature and by the humid condition of the ballast. A new line shows less resistance than an old, owing to the oxidation of the points and the slow transformation brought about in the molecules of steel under the influence of vibration. By setting up the necessary apparatus in the stations and in the guard's van, telephonic correspondence may be carried on in both directions.

At a recent meeting of the Linnean Society Dr. F. Day exhibited specimens of Loch Leven and sea trout raised at Howietoun to illustrate his observation that the markings usually relied upon to distinguish the species are not constant, and, therefore, taken alone, are of no value for the purpose of identification. He also exhibited specimens of trout from Otago, N.Z., descendants of some which had been introduced there, presenting some curious modifications of structure.

The new building for the College of Science, Newcastle-on-Tyne, is being proceeded with rapidly, but some time will elapse before it is completed. It is being erected on the site of some old gardens at the north end of the town, not far from the late Jubilee Exhibition. Prof. Garnet is the principal.

The tunnel under the St. Clair river will, according to the report of the Canadian Minister, be a rather formidable piece of engineering work, for it will be about a mile long, and half of that under the river. It is to be cylindrical in section with 20ft. clear diameter, the greatest depth of water over the tunnel being 40ft. The middle 1,500ft. is to be level, with a gradient of 1 in 50 at each end. The total length of tunnel and approaches will be 15,150ft.

At the recent meeting of the Physical Society, a paper by Profs. Ayrton and Perry was read on a "Simple Apparatus for the Measurement of the Coefficient of Expansion by Heat." The apparatus consists of a metal tube within which the wire or rod, whose coefficient is to be determined, is placed. One end of the wire is rigidly attached to one end of the tube, and the other end connected to an Ayrton and Perry magnifying spring, a pointer attached to which indicates the change of length due to alteration of temperature. Steam or water may be passed through the tube, the temperature of the wire being shown on a thermometer. The arrangement is very sensitive, and with a pointer about 20cm. long the motion is magnified about 1,000 times. A magnifying spring attached to an aneroid was also shown and its great sensibility demonstrated. A combination of a spring of large diameter and pitch, with one of small diameter and pitch was exhibited. By such a combination small rotations can be immensely magnified. The great features of the patent spring as a magnifier are the entire absence of friction and backlash, and the large range of proportionality.

M. Marambet, in a communication to the Paris Academy of Medicine, states that after examining 3,000 convicted criminals he found that of the vagabonds and the mendicants 79 per cent. were drunkards; of the assassins and incendiaries, 50 and 57; of robbers, 71. Of those convicted of crimes against the person, 88 per cent.; and those guilty of attacks on property, 77 per cent. were alcoholics. Of 100 criminal youths under 20, 64 are already drunkards. Drunkenness has greatly increased in France since the consumption of spirits has supplemented that of wine.

General Prjevalsky will start in August on his fourth journey in Central Asia. He will be equipped for two years' travel, the ultimate destination of his expedition being Lhassa, the capital of Tibet. The General will be accompanied by an escort of 28 persons, including twelve Cossacks, and two scientific companions, Lieutenant Robrowsky and Sub-Lieutenant Koslow.

LETTERS TO THE EDITOR.

◆

[*We do not hold ourselves responsible for the opinions of our correspondents. The editor respectfully requests that all communications should be drawn up as briefly as possible.*]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, *332, Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

⁂ *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."—*Montaigne's Essays*

◆

CHEOPS AND HIS PYRAMID.

[28760.]—THOUGH Euclid nowhere, I think, proposes as a problem to make a right-angled triangle whose three sides are in geometrical progression, his cutting of a line in "extreme and mean ratio" made this easy. If the longest and shortest sides are as the two parts of such a line, and we make the third side their mean proportional, we get the triangle of "M.I.C.E.," p. 238, letters 28735—28738, or his angle, whose sine and cosine equal its cotangent and tangent. He points out two singular properties of this, and there is another in the square pyramid with that slope which the very first describer of the Cheops Pyramid, Herodotus, seems to have known, or at least, to have heard of. Perhaps he did not quite understand what the guides told him, for his statement that "each face of the pyramid contains 8 plethra, which is also its height," makes no sense. It was like a modern writing "each face contains 5 acres, which is also the height." Critics assume that perhaps he wrote "the squared height," and the word *squared* has dropped out.

It is no longer possible to decide whether the Great Pyramid's slope came nearest to this or to either of two other angles very near it. Less than one minute higher is the angle whose sine : cosine :: 14 : 11, and again, less than three-quarters of a minute above that is the angle whose cotangent = the arc of 45°, which would make the circuit of the base = the circumference, whose radius was the height. Now, 6in. of difference in the pyramid's height would include all three of these theoretical forms, as will appear if we take the base as 440 cubits, and reckon the three heights by ten figure logarithms, thus:—

	°	′	″		Cubits.	Inches.
The circle-squaring angle	51	51	14·1	...	280	2·2
The arithmetical angle	51	50	33·9	...	280	0·
The Euclidean angle (of "M.I.C.E.") ...	51	49	37·6	...	279	17·

Though each cubit is 20·75 of our inches, I here suppose the last one divided into 20, for English understanding.

You see that, since 1839, when Col. Howard Vyse, or his surveyor, Perring, after discovering the last three remaining blocks of the footing, neglected to measure them accurately, and left them unburied, to be chipped to pieces by relic-hunters, there is no longer a possibility of knowing to a foot, or even a yard, the original height. The faces of those blocks being 7ft. deep, and finished almost like a mirror, their angle, even to a minute, was then knowable; but it was not taken, and the secret is gone for ever.

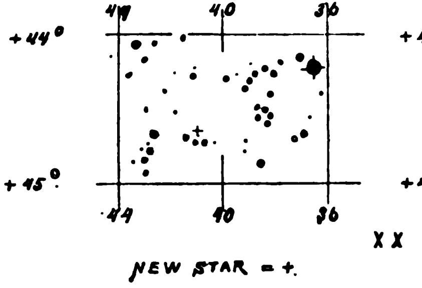
An examination of all the angles accurately taken, however, in other Egyptian works will show that they invariably defined them (like our engineers) by some simple ratio between base and perpendicular. The three passage angles quoted by "M.I.C.E." on p. 238 were doubtless all meant to be two horizontal to one vertical—that is, 26° 23′; but Mykerinus and Kephren built with more mortar than Cheops, and the settlement has made their angles lower. His entrance passage is now indeed a few minutes above 26° 31′, but the next, the ascending passage, is only 26° 18′; for I note, with Lord Grimthorpe, that the entire hill has had a tilt. The builders of Cheops cannot have raised all the walls of his chamber out of plumb, as they are. The earth's crust there has been tilted since his time—perhaps gradually, perhaps suddenly—by the shock that broke every one of his ceiling beams across, we know not when.

All those passages were designed "2 to 1," and the outer slope of Mykerinus's pyramid was nearly as simple—4 horizontal to 5 vertical. That was the last but two, I hold, of all pyramids. Perhaps he and his two successors were all aiming at the Euclidean angle of "M.I.C.E.," but there was not then, seven centuries before Euclid, geometry enough to solve the problem. Kephren building next, on lower ground, not only doubled exactly the side of his predecessor's base, but finding the desired equality of each face to the square of the height had not been hit upon, increased the slope to 7 horizontal to 9 vertical. This was found to err the other way, and when the last of all pyramid builders—Cheops—planned his on still lower ground, but so as to bring its apex to the level of that of Kephren, his architect took the simplest way of going between the two slopes that had been found in opposite errors. He added together the base-figures, 4 and 7, making 11, and the same with the height figures, 5 + 9 = 14. The final Cheops slope was thus made 11 horizontal to 14 vertical, or the base and height of pyramid as 11 to 7, each of which, multiplied by 40 cubits, gave its dimensions, the side of base 440, and height 280. That this gave a height within 8in. of the Euclidean angle, and within three also of the circle-squarer's angle, and between the two, was one of Nature's freaks of coincidence.

E. L. G.

THE NEW RED STAR NEAR α CYGNI.

[28761.]—I INCLOSE herewith a tracing from Argelander, showing the position of the red star found here on May 8th. The large star is α Cygni, and the red star will easily be found from its configuration with the wide pair (D.M., mags. 8.3 and 8·7). As stated in *Circular* No. 20, it is not in the D.M. On the night of May 8th it was 0·1 mag. brighter than the *p.* star of the wide pair south, and, consequently, 8·1. These magnitudes are probably overrated in the D.M.



NEW STAR = +.

Mr. Knott finds the place of the new star approximately as follows:

R.A. 20h. 41m. 4·5s. Dec. + 44° 19·7'.

My first observation gave me from α Cygni:

R.A. 20h. 41m. 10s. Dec. + 44° 19·6'.

My second observation, May 9, from the first star of the pair:

R.A. 20h. 41m. 6·7s. Dec. + 44° 24·2'.

It seems probable that some slip was made in reading the declination circle on May 9.

A small companion to the red star was detected with a power of 200 on May 9. A rough estimation made it:

P = 250° ±. D = 12" ±. Mag. 13·0.

The distance may be over-estimated, as it is not visible with a power of 70.

The spectroscope does not yield any certain information about the spectrum of the star. It is obviously not a continuous spectrum; but whether III. type or IV. type I have not been able to make out. Last night I thought the spectrum probably III. type, with very wide, but not deep, bands.

The colour of the star is red, or orange-red.

T. E. Espin.

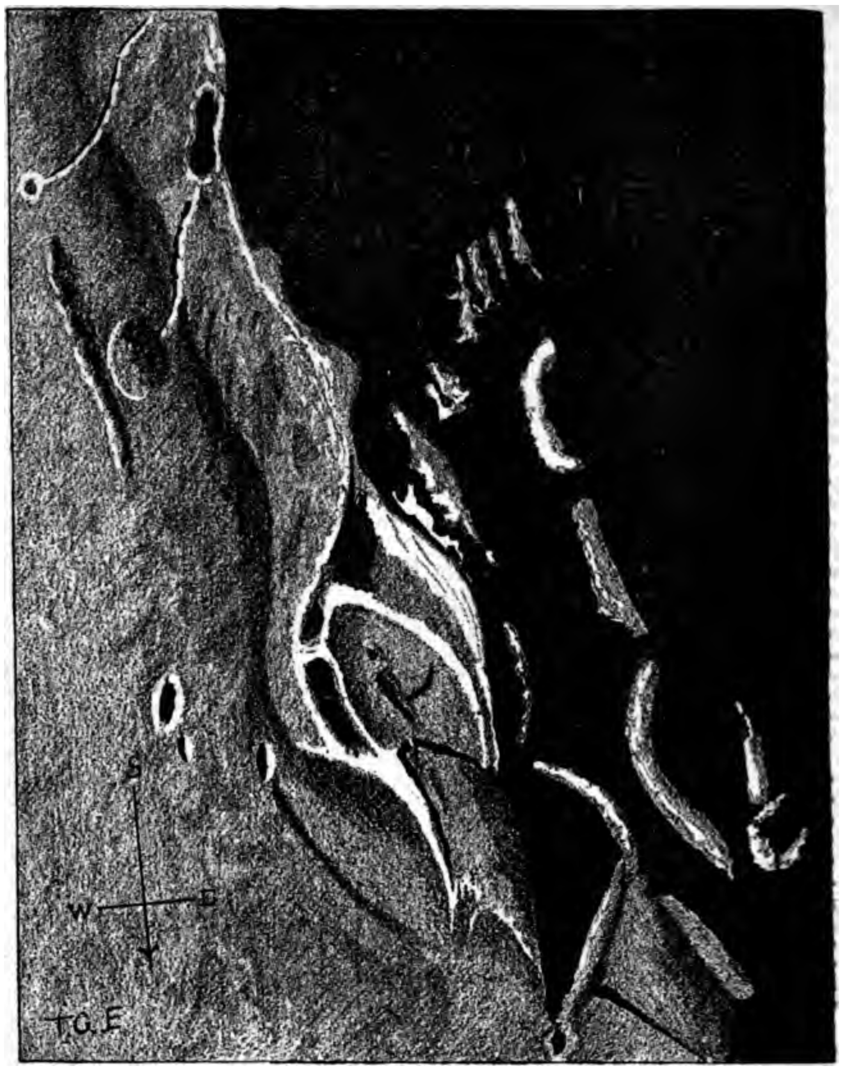
Wolsingham Observatory, Darlington, May 12.

A MOCK SUN.

[28762.]—AT 9.5 this morning (May 12) my attention was called to the curious appearance of the sun, and on going to the window, I saw what I at first thought was a mock sun. The sun was shining in a hazy sky, and just below it a rather smaller and redder disc appeared—the interval between them being about equal to the real sun's diameter.

I found on moving my head that the lower image moved about, and concluded that it was in some way due to double refraction of the glass, such as occurs when looking through Iceland spar. The angle made by the line of sight with the window-pane was 89.° Has this effect been noticed before?

Glatton.



DAMOISEAU.

[28763.]—IN response to the request of "Ajax Oileus," I forward a sketch of this curious formation, made between 8h. and 9h. on December 27th, 1887, with a power of 250 on my 8½in. Calver reflector. I had some difficulty in making out the details on the floor at this stage of illumination; but the crater shown by Schmidt near the southern side of it, what appeared to be a shallow valley north of this, and a ridge running up to the east wall were noted. The great crater-rill extending in a northerly direction from Damoiseau B, and a more delicate rill south of this, were easily seen.

Thos. Gwyn Elger.

Kempston, Beds, May 16.

TURRET CLOCKS.

[28764.]—HAVING a new turret clock, three dials, each 4ft. diameter, without striking gear, by W. H. Bailey, Manchester, I could give Mr. Carre (28731) the number of teeth in each wheel, if it is of any use to him. All the gears are brass, of fine pitch, and are all cut by machine—no easy work for an amateur, unless he has special facilities.

Vulcanite.

[28765.]—ALONG with Mr. Fredk. Carre I read with interest Wm. Marson's able description of the clock maintaining power. The system is very generally used in high-class turret clocks and even in regulators. I am surprised that such a beautiful movement has never before, to my knowledge, been described in your columns. The inventor is unknown. Reid in his book describes it, he having taken the description from a French work published in 1741; but it is evident that in Reid's time the correct proportions were not so well applied as they are now.

In most of Cooke's magnificent turret clocks, and doubtless in many others, this system can be seen in all the perfection of design and workmanship. What I never could understand is that Beckett's work ignores it, but describes others that cannot hold a candle to it.

In reply to Mr. Carre, I would not advise his purchasing Reid's book; it is out of print, bad to meet with, and expensive. It is not a practical work in the sense he desires. It is a scientific treatise, heavy reading, and for calculations a skull-cracker. In Beckett's book there is more practica information condensed than in all the other horological works I have met with. If our esteeme querist has thoroughly digested that, can use lathe and a file, and has a true mechanic's sense o proportion, a small turret clock is certainly withi his capacity. His previous questions to which h refers I have not seen.

Tuebor.

THE ISOSCELES TRIANGLE.

[28766.]—THE little difficulty our frien "M.I.C.E.," has met with in the isosceles triangl may be overcome by the following consideratio When the base of the isosceles triangle is equal t the sum of the equal sides, the vertical angle wi be 180°, and the inscribed circle will be a point i the middle of the base: now, as the vertex slide on the perpendicular, the sides always being of th same length, the vertical angle will decrease i magnitude until it becomes 60° and the triangl equilateral. As the sides continue to approac each other, and the vertical angle to become le than 60°, the centre of the inscribed circle wi move downwards to the base, and it will coincid with its first position when the vertical angl vanishes. Hence, in all those isosceles triangl whose equal sides have the same length, the equilateral will have the greatest inscribed circle.

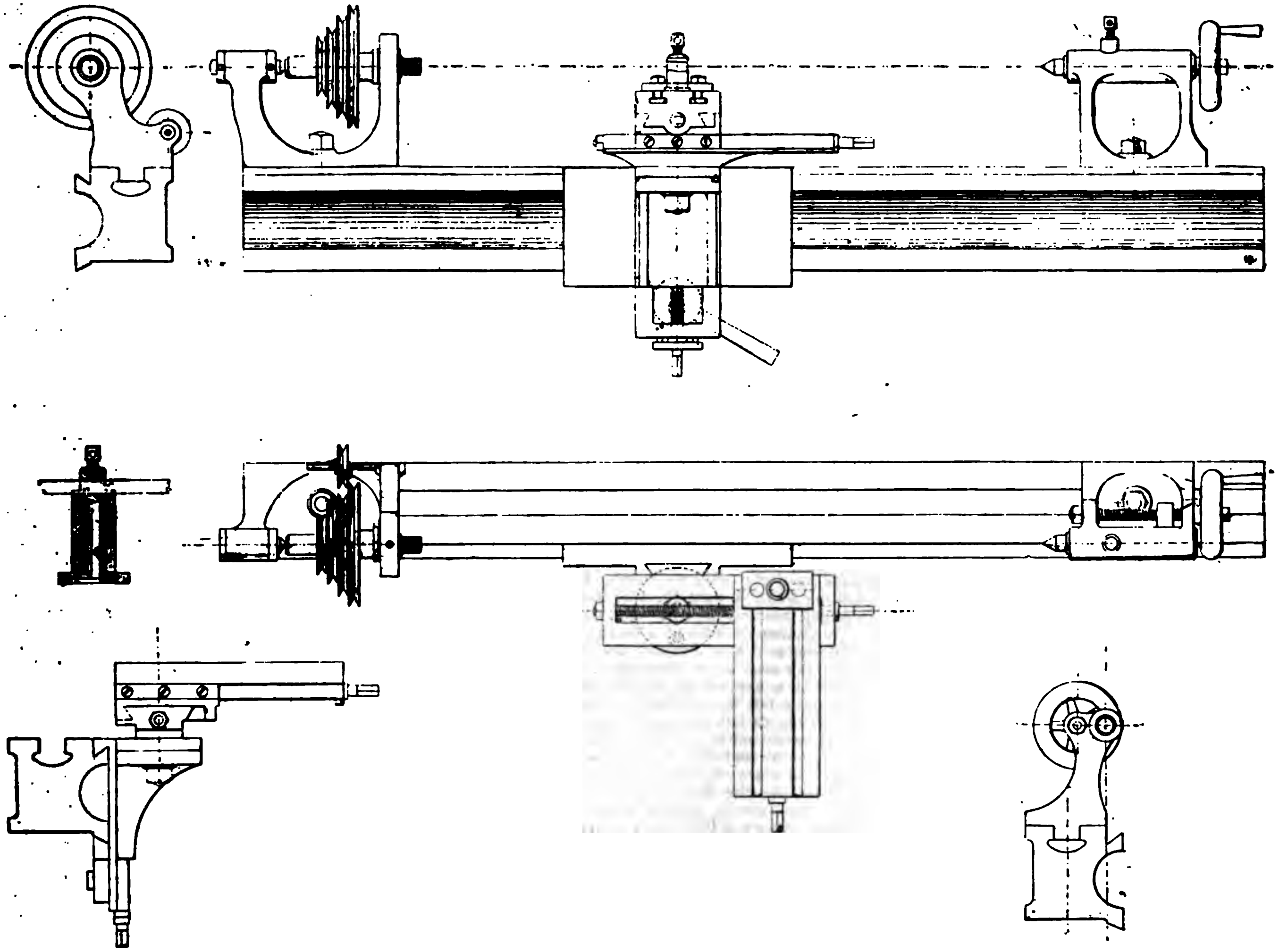
Again, as the centre of gravity in an equilater triangle coincides with the centre of inscribe circle when the vertical angle is 100, it will descend the perpendicular as the vertical angle becomes less, and will meet the centre of circle whe the vertical angle becomes 60°. Afterwards it wi rise, and as the centre of gravity is always at th intersection of the bisectors of the sides when the coincide with the perpendicular, the point of intersection and the points of bisection will co together.

L. S.

PRICE'S "UNIVERSAL" FRONT-SLID AND GANTING HEAD LATHE.

[28767.]—THE bed is 8½in. wide and 8½in. dee so made that a leading screw can be applied wanted for screw-cutting, and has webs every 6i of its length. The metal is distributed to give lightness and strength combined.

The head and poppet are made so that the li of centre will be parallel with the edge of the be



The mandrel and collar are of the best cast steel and carefully hardened. The mandrel is hollow, 2⅛in. deep, 5/16in. diameter, nose ⅝in. Whitworth's driver chuck is of gunmetal, with steel centre: drill or cutter chuck is ¼in. bore. Cone pulley has four speeds.

The poppet has a steel cylinder mandrel, and it is so arranged that the hand wheel does not project beyond the barrel of the headstock, so that the front slide will pass the poppet without it being loosened.

The front slide is fitted so that it will slide along the front of the bed, and can be locked instantly by a cam lever; the vertical slide is well fitted to saddle and arranged to rise and fall, has steel square-threaded screw, and gunmetal nuts.

The slide is fitted to vertical slide bracket and indexed to take any angle; the transverse slide is made and arranged with two T-slots, and is 8in. long and 8in. wide. All the slides are carefully ground in, and are as firm as if they were of one piece of metal. The tool-holder is on Willis's principle, and can be placed on any part of the T-slot table, and is supplied with two T-rests and socket.

The standards are of the best form to give it stability and strength without being cumbersome; the crank is of forged iron with steel ends for centres. The flywheel is accurately turned, and has three speeds. Treadle motion is light and strong. The whole lathe is so easily worked that a child can run it. Approximate weight about 2cwt.

Whereas an ordinary slide-rest lathe can only be applied to turning, this lathe can be applied instantly to milling of every description by simply putting the cutter between the centres of the lathe and bolt the work to the table, the cut can be adjusted to a nicety,

This lathe can be applied instantly to the following work, and will save its cost in a few weeks in time and files. It can be applied to any description of work, and it will do the work of six different machines in one.

The front slide has an enormous advantage: it can be put out of the way and replaced instantly, and is always at hand.

Having a vertical slide fitted to saddle, the depth can be adjusted, and the tool can be raised and lowered according to the diameter of the work, and therefore does not require packing as in a slide-rest lathe.

Poppet traverse screw is arranged out of the side of poppet, so that no chips will get into the screws, and the barrel is full length of the head-stock, so that it will not spring when a heavy cut is taken.

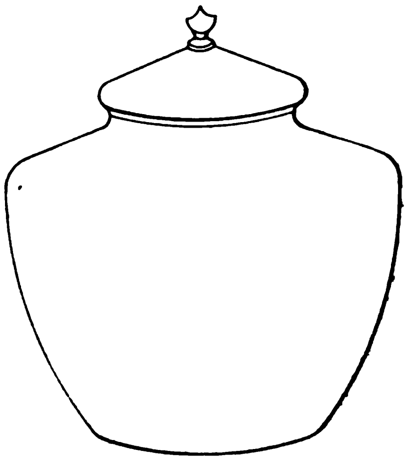
1. The vertical slide has a fall sufficient to cut gear wheels 8in. diameter, and will cut them as small as ¼in. diameter.
2. The lathe will turn and cut up its own cutters any form according to shape required.
3. Most handy to mill up hexagon nuts and bolts to uniform sizes.
4. To mill up cams of any shape, face, or barrel.
5. For milling up key seatings in shafts.
6. Drilling and dividing hubs for tricycles and bicycles the same time.
7. Profiling steam ports of cylinders.
8. Profiling quadrant links of locomotives.
9. Milling the bearings.
10. Cutting slots in screws.
11. Shaping cranks.
12. Fluting taps and rimers.
13. Milling grooves in dies.
14. Fluting drills that will cut equal to Morse.
15. Mill up slides for any machinery, and many other useful work too numerous to mention in this specification.

Anyone with ordinary skill can do all the work on this lathe without a vice or file, as it can be machined throughout.

102, Teviot-street, Poplar, E. **R. Price.**

METAL SPINNING.

[28768.]—MY last letter contained a misleading addition to the title. I had written the word spinning at the head, but lack of time compelled postponement. The purchase of Lukin's book on turning, with its chapter on spinning, and well-deserved praise of this pretty art, revived an old desire to practise it, baulked on a former occasion by failure to procure proper burnishers. Though I might like to underline certain passages, I am not in a position to add to his directions, but I am able to suggest an easy and useful exercise suitable to the thin metal, which is safest for a beginner, and that is to turn wooden stoppers for jars and such things, and cover them with sheet brass. An old ginger jar thus supplemented becomes, if not a drawing-room ornament, at least a respectable member of society; the little knob at top is turned out of the solid. In this connection read Mr. Sweet's remarks on the little difference between a good and bad *line* ("E.M." page 231), and don't make the section of your jar cover or any other curve either of circular arcs. I should be glad to hear more of Mr. Sweet. After spinning, the other lathe matter which has taken me from the pole is screw-cutting. My lathe is a common-looking 4½in. lathe, bought for me in Southwark by a friendly brass-finisher for £7 10s., but I have no fault to find with the work. A Cushman chuck hardly ever leaves the mandrel nose, unless to give place to a taper screw for plank wood or a main chuck, on to which screw various sizes of iron gas barrel sockets, most useful and economical chucks for endless purposes. This is but a prelude to saying that I have rigged a device thereon, whereby the difficulty of screw-chasing bids fair to be abolished, but for the present it is not quite in condition to see daylight.



W. A. S. B.

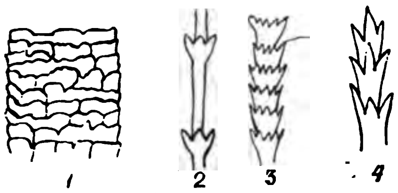
EVOLUTION.

[28769.]—"DENS," on page 89, asks whether there is any reliable information to show that mankind were ever in any way different from what they now are? Such information, I believe, does not exist.

Contrasting the skeleton of the so-called primitive man with that of a recent man, no real difference is manifest, except perhaps that the bones are rather larger and coarser in the former. In size of brain, also, there is very little difference —in fact, we cannot say that any of the skeletons of men as yet found are any nearer the apes than we ourselves are. This, of course, refers to structure, not mental power. So, in structure of adults, there is no connection of man with monkeys. But, when a fœtus is within two or three months of being born its body is covered with a long, thick crop of hair, called lanugo, closely resembling the hair of the anthropoid apes, and, at a younger stage, it can hardly be recognised from a monkey fœtus. So this points to a hairy ancestor.

Another proof of a hairy ancestor is that now and then people are born completely covered with hair. There is no actual proof that these hairy human beings are the representatives of our common ancestor; but, by taking a parallel case in which there is proof, we can see that there is a very strong probability that such is the case. One parallel case is mentioned by Darwin in his "Origin of Species," pages 18-19, in which he crossed some white fantails with some black barbs and a barb with a spot; he then crossed one of the mongrel barb-fantails with a mongrel barb-spot, and the result was a pure rock pigeon, the rock pigeon being the ancestor of other domestic pigeons.

Might I also ask "Dens" in what way the hair of man is different from the hair of monkeys, pigs, cats, or sheep? To me they have always seemed very similar, all looking like a pile of bowls, whose edges are serrated. The accompanying cut will show what I mean. Fig 1 is a human hair, Fig. 2 is the down of the eider duck, Fig. 3 is a hair from the Indian bat, and Fig. 4 is the hair of a caterpillar. They are so similar in structure that the difference can be put down to what Darwin calls "correlated variation"—that is, that it is due to the difference of organs, tissues, &c., of the different animals to whom the hairs belong. A very curious instance of correlated variation is shown in the parasites of the different animals, which are very liable to variation when placed on another animal.



Those who write to the "E.M." fall, I think, under the following sets:—1. Those who believe that every animal, or at any rate every species, was separately created. 2. Those who believe in one starting point of all animals, which was created, and that improvements were from time to time given it by a Creator; and, 3. Those who believe that life was made by inorganic means, and which was, by a law yet undiscovered, subject to variations. Of these three theories, I think the third is the most probable, for the first two have a past to support them: they rely merely on records written by ignorant men—as the savage of even these days puts down the rustle of the leaves or the fall of a stick to a spirit, so they put down things inexplicable to them to a god. The religion of a thousand years must surely fall if in the laboratories of to-day there is produced a compound which will live, like one of the Monera. And Science is leading up to such a point; she has produced compounds, formerly made by plants and animals alone, such as the poisonous base of hemlock and many others—and why not also protoplasm?

Satine.

SURVIVAL OF THE FITTEST.

[28770.]—"E. L. G.," 28723, p. 235, should take to heart the safe old proverb about looking before you leap. The fascination of a mare's nest is very great, no doubt; but a little caution is useful. He proclaims that this is an inopportune time for maintaining, like "Sigma," "that Australia has inherited naturally its fittest animals." But I said nothing of the sort. A reference to my letter, p. 193, will show it headed "*Survival* of the fittest," not inheritance, or evolution, even. The fact which I had in view, and wished to impress, was that the native animals of Australia are purely a *survival* of animals over the world many an age antecedent to the existence of those now found in the rest of the world, and that these indisputable facts show that they must have been isolated long ages before that period of 5000 years ago of which "E. L. G." is so fond, and were not destroyed by *any cataclysm* at that period; for, of course, though it may suit "E. L. G." to try and twist a meaning to suit himself, out of the words, "all in whose nostrils was the breath of life, of all that was in the dry land, died," common sense and the whole account will tell any one else that these words mean what they say—the total destruction of all breathing land creatures. It is mere childishness to talk about creatures surviving, floating on driftwood, and so on, under torrents lasting for many days, so violent as to wash away the surface of the earth and altogether modify its form—according to "E. L. G."—and without food for a long period.

But we have another closely related fact to take into account. On the neighbouring land of New Zealand there has not remained a single inhabitant: when discovered it did not contain any quadrupeds at all. This is readily understood in the light of successive submergences at vast intervals of time. At the last submergence, if New Zealand were wholly covered, its animals would have perished entirely. In Australia, with its highest mountain districts remaining, the larger animals of the mammoth kind, if they existed, may well have found the conditions of life unsuitable ages before the smaller animals were much affected by the gradual reduction of the available land; and at the extreme submergence they might easily have maintained existence so as to repopulate the Continent on its emersion with the same races of animals which had existed there at the earlier geologic epoch, everywhere else destroyed or superseded by more advanced types, much as the rabbits are threatening to treat the survivors in Australia.

Those rabbits have, however, nothing to do with the subject; and, moreover, I had them in my mind when I said (p. 193) that the marsupials might probably be the best suited to Australia, "until man's advent altered the conditions of existence." For civilised man's advent did profoundly alter those conditions: under my own observation the whole aspect of vast tracts was changed, not by cultivation, but by the ceaseless treading, eating, and manuring of the grass by the vast herds and flocks. The old grasses vanished, and were replaced by new kinds, dry beds of streams were changed into overflowing springs. Then came the further effects of timber-clearing and agriculture, which made the country very different by the time the rabbits came from what it was in the older times.

I may just remark in reply to "E. L. G.'s" animadversions on my letter, that I in no way "mislabelled" it. I wrote, as I have often done before, under the stimulus of that sublime air of cool omniscience with which he sets down anyone of an average modesty. It was his mere assertion that the world would be in a glacial period now if there were only 90 per cent. of the present water or air (p. 169), a matter about which he really knows only just as much as anybody else, and that is nothing at all; his equally cool assertion about the "obvious non-survival of the fittest on any land disconnected with Asia," was the text of my letter, and justifies its heading. It is introducing an altogether new problem to talk about rabbits and sparrows; the fact that later immigrants drive out the older races may show, as I remarked, that there had not been an evolution of the races best suited to the circumstances; but the survival of the fittest can only relate to those in existence when connection with the rest of the world ceased.

I have a little piece of information to ask of "E. L. G." It appears that the Glacial period existed, and the mammoths managed to endure it; the Flood came, and they all took to swimming away south (I do not vouch that); but this rush of water, which carried off the poor mammoths, was, it appears, hot water. Now, granting that it had to melt glaciers in order to end the Glacial period, I cannot see how these mammoths got frozen in. I see it is stated that they were swept from the Temperate region northwards; but I have not heard that the complete examples show any signs of having been parboiled before freezing, and I do not see why the water should rush northwards. Surely, if immersed in condensing vapour, there should have been an excess supply at the colder poles rather than in the hotter regions.

Further, I do not see any impertinence in a "Sigma" (no more anonymous by the bye than an "E. L. G.") asserting that no Deluge destroyed the animals of Australia. *They are there to this day*, surviving from days many times 5,000 years ago; how, then, can they have been destroyed?

Sigma.

OLIVE-TREES AND THE DELUGE.

[28771.]—In letter 28723 "E. L. G." says, in effect, that the fact of the dove having found an olive in leaf proves that some land had not been submerged. He is not aware that olive-trees will live and flourish under water for a long time.

J. R.

PICTORIAL COMPOSITION.

[28772.] — Your correspondent, "Avicula," p. 258, expresses a wish for further remarks on colour. I regret that I cannot at this moment quote chapter and verse; but John Ruskin, in one of his very best and truest passages, points out that white paint is the artist's highest approach to nature's sunlight, and that black paint is the artist's lowest approach to nature's deepest shadow. He shows that white paint is black almost as compared with sunlight, and that black paint is light as compared with nature's utter darkness. The artist's genius is proved by his succeeding with, or in spite of, his miserably limited range of intensities of colour in producing powerful pictures even of such apparently impracticable subjects as effulgent skies and seas of molten ruby and gold. For example, Turner's "Polyphemus" and "Old Temeraire." Ruskin shows that Claude de Lorraine contented himself with simpler and fewer transitional stages between his yellow suns and his dark foregrounds. while Turner attempted the much higher and more difficult task of proportioning his expenditure of effect according to the necessarily limited range of human means, so as to include in his scenes gradations and effects which the great Claude neither perceived nor aspired to.

F. C.

"FORCE" AND "ENERGY."

[28773.]—While recognising the generosity of "F.R.A.S.'s" defence of Mr. Clodd (and Grant Allen, on whom Mr. C. relies) against Wm. J. Grey, I submit that the last is doing the right thing in protecting the interests of Mr. Clodd's readers. We can very well imagine what "F.R.A.S." would say if someone wrote a chapter bearing on astronomy in which special and utterly unheard-of meanings were given for a special purpose to right ascension or to parallax, for instance. Why should a privilege be conceded in dynamics to one who is evidently not a dynamicist, which "F.R.A.S." would not claim for himself in astronomy, though he *is* an astronomer? "Force" has had, indeed, a variable meaning in dynamics; but that does not entitle every person to give it his own arbitrary and totally new application or limitation. But "energy," since its introduction into dynamics, has never had any meaning but one—viz., that given it by Wm. J. Grey. Mr. Clodd, having defined force as attractive power and energy as repulsive power (!), tells us that such force has persistence and such energy conservation—which, however, is by no means the case. He also tells us that kinetic energy is active en., and that potential en. is passive en., which is as inappropriate a contrast between them as could be devised.

Dubliniensis.

THE ORGAN IN THE FIRST PRESBYTERIAN CHURCH, BALTIMORE, MD.

[28774.]—This magnificent instrument was built by Mr. Frank Roosevelt, whose headquarters and principal factory are in New York City, but who also has complete factories in Philadelphia and Baltimore, this organ having been built in the latter. The organ stands in the tower fronting on the gallery opposite the pulpit, but projects so little that there is abundant space for a chorus choir in front of it. The case, a noble pedestal upon which the front pipes stand, is made of black walnut richly carved and handsomely finished, of Gothic design, and harmonises admirably with the stately grandeur of the church. The displayed pipes are symmetrically arranged in two large "towers" at the extreme sides with intervening "flats," surmounted in the centre by a fan-shaped design of Trumpets, all being richly and artistically decorated in gold and colours. The large side towers of pipes stand upon overhanging corbels, so that no gallery space is lost on the floor level. The dimensions of the organ are width 25ft., depth 10ft. 6in., height 31ft., the keyboards and organist projecting in the centre, so that, including them, the total depth is 13ft. 6in.

The excellence, durability, and finish of the work in every detail, however insignificant, have been carried to the highest attainable standard, and the instrument as a whole is a representative one of the perfection to which the art of organ building has been advanced, and is in every way worthy of the venerable church in which it stands.

The amount of 16ft. and 8ft. flue work, particularly of the diapason tone, is greatly in excess of that usually met with, thus forming a foundation of extra solidity, and giving that impressive and dignified body of tone which is the noblest feature of the "King of Instruments." It will be observed, too, that there is a carefully regulated proportion of the diapason, flute, string, and reed qualities in stops of the various pitches, the strength of each being admirably balanced and adapted to the acoustics of the building and the position that the organ occupies. Every stop extends throughout the entire compass.

Attention is called to the extensive use of swell-boxes. In addition to the Swell Organ itself, which comprises tweve stops and is of unusual amplitude as compared with the Great, the Choir Organ is inclosed in a box of its own, a device which greatly enhances its value, and is productive of many charming effects of expression, in general only obtainable by the use of a Swell Organ. Then all the stops of the Great Organ, except the first two, are included in the Choir swell-box, thus enabling the organist to subdue at will these usually assertive stops, and to utilise their tones in a far more extended field than is commonly practicable. Hence twenty-eight stops out of a total of thirty-three are placed under absolute control as regards expression, making it possible for the organist to vary the strength of the tone by very delicate gradations, or to make a *crescendo* and *diminuendo* of startling intensity. Besides this, a most beautiful and novel effect can be produced by gradually closing one box while opening the other.

The use of overhanging keys for all three manuals, the oblique-faced draw stop-knobs, and the unusual number of couplers, by which many charming combined effects can be made and the volume and power of the instrument greatly increased, are mechanical details worthy of note.

The draw-stop action consists only of "trackers" and "squares" the same as are used for the key action, and the mechanism throughout serves as a specially perfect sample of the highest class of workmanship. The greatest care has been exercised, and every known precaution resorted to, to eliminate friction, noise, lost motion, and all the evils that this sort of mechanism is liable to. All the "rollers" and "squares" are made of iron, every point of contact is "bushed," every piece of small hardware, whether of brass or iron (excepting the screws) is silvered, nickelled, or tinned, and adjustability is accomplished at every joint.

The windchests are those known as "Roosevelt Patent Chests," and may be briefly described as being "tubular-pneumatic" in principle, and affording a separate pallet for every pipe. The construction and operation is such as to preclude the possibility of almost all of the derangements common to most organs, arising from thermometric or barometric variations. No matter how large the organ, these chests render the touch light and agreeable, without the intervention of the complicated "pneumatic lever," and, above all, insure a degree of perfection in "repetition" never before attained in an organ, and equal to that of the most perfect pianoforte. They dispense with the objectionable "sliders" heretofore commonly used, and are so arranged that each and every part is easy of access for removal or replacement in case of accident.

The bellows, which is of ample dimensions, is fitted with large horizontal action feeders, insuring a copious supply of compressed air, without the necessity of operating them rapidly, and thus causing a disagreeable unsteadiness. In addition to the usual hand-lever, these feeders are connected with, and operated by, a "Jacques improved hydraulic engine," situated in the corner of the vestibule beneath. The water valve is automatically controlled by the rise and fall of the bellows, so that the speed of the engine is regulated by the demands made for wind, and no water is wasted. From the bellows the compressed air is conveyed to a smaller receiver, called a "regulator," which insures absolute steadiness, and from thence it is distributed to the different departments of the organ. To avoid friction, and consequent loss of pressure when the utmost demands are being made on the wind supply, all the wind trunks have been made of extraordinary sectional area, and right-angled bends in the same studiously avoided. Each trunk is fitted with a "concussion bellows" or "lung" to prevent unsteadiness arising from the recoil caused by the simultaneous closing of many pallets, and a telescope joint to avoid the weight of windchests and pipes being transferred from the frame to it, by possible shrinkage or the settling of the floor.

The Roosevelt patent automatic adjustable combination action is a recently-invented device of the most inestimable value as regards the complete and convenient control of the instrument, and is undoubtedly the most remarkable mechanical feature in this organ. It is simple and durable in construction, and enables the organist to change the effect of each combination pedal at any moment by simply drawing the desired selection of stops and then "setting" or "locking" the same, by a single touch, to such pedal as he may desire, after which the latter, on being depressed, will instantly cause the knobs to revert to the positions occupied when set. As this mechanism moves the knobs themselves and releases itself at the close of action, the stops can be operated by hand in conjunction with the combination action, which is not the case with any form that fails to move the knobs. With the above unusual resources in the combination mechanism, and considering the increased number of pedals here introduced, this organ is probably more completely equipped for combined and convenient registration than any instrument that has yet been built in this neighbourhood.

The voicing, on which mainly depends the success of the instrument, is deserving of the close study and examination of those interested in the subject, and combines all the best points of European schools with some effects seldom produced. The great delicacy and characteristic quality of tone in the different stops, the dignified power of full organ without harshness, and the perfect blending of the whole into an agreeable and massive tone, yet not lacking in brilliancy, are all noteworthy features, and the result of a most careful and yet progressive treatment.

SPECIFICATION.

Three Manuals, Compass CC to a^3, 58 Notes; and Pedals, Compass CCC to F, 30 Notes.

GREAT ORGAN.

1. Double Open Diapason ...	16ft.	6. Flute Harmonique	4ft.
2. Open Diapason	8	7. Octave Quint	2⅔
3. Viola di Gamba	8	8. Super Octave	2
4. Doppel Flöte	8	9. Mixture 3 & 4 Ranks	
5. Octave	4	10. Trumpet	8

(Stops 3 to 10 are included in the Choir swell-box.)

SWELL ORGAN.

11. Bourdn (treble and bass split knob)	16ft.	16. Stopped Diapason	8ft.
12. Open Diapason	8	17. Gemshorn	4
13. Salicional	8	18. Hohl Flöte ...	4
14. Dolce	8	19. Flageolet	2
15. Vox Celestis...	8	20. Dolce Cornet 3 ranks	
		21. Cornopean......	8
		22. Oboe	8

CHOIR ORGAN.

(Inclosed in a separate swell-box.)

23. Geigen Principal	8ft.	27. Fugara	4ft.
24. Dulciana	8	28. Flute d'Amour	4
25. Concert Flute	8	29. Piccolo Harmonique	2
26. Quintadena ...	8	30. Clarinet.........	8

PEDAL ORGAN.

31. Open Diapason	16ft.	33. Violoncello ...	8ft.
32. Bourdon	16		

COUPLERS.

34. Swell to Great.	38. Swell to Pedal.
35. Choir to Great.	39. Great to Pedal.
36. Swell to Choir.	40. Choir to Pedal.
37. Swell Octaves on itself.	

MECHANICAL ACCESSORIES.

41 Swell Tremulant.	43 Bellows Signal.
42 Choir Tremulant.	44 Wind Indicator.

PEDAL MOVEMENTS.

45—46 Two Roosevelt Patent Automatic Adjustable Combination Pedals, affecting Great and Pedal Stops and Nos. 34, 35, 38, 39, and 40.

47—48 Two Roosevelt Patent Automatic Adjustable Combination Pedals, affecting Swell and Pedal Stops and Nos. 37, 38, 39, 40, and 41.

49—50 Two Roosevelt Patent Automatic Adjustable Combination Pedals, affecting Choir and Pedal Stops and Nos. 36, 38, 39, 40, and 42.

51 Full Organ Pedal.—Drawing all Couplers and Speaking Stops except No. 15.

52 Great to Pedal Reversible Coupler.

53 Engine Starter.

54 Balanced Swell Pedal.

55 Balanced Great and Choir Pedal.

SUMMARY.

	Stops.		Pipes.
Great Organ..................	10	....	718
Swell Organ..................	12	....	800
Choir Organ..................	8	....	464
Pedal Organ..................	3	....	90
Total Speaking Stops	33		
Couplers	7		
Mechanical Accessories...	4		
Pedal Movements	11		
Total	55	Total Pipes	2072

R. H. W.

THE ORGAN BUILDER.—II.

[28775.]—THE "Bourdon" derives its name from the French verb "Bourdonner," to hum or buzz, and as far as the name is concerned, is quite new to English work. Its name came into vogue about the time of the enlargement of the French harmonium, and since then has been used indiscriminately to represent a stop of 16ft. pitch.

In the older organs of English build, the simple name of "double diapason" was generally adopted, and then referred to the bass octave of the stop known by the name of the "Tenoroon," it being an open diapason of 16ft. pitch and terminating at tenor C—hence its name. The scales adopted by the builders at this period were of rather lavish dimensions, and being cut up only one-fourth the breadth of the block and on light wind, produced a wonderful fulness and impressiveness that made itself apparent to all lovers of our noble instrument. By degrees the double open diapason became more extended in its range, and the stopped pipes that completed it were discarded so far as the manual (it chiefly being on the Great) was concerned, and put on the pedal organ, and here the scale was increased to such an extent that it was out of all balance to the reedy quiet tones of the smaller diapasons and dulciana, and the flutey, stopped diapasons.

The bodies of the pipes were "bellied" or increased in size in the middle, and this gave great sonority to the pipes; but the unequal regulating in the voicing seemed to be discarded altogether; the simple getting them to speak appeared to be the only attainment the builder sought for. The stop might then be described as a "thumping, irregular, and windy one," and as such we leave it. The Bourdon we have to deal with is one of scale and character to suit our own chamber instruments, and I shall describe the stop minutely enough to enable all hands to build it. The Pedal Bourdon is a stop of 16ft. pitch, or speaking the octave below the Open Diapason of the manuals. The scale or diameters of its longest pipe C C C at the mouth and top end being 5⅜in. by 3¾in.—i.e., 5⅜in. from back to front, and 3¾in. from side to side. Such a pipe as this will be quite sonorous enough without "bellying," therefore the sides are to be perfectly straight throughout the stop.

The mouths are cut up the breadth of the blocks; but the form or finish is to be a perfect semicircle. The tops of the blocks are "stepped" —i.e., a piece is cut out of the back part of the top side of the block, the object of this being to steady the vibrating column of air when the pipe is speaking. It also tends to give promptness to the "speech" of the pipe. The step of the C C C pipe may be ¾in. deep, and the top F may be ⅜in. The blocks from C C C to F F F are to be 5in. in length; F F F sharp to D D sharp 4½in. in length; and the rest 4in. in length.

The holes in the feet are to be as follows: C C C to D D D sharp, 1¼in.; E E E to G G G, 1⅛in.; G G G sharp to A A A sharp, ⅞in. The rest may be ¾in. The lowest octave is to be "bearded," the projection of the beard on C C C to be 1⅛in. beyond the surface of the "cap," and the B B B ¾in. "Ears" are glued to the sides of the mouths, and are kept level with the front surfaces of the beards; from the 4ft. C to the E or F above it beards may be glued to the caps; but ears are not necessary. The "caps" are hollowed out on the under side, and are kept level with the tops of the blocks.

In voicing this stop the edge of the cap is filed away until a good flush of wind is got. This may be known by the tendency of the pipe to "speak" its fifth above, or perhaps its octave; if the latter, the opening is rather too much, and must be reduced by planing a little off the whole surface of the inner side of the cap; the foot is then plugged with pieces of pine of close texture to reduce the superfluous wind. The "faces" of the blocks are to be slightly bevelled from the top edge towards the "throat," and *no nicking* is to be done to the blocks.

W. B.

CONTINENTAL ORGANS.

[28776.]—I WAS much amused by reading remarks by Mr. John T. Lawrence, M.A., in your last issue on the subject of Continental organs, and can fully endorse his description of the wretched instrument in that magnificent Dom at Cologne. Last August I attended a Sunday service there, expecting some such treat as one gets at Westminster Abbey or St. Paul's, but a dreadful disappointment was in store for me. The miserable box of whistles was disgracefully out of tune, and the singing simply execrable. So much for the so-called music-loving Germans; but Mr. Lawrence should have gone on to Mayence. I certainly did not hear the affair they have in the Dom there doing duty for an organ, but a more frightful outside I never saw in my life. Fancy a miserable, diminutive box like a wardrobe, very much carved, show-pipes, the largest of them not above 3ft. long, and the woodwork painted a lively pea green! There, that's beautiful, is it not? And this in a fine, large, handsome cathedral.

Then again, in Heidelberg, I suppose the Oxford and Cambridge of Germany, the largest church (they *call* it cathedral) has an organ of only very moderate size and middling tone, but certainly no better than would be found in a second-rate provincial church in England. Altogether, I think we English may rest very well satisfied indeed with *our* cathedral organs, and the singing along with them.

Devon. C. R. O.

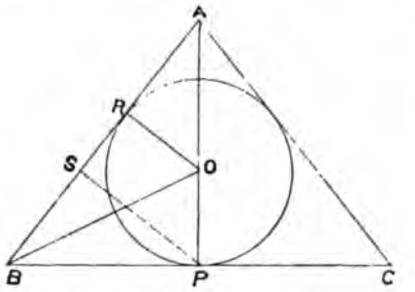
SOME LITTLE-KNOWN PLANTS OF THE "FLORA MEDICA."

[28777.]—ORDER: Labiatæ; genus, Thymus. Of this family the *Dracocephalum Royleanum* is very largely cultivated for its seed, sold very cheap in nearly every Indian town and village under the name of *Tukhm balungoo.* On pouring enough soft water to cover these seeds, in a few minutes a very cold, mucilaginous drink is obtained, greatly used in all urinary diseases—in fact, these remarkable qualities of the seeds are known to Europeans and natives alike. A medical friend of mine sent a quantity to England over forty years ago; but I never heard the result. Our British druggists should import a supply.

Eos.

PURE MATHEMATICS.

[28778.]—THE two problems suggested by "M.I.C.E." (letter 28735) may be worked out as follows:—Let B A C be the isosceles triangle, where $AB = AC = d$, a constant, and the angle at $A = 2\theta$. Complete the construction as in the figure, O being the centre and $OP = OR = r$, the radius of the inscribed circle. Put $OA = x$. Then, since the angle $OBP = \frac{1}{2} ABP = \frac{1}{2}\left(\frac{\pi}{2} - \theta\right)$ and $BP = d \sin.\,\theta$, we have—



$$\frac{r}{d} = \sin.\,\theta \tan.\tfrac{1}{2}\left(\frac{\pi}{2} - \theta\right) = \sin.\,\theta.\,\frac{1 - \sin.\,\theta}{\cos.\,\theta}.$$

Now when r is a maximum, $\frac{dr}{d\theta} = 0$. Differentiate the above equation with respect to θ, multiply the result by $\cos.^2\theta$, and we get, after arranging terms—

$$1 - \sin.\,\theta = \sin.\,\theta \cos.^2\theta = \sin.\,\theta\,(1 - \sin.\,\theta)$$
$$(+ \sin.\,\theta)$$

Or—
$$1 = \sin.\,\theta + \sin.^2\theta$$

Hence—
$$\cos.^2\theta = \sin.\,\theta, \text{ or } \cos.\,\theta = \tan.\,\theta$$

The second proposition is a sort of rider to the first. Suppose B A C to be the upper of the two similar and equal triangles, based on the line B C, and draw P S perpendicular to A B (and therefore parallel to O R). P is the centre, and P S the radius of a circle inscribed in the rhombus compounded of the triangles. Let $PS = R$; then—

$$\frac{r}{R} = \frac{x}{x + r}, \text{ or } xr + r^2 = Rx \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(1)$$

And—

$$\frac{r}{\sqrt{x^2 - r^2}} = \frac{\sqrt{x^2 - r^2}}{x}, \text{ or } xr = x^2 - r^2 \quad \ldots\ldots\ldots(2)$$

Eliminating r between (1) and (2), we obtain $R = x$, the result given by "M. I. C. E." With respect to the triangle B A P, it is perhaps worth observing that $BA \,.\, BP = AP^2$.

Charing. **J. R. C.**

MATHEMATICAL PARADOXES.

[28779.]—I WRITE this in answer to the suggestion of "M.I.C.E.," Bath, but I cannot conscientiously write it under the heading of "Pure Mathematics," inasmuch as my object is to decry some recent pseudo-advancements in mathematical science. Since the beginning of the present century the prevailing doctrines of imaginary and isolated negative quantities have been assailed, notably by Maseres, Frend, Buée, and Peacock, whose ideas were quite antagonistic to general opinions, and at the same time were at variance with one another, though the "Algebre-langue" of M. Buée was adopted by Peacock under the title of "Symbolical Algebra." In a note at the end of Bryce's Algebra, that author proceeds in a very unpretentious manner to demolish the whole superstructure of symbolical algebra. He tells us in effect that Dr. Peacock is all wrong in his views thereon as published in the British Association Report for 1833—that, in fact, there is no such thing as symbolical algebra, it being only a myth, and notwithstanding the astounding display of erudition in the aforesaid report, that he did not even know the true meaning of the algebraic signs. But in this controversy the arguments involved were metaphysical rather than mathematical, there being no question as to actual results, but only as to methods of interpretation. But latterly attempts have been made to extend the domain of mathematics into the regions of cloudland, and to sacrifice legitimate principles of deduction to the mere play of metaphysical subtleties and ostentatious appearances somewhat resembling the nebulous haze of the modern German philosophy. But how unphilosophical it would be to make sound mathematical deduction assume appearances like the airy speculations and the misty idealisms of Hegel and Schelling and such other thinkers, whose very mysticism seemed to be their pride and boast! Lagrange, indeed, contemplated accomplishing in the deductive sciences what Hegel is regarded to have done for the mental sciences; yet no comparison could be drawn between the great mathematical philosopher and the great metaphysical philosopher.

Our conceptions of space are necessarily limited by space of three dimensions; yet what on earth can be the meaning of that *World of Four Dimensions* of which Cayley, Lobatcheffsky, and other daring travellers have given us such interesting accounts, but from which they never have been able to convey a single native specimen or credential of its existence into the known world of three dimensions? Are we to suppose that everything in the nature of fauna and flora in that unknown country is incapable of importation? For all that, in the world aforesaid a great many curious and incomprehensible things are said to be observed by those who are privileged with passports into its realms, as, for instance, that a hollow sphere, such as an indiarubber ball, can be turned inside out by simple flexure, though it be without crack or opening in its surface. But in sober reasoning what could be more axiomatically impossible than such an idea. And as if that were not extraordinary enough, we are told, moreover, of a sixfold world, a sevenfold world, an eightfold world, and so on. Those who would care to read something of this science can do so in the addresses of the Presidents of the British Association for 1869, 1878, and for some other years. In perusing the former, let not the reader be discouraged if he cannot understand the definitions, on first reading them, of such mysterious entities as the "Canonisant of the Quartic" and the "Octodecadic skew Invariant." In the latter report, Dr. Spottiswoode takes a very moderate and sceptical view in declaring that even the world of four dimensions "is not seriously regarded as a reality in the same sense as ordinary space."

Prof. Clifford, though so sceptical in religious faith as to believe the non-existence of a God to be scientifically demonstrable, yet seemed to have abundant faith in the reality of space of four dimensions, and, nay, more, in hypothetic planes and right lines which are curved, parallel lines that meet, and *the whole of space as limited!* These be bold words, but there is a remarkable paradox in no way connected with the preceding speculations, and generally admitted to be true, which consists in the idea that the opposite ends of a straight line extended to infinity meet together in one and the same point, instead of being infinitely distant one from the other. To this proposition I unhesitatingly say *Non credo.* Such an absurd idea is a unique excrescence arising from the existent imperfect conceptions of the nature of infinity. Prof. Clifford, discoursing on this paradox, seemed to consider it in the nature of a practical result, instead of viewing it in the abstract, for he said that if standing on his doorstep he could travel off into space in a right line, *he would expect* at last to arrive on his own doorstep again, only in the opposite direction to that he had started in; and, arriving in this direction, we may suppose that he would mean to re-enter his house by the back door, supposing that it was from the front door that he had started off on his long journey through space. What becomes of the fabled flight of Icarus as a wonderful adventure after that? In his confident expectation, no doubt, the professor would never think of advertising his house for sale before his departure, which most persons would prudently do if their only chance of returning home was by continually going away from it in a direct straight line. Mathematical deduction to be genuine must always proceed on *terra firma*, and it should not seek to obtain a false renown by recklessly springing into the chaotic depths of metaphysical abstraction, in which empty sounds take the place of solid sense.

Wolfenbuttel.

ON VIOLINS.

[28780.]—IN answer to F. Watson (letter 28683), surely there are makers of violins who read this paper and could answer this question at once, without the necessity of experiment. I said before I attached very little importance to it; but he might be a little more exact in reference to what I said. As to the difference in tone between the backs and breasts of the two violins I made, I say nothing about 3½ semitones. If he will refer to letter 28481 he will find the backs gave mid. C, the breasts E above, or two full tones.

"T. W." gives two eminent authorities on experiments made on Stradivarius violins. Still, this does not satisfy him. He wants to know the difference that ought to exist between the two plates. I have no wish to set myself up as an authority against the names he mentions.

E. J. Payne, in a paper read before the Cremona Society on "The Violins of 'Stradivari,'" says:—"I ought to give you warning that much as I admire their qualities, I am not, in the ordinary sense of the word, a great enthusiast about them. When once we begin the scale of admiration, it is not easy to stop; hence in books about violins we sometimes find so much exaggerated praise bestowed upon the great makers that we are led to conclude that their admirers seriously think that Stradivari and Joseph Guarnerius were intellectual giants, men of the type of Shakespeare and Raffaelle, Sir Isaac Newton, and Michael Angelo, instead of comparatively humble artisans." He also says the scientific improvements made by "Stradivari" were foreshadowed by Nicholas Amati; but "Stradivari" was the first to set to work. He seems to have enlarged his corner blocks; what this was for I am at a loss to understand, unless to make more area of breast. He altered the curve of the model to a curved section; this is where I think he improved his violin in a mechanical sense. He seems to have been halting about the *f* holes. Some of his violins have the *f* holes on the bass side lower down than the other. Now, I think if he had possessed a method of finding the centre of the instrument, he would have had no hesitation about this. I should like some of our correspondents who are owners of a "Strad." to try the centre of this instrument by the method I gave a few weeks since.

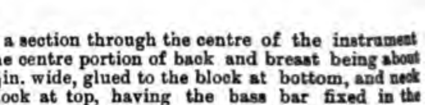
The same authority also tells us that "Stradivari" reduced his breasts to such an extent that they had to be strengthened by gluing new wood inside. Now, surely, if he had known what our authorities to-day allege of their experiments on his violins, he would never have thinned them down to such an extent had he been acquainted with the fact that there just wanted to be a tone difference between back and breast.

It would seem by F. Watson's argument that the same amount of wood cut out of *f* holes should just go to make the sound-bar. Is this the way its dimensions are found? Would length, breadth, or thickness have nothing to do with its bearing properties? Now this seems to be a mechanical problem. I don't think acoustics has anything to do with it. The breast wants to be of such a strength to support the downbearing of the strings, and to be at the same time sensitive enough to the slightest touch of the bow.

The sound-bar increases the difficulty. This has to be humoured to the swing of the bass side, which is the greatest. I know of but one method to get at this, and perhaps, like "Strad," if too much is taken off the wrong place, it might have to be patched up from the inside, for it is evident there can be just a difference of a tone between back and breast—working on the acoustical principle—and still as to bearing having the wood distributed in the wrong place or places; so that we have still to fall back on the mechanics of its structure. It is known that the greatest thickness is required at the point where the pressure is applied—viz., a combination of elastic springs in carriages or other vehicles, which forms an elastic arch. The necessary strength in the case of the violin can only be found by trial or experience.

I have, in the experimental violins made, worked both back and breast to the same mould, and after glued together complete, but not finished, strung them up to pitch and tried them; worked the breast down till the balance on both sides of the instrument is found, and the greatest resonance is attained. Sometimes I have had to use a bent, pointed knife, to get in at the *f* holes, to take off the strength of the soundbar. I have no royal road to achieve this problem; only an innate intuition.

Here is an experiment, the object being to get at the action of the back and breast. The diagram



is a section through the centre of the instrument the centre portion of back and breast being about 2½in. wide, glued to the block at bottom, and neck block at top, having the bass bar fixed in the ordinary position. This I tried in its normal state, before the strings were on or the soundpost inserted.

With a straight edge just the thickness of blocks in width (see dotted lines), putting the same in against blocks, I gauged the space from edge of straight edge to edge of back and breast, on both sides, at a point opposite the bridge. I then strung it up to pitch, and with the straight edge as before, and applying the gauge, I found by the tension of the strings that they have exerted a tension on the back, the neck, by its forward pull, acting as a lever. The breast on bass side is compressed about same amount as back, the treble side still more. The strings again slackened down, and the sound-inserted, the strings being strung up again, eble becomes the most rigid, the bass side reing about the same as before. Slackening the s again, I glued a piece of thin paper against lges of back and breast, on both sides, stretch- tight. When this was dry, I strung up again, aper on bass side becomes slack, the treble emaining tight, except a little in centre of h betwixt bridge and neck; the length (see points) between blocks remaining constant, eing able with a staff to detect any difference.

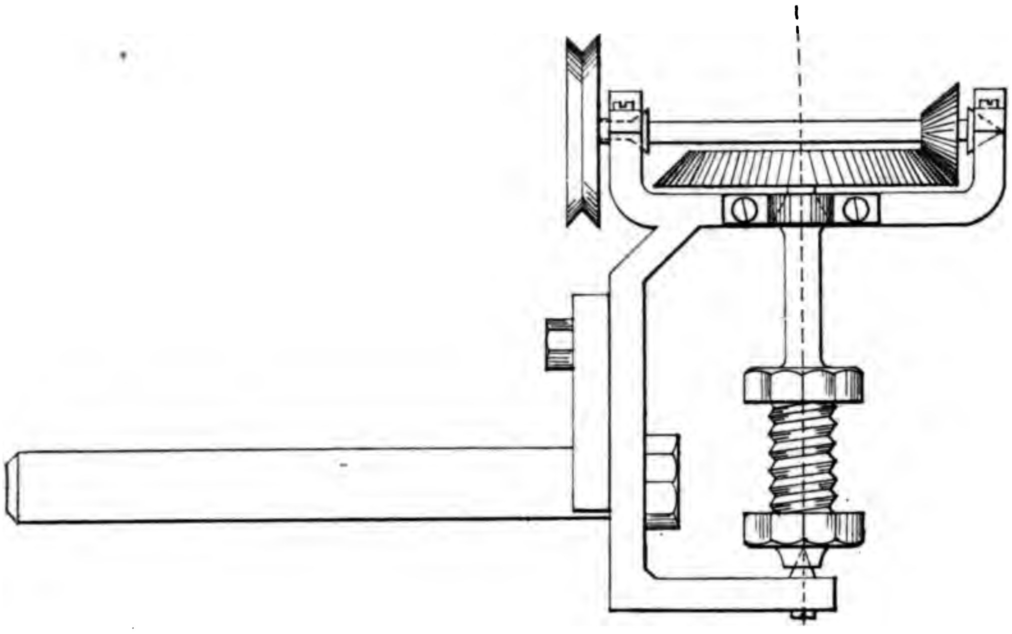
Oasis.

NIVERSAL GEARED CUTTING FRAME.

781.]—I NOTICED in the ENGLISH ME- NIC, on page 228, that the L. L. and T. Co. brought out a new universal geared cutting e for overhead motion. I beg to inclose h of a similar tool I designed some time ago, which I think is less complicated—so far, that es away entirely with the guide-wheels, &c. adjustment is obtained by raising or lowering locking-nuts which hold the circular cutter, I should like to know the opinion of "ours" e above.

W. H. Taylor.

ndon.



CERTIFICATES AND STRIKES.

782.]—I AM surprised to find that Mr. ael Reynolds, in your last issue, p. 257, No.), implies that I am "opposed to enginemen ving a certificate." He certainly cannot have my letter which appeared on the 6th April, 5, in which I expressed my opinion that it very important that those in charge of boilers ld be efficient, and that "the examination ld be of a practical character, and made by a ical man—one who had himself been a r."

. Reynolds, in years past, has rendered able aid to railway men, but I am disappointed ad his views with regard to strikes in general; with regard to the one on the Midland in icular he expresses some very strong opinions regard to the *cause* of the unfortunate Mid- strike last August. But he does not tell the *truth*—in fact, he carefully leaves out the important part of the whole matter—namely, on Wednesday, August 3, 1887, a meeting was at Derby between the chairman of the com- and the delegates, which lasted for more than hours, and the following compromise was ed by the chairman:—

he Chairman will recommend the Board to end the action of the new circular until after ember 1st, to give time for the delegates to sent their views to the Board on August 11th, delegates present on their behalf agreeing that men not prepared to work under the circular, ld the directors determine to retain it, will give teen days' notice of their intention to leave the ce."

nfortunately, the delegates were badly advised eir so-called leaders, and declined this compro-, and the strike was ordered.

. Reynolds will probably express *his* views that offer; my opinion was, and still is, that ould most certainly have been accepted would have given time for full and consideration, and it is almost certain that if the directors and delegates had met on August 11th, the whole difficulty would have been avoided. Instead of that, as we all know, the strike was ordered to take place at midnight on August 4th, the result of which has been a loss of £38,000 to the company, an expense of about £7,000 to the Amalgamated Society of Railway Servants, and about 1,000 engine-drivers and firemen have lost their situations, a large number of whom are, even now, unable to obtain any work, and those who unfortunately carried out the illegal instruction to pull out the fires, and thus left about 120 engines standing upon the main line, have found it extremely difficult to obtain employment. Mr. Reynolds hints that Mr. Stretton "is *not on the side of 'progress,'*" but I think that the readers of the ENGLISH MECHANIC will agree with me that every true friend to railway servants must urge upon them the great importance of avoiding unnecessary strikes, which in their case always end, like the one on the Midland, in disaster and ruin to the men.

Clement E. Stretton.

40, Saxe-Coburg-street, Leicester, May 19.

ALKALI MANUFACTURE BY ELECTRICITY.

[28783.]—THE separation of common salt into caustic soda and chlorine by one process has been aptly designated the "dream of the alkali maker," and the object of this letter is to show that its realisation by the agency of electricity may be within measurable distance. When the only sources of electric energy were galvanic batteries of various descriptions, all involving the consumption of zinc as the real basis of their power, any attempt to utilise electricity on a large scale was necessarily out of the question; but of late years the production of electric currents of any desired magnitude has become a mere matter of machinery and coal, hence results and applications which would have been entirely chimerical only a few years ago are now fairly within the range of applied science. The decomposition of sodium chloride by electricity, and the direct production therefrom of caustic soda and chlorine, seems to be one of these now possible results. In the simplest view which can be taken of the decomposition, we have Cl liberated at the positive pole, and caustic soda, together with a volume of hydrogen equal to that of the chlorine, at the negative electrode. The solubility of chlorine in water is a difficulty; but this may be got rid of almost entirely by heating the solution, chlorine being, like all gases, very much less soluble in hot water than in cold. If the solution to be electrolised were heated enough to cause the chlorine to bubble off as it was liberated, the risk of diffusion would be entirely eliminated, and probably secondary action would be materially diminished.

All, or very nearly all, the chlorine existing in the salt would be utilised in the production of bleach, and hence a very much smaller quantity of salt will suffice. At present, alkali makers do not produce more than about 85 per cent. bleach on their decomposition of salt; but as in the suggested process the Cl would all be used, we would have (adopting Kolk's formula $Ca_2H_6O_6Cl_4$) 100 tons NaCl = 155 tons of bleach—that is, the production would be increased about five times, and therefore the quantity of salt decomposed might be decreased in the same ratio. It may be remarked here that the question of secondary action will not in any way interfere with the evolution of the chlorine, especially if the solution be heated sufficiently.

If direct decomposition of NaCl can be effected, the cost of production must be materially lessened, especially taking into account the greatly increased output of bleach. The sulphuric acid plant, hydrochloric acid towers, decomposers, balling furnaces, Weldon's plant, black salt pans, stone crushers, and much other costly plant will be dispensed with, being substituted by steam-engines and dynamos, which will cost considerably less. The saving in raw material will be very great—pyrites, nitrate of soda, manganese dioxide will be entirely done away with, the only material needed in the suggested process being (a very much reduced quantity of) salt, together with coals and limestone. Wages will be very much reduced, the number of men required being much less than in the old method. The cost of repairs will also be smaller. Works would be free from nuisance, and would be very much smaller, instead of as at present occupying so much space, and tank waste would be got rid of.

Some experiments have been made to decompose NaCl by electricity; but the dynamo used was very unsuitable for the work, being an electric light machine, and the arrangement of vessels, &c., was not at all well arranged. At present it is probably the case that dynamo machines scarcely exist which will be suitable for the manufacturing decomposition of NaCl; but it may be fairly contended that should a demand arise they will soon be forthcoming. What is needed would be a machine capable of sending an enormous current at very low tension—a plating dynamo considerably magnified.

It may be remarked that the currents needed being of low tension would, notwithstanding these enormous volumes, be free from danger. The machines would be constructed to send a large current through a very small resistance, and would be incapable of sending an appreciable current through such a high resistance as the human body.

Another application of electricity is to decompose fused NaCl, producing chlorine and metallic sodium. I shall be glad to learn the views of your correspondents.

W. S. B.

FLAT EARTH.—ERRATUM.—The letter 28757, on p. 259, should have been signed Thomas Moy, not May. Mr. May's letter appeared on p. 217.

Gas for Military Balloons.—An invention connected with military ballooning has just been tested in Berlin. It consists in apparatus for producing the inflating gas on the spot when required instead of storing it under pressure and transported to the scene of action in iron pipes on the plan adopted by the English authorities. This generator is said to resemble a traction engine in appearance and is drawn by six horses. In its lower portion is a furnace specially adapted for burning wood, and over this are ranged a series of iron retorts (thirty in number) which are filled with a mixture of zinc dust and hydrate of lime, which on heating gives off hydrogen, about two hours being required to obtain sufficient gas to inflate a military balloon. This system, which is the invention of Lieutenant Richter and Dr. Majert, is said to be cheaper, more rapid, and less dangerous than all previous systems.

REPLIES TO QUERIES.

⁂ *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[64263.]—**Bearing Springs.**—On Jan. 20, 1888, you very kindly inserted my query on Bearing Springs. Since then I have looked every week expecting it would meet the eye of some one who might be able and willing to give a reply, but have looked in vain. I may state that the springmakers have sent a set of springs 38in. on centre of bearing tips, having three top plates ½ by 3½, and 12 other plates ⅜ by 3½ to carry a load of 6 tons on each spring. I have tested one of these springs with the following results:—

Camber at rest	$8\frac{8}{16}$
Camber with 2 tons on	$7\frac{5}{16}$
Camber with 3 tons 18cwt.	$6\frac{1}{4}$
Camber with 6 tons on	$5\frac{3}{4}$

This is ¼in. less camber than it ought to have been. Perhaps with these results someone will kindly reply to the points raised in "E. M." for Jan. 20, 1888.—SYDNEY.

[64478.]—**Church Bells.**—A friend of mine—now F.R.S.—made many experiments, when I was a boy, on the vibration of glass and metallic vessels, and had the latter made on one pattern, 6in. diameter and 3in. deep, I think, of copper, iron, zinc, brass, bell-metal, pewter, German silver, and real silver (whether pure or of coinage standard I cannot tell). I well remember that the yellow brass (of copper and zinc) gave the finest sound, and next to it the bell-metal; while the silver gave one of the dullest—inferior, I think, even to the zinc, certainly to the iron. Of course their shape, a deep saucer, was very unlike any bell.—E. L. G.

[64840.]—**Science and Art Examination—Test for Morphine.**—Place a small portion of substance on a porcelain crucible lid, and dissolve with a drop of HNO_3, orange-red coloration. Heat gently, yellow coloration; add a very minute quantity of $KClO_3$ to warm solution, it remains yellow; then add one or two drops of Amho, red brown ppt., which, on evaporation, leaves a light brown residue; dissolve in H_2O, add Kho, light brown coloration; add HNO_3, light brown coloration. Use one solution throughout; the first test is very characteristic, and by far the best.—STUDENT.

[64895.]—**Manufacture of Rubber Substitutes.**—If your correspondent sends me his name and address, I will forward him a sample of a substitute that may suit.—J. ORR, 71, Mount Pleasant, Barrow-in-Furness.

[64895.]—**Manufacture of Rubber Substitutes.**—I do not know why "M.D." should go out of his way to change the title of this reply—thus bothering whoever has to do the index,—but I guess that, if "Hammer" will spend an afternoon at the Patent Office looking up old patents, he will learn a great deal more than he will by advertising his address, so that "M.D." can write to him. I am not in the slightest degree interested; but I do know something of what is to be found in the archives of the Patent Office, and also of what has appeared in the old vols. of the *Mechanics' Magazine*. I retain the opinion expressed on p. 239. I am quite sure that anyone who has a satisfactory substitute for indiarubber—especially if he can manufacture it at 6d. a pound,—would take out a patent at what is called "post haste."—NUN. DOR.

[64924.]—**Chiretta.**—"M.D." says that in about six weeks, if I persevere with infusion of chiretta, I shall get "atony of the stomach." I had some difficulty in finding "atony," and got at it through the German, "Abspannung, relaxation, unbending." Referring to a Dictionary of Medical Terms, I found "Atonia," which is said to be a Hippocratic word denoting relaxation or want of tone in the system generally. But I am no wiser. So far as I can see, that is just what I have suffered from occasionally for more than a quarter of a century, and I found the Chiretta infusion a remedy. By the way, how is that for homœopathy?—NUN. DOR.

[64949.]—**Organ Swell.**—I notice "Oboe" has mentioned my name with regard to this query. Perhaps one reason why the query has not been answered is that it is rather vague. Personally, I have been too busy with other matters to reply, for whether "organ building" is considered a "trade" affair, or dubbed with the high-sounding term of "art," it must be attended to. The vagueness of the query lies in the fact that "Mechanic" says he has bought a small organ, and he wants to make a swell; but does he wish to inclose the organ in a swell, or add a swell to the organ he has bought? To add a swell of a given number of stops is easy, but to make the organ he has purchased into a swell, so as to be satisfactory, he will find a difficult matter—at least, accordingly as small organs are generally built. If any of the pipes form portion of the front of organ, he cannot inclose those in the swell-box, and if he wishes to leave the stop forming the front pipes out of the box, he will most probably have to sacrifice one stop to make room for the swell-box front and the shutters to work. Supposing he means to "add" a swell organ, I will tell him how to make the box; but the same directions would not answer in every detail, if he wishes to inclose portion of the present organ in a box. First obtain the requisite quantity of 1½in. pine to make the whole box. The size I do not know, but the material must be very dry. I could not advise the box being made of less substance than 1⅜in., as that will only work up a good 1¼in. unless cut out of timber. Cut sufficient lengths to form the proper width, when jointed up, of ends and top, the top will lie on the ends, and be secured by two cleats at either end inside. Next take the front in hand. This will consist of a single frame mortised and tenoned together, the top rail being bevelled inwards at an angle of 40°, or thereabouts; the remainder of the frame is square. At each side of the frame two strips of well-seasoned birch are screwed, ⅝in. thick, 1½in. wide, the full height of the opening in the frame. These strips are for the centres in the shutter ends to work in. If the shutters are to work vertically, the bevelled rail will be at the side, in fact both sides will then require bevelling, one inside and one outside, the strips being top and bottom. In the case of vertical shutters, it is advisable to insert a rail some 16in. or 18in. from the bottom, a movable panel being provided, so that the reeds may be tuned without disturbing the shutters. The shutters require setting out according to the width of material and bevelling at each edge, then covering with felt. A good width for small swell shutters is 7in. The centres for the shutters to swing upon may be about two-thirds from the bottom edge of shutter, and the centre for the lift one-third. These are matters of details that cannot be definitely given without knowing the conditions under which the swell box is to be stationed. The back will be the next consideration. This is simply so many pieces cut to the same length as the top, and glued up into convenient sizes—say, two 11in. together, all screwed on to the sides and top, then planed level all round. The box being finished requires two linings of strong brown paper, well sized. The rod to open all the shutters together is connected with the lifts in several ways, but generally by a pin in the rod, one for each lift. Another way to make the top, sides, and ends of a swell box is to nail together a rough 1in. frame; nail upon this narrow strips of wood diagonally, within, say, 1in. of each other, both inside and out; over this both inside and out are pasted three layers of thick brown paper, well sized, and outside over all, glue one thickness of stout, firm felt, the inside having only the hard coating of brown paper. This inner coat is better still if painted and varnished. The front frame and shutters are the same as for a solid timber box. Beyond the remarks above, it is impossible for me to give any useful details, the query being so indefinite; but if "Mechanic" will say exactly how and where he wants the swell-box, I will send him a sketch. I fancy I have seen a portion of a swell-box illustrated some time since.—URANIUM.

[65000.]—**Methylated Spirits.**—For what purpose does this querist wish to "disguise the smell of methylated spirit"? That is alcohol sold free of duty, because it is useful in the arts, but on the express condition that it is methylated, and so presumably made undrinkable and useless for the manufacture of tinctures, perfumes, &c. I am afraid that it is for no honest or bonâ-fide purpose the querist wishes to disguise the smell of methylated spirits.—NUN. DOR.

[65002.]—**Deodorising Fish Oil.**—Depends on what is meant by "fish oil." However, boil with a solution of caustic soda (about a pound to the gallon of water); that will be sufficient for two tons of oil; stir well, and add a solution of sulphuric acid (a pound in six times water); after boiling for twenty minutes, let it rest, and then deodorise with the bichromate of potash process. I don't believe you will get all the odour out, though.—NUN. DOR.

[65006.]—**Protecting Iron from Rust.**—The paragraph referred to on page 108, Vol. XLVI., quotes the authority for the statement, and gives the name and address of the discoverer of the preparation. Does "Sardegna" wish someone else to write and find out the information for him? There are some people who, if you tell them how to do a thing, consider you unkind if you don't also do it for them.—T. J.

[65008.]—**Kiln.**—A muffle is a more likely thing, I should think, and "F. B. S." would no doubt find what he wants by looking through the catalogue issued by Mr. Fletcher, of Warrington.—S. M. P.

[65017.]—**Incubator.**—You want an artificial mother, and you can easily make one, by means of a hot-water tank and a couple of boards placed somewhat like >, and lined with a bit of sheepskin with the wool on, or with cotton-wool. A temperature of 100° Fahr. is sufficient, or less, because when the chickens get into the artificial mother they keep one another warm.—GALLUS.

[65027.]—**Perspective.**—May I add a few words to my former answer on page 176? Notwithstanding the many able replies that have have appeared from the pens of other writers, I am inclined to think that my answer was not far out, if properly understood. Unfortunately, I used a word (panorama) in the popular sense, whilst my readers have taken the strictly technical meaning. There have, from time to time, been exhibited shows called "panoramas," or "moving panoramas"—such as the "Panorama of the Nile," and others. Now, what I meant to convey was, that when it is required to depict a row of houses, or other objects, too long to be taken in by a single glance of the eye, it must be effected in a way similar to these popular exhibitions.—F. S. S.

[65031.]—**Paralysis.**—Does "Rex" expect that anyone will take upon himself the responsibility of advising in such a case? Galvanism is, no doubt, useful; but it should be applied under medical direction.—S. M.

[65034.]—**Incubator.**—1. Zinc is better than tin-plate; but, of course, the latter will do. 2. The water must be kept to the required temperature. 3. Funny mixture of questions. "Burnisher" presumably refers to a piece of photographic apparatus often described—presumably means one with a roller 6½in. long.—C. M.

[65042.]—**Cold Bluing.**—Suppose "J. W. M." adds the "indigo blue" of his recipe to some lacquer or suitable varnish, and tries that. "Ultramarine." Paris blue, or Prussian blue would be better, I think. Is it one of the recipes advertised as trade secrets? The "3oz. bromic acid" reminds one of the celebrated recipe for cold soldering in which fluoric acid is used with brass filings, which recipe appears, by the bye, in many of the books compiled for the edification and technical education of the masses.—NUN. DOR.

[65056.]—**Box Tunnel.**—This tunnel is 3,195 yards long, and in places is 300ft. below the surface. How the sun can "shine through it" is a puzzle; but I am not sufficiently acquainted with the locality to answer the question. The gradient descends at about 1 in 100 W., so that one end would be, say, 30 yards higher than the other. Will Mr. Mashiter give his authority, and some reader supply particulars of the position?—J. M.

[65144.]—**Engine Query.**—I am afraid the querist must be a little puzzled by so many values for the power of his engine. His data are rather loose, which may account for some of the variations, but not for all. He has to choose apparently between $8\frac{68}{273}$ (!) 20, 10·82, 13·9, 9·85, 8½ to 9, 4¼, 10½. The area of 8in. is 50·2655, and the "piston-constant," will be, therefore, $\frac{12 \times 50{\cdot}2655}{198000} = {\cdot}003046$, and this multiplied by the mean effective pressure, and by the revs., will give the horse-power. A theoretical estimate of mean pressure is sure to be very different from the real thing; but taking from Rankine's table (on p. 292 of Rules and Tables) the constant ·846, corresponding to a cut-off at half-stroke with moist steam, we get, for an initial pressure of (30 + 15 =) 45lb. absolute, a mean absolute pressure of (45 × ·846 =) 38·07lb. The effective mean pressure will depend on the back pressure, and it is here, I suspect, that some of the differences in the replies take their origin, each assuming a different back pressure. Assuming, as engine is running slowly, a back pressure of 1lb. above atmosphere, or (1 + 15 =) 16lb. absolute, we get a mean effective pressure of (38·07 − 16 =) 22·07lb. The revolutions being 140, the theoretical indicated horse-power will be (·003046 × 22·07 × 140 =) 9·41, and the actual horse-power will be, of course, less than this in a ratio depending on make of engine. If back pressure is greater or less than 16lb., add or subtract (·003046 × 1 × 140) = ·426H.P. for each pound less or more. I see some of your correspondents have taken the pressure above atmosphere instead of absolute pressure, which will, of course, account for some other discrepancies.—GLATTON.

[65144.]—**Engine Query.**—The engine, I assume, is non-condensing, and with the stated speed and pressure, which latter, by the way, is abnormally low, would develop only 9·8H.P. The power can be easily worked out by the following formula—

$$\text{H.P.} = \frac{P\,L\,A\,N}{33{,}000}$$

In this P represents the mean effective pressure in the cylinder; L, the length of stroke in feet—in the case under consideration 1; A, the area of the piston = 50·25 square inches; and N, the number of revolutions per minute, 140. The pressure stated, 30lb. (boiler pressure, as I understand it), will, with ½ cut-off, give a mean effective pressure

23lb., and the formula, by substitution, refore read—

$$\text{P.} = \frac{23 \times 2 \times 50\cdot25 \times 140}{33,000} = 9\cdot8 +$$

re 2 here represents twice the length of n feet, since for every revolution the stroke is passed over twice. The method uting the mean effective pressure is ex- in several engineering pocket-books, such ell's, for example, to which I would refer a Fix." In plain English, the above amounts to this:—Multiply the mean pressure per cylinder area, or 23 × 50·25, e distance—in feet—through which it is per minute, or 2 by 140; this gives -lb. per minute of work done in the ylinder. Dividing this by the equivalent . per minute, or 33,000ft.-lb., we obtain the H.P. of the engine. The mean effective , of course, can also be obtained, and with ccuracy, by applying the indicator.—A. S., ity, N.J.

.]—**Boot - cleaning Machine.**—Boot- machines, consisting of two cylindrical g brushes, are in use in some places in this ; but the power is transmitted by means le shafts, so that no arrangement on the foot-lathe, as mentioned by your querist, ary. Such a fixture, it seems to me, would ersome and objectionable. The flexible ush is simple, and, I believe, works quite is used not only for cleaning boots, but brushing horses, and occasionally in some ing hair-dressing establishments.—A. S., ity, N.J.

]—**Beam Blowing-Engine.**—In read- ny reply I see one or two printer's (?) errors pt in. Line 11, for "lagged," read "un- line 28, for "full," read "bottom." All ers" except the last, should read "pres- .I.C.E.

].—**Electric Bells.**—Thanks to Mr. ." for his kind illustration. I have made e switch as illustrated by "X.," but cannot to ring as required. If "X." will kindly clearer he will greatly oblige—CHAT-

]—**Lever.**—Cannot "Samson" get at the esult by simply multiplying weights arm lengths? Thus, assuming that his hts are at 6in. from centre on each side, then, of course, balanced. Should it be move one of the weights, say ½in. further ½in. from the centre, its weight must be $\frac{12}{13}$ths of an ounce to preserve a balance; ance of 7in., the weight must be only $\frac{12}{14}$, an ounce; for 7½in., $\frac{12}{15}$ths of an ounce, and erhaps, however, I do not rightly under- question.—A. S., Jersey City, N.J.

]—**Ritchie's Revolving Magnet.**— d "Sigma" has noticed this query. I pected replies from many more corre- . I am sorry to disagree with Mr. having been the recipient of many but it does make a lot of difference the revolving armature is wound with thin wire. I made one some years ago, he armature with No. 18 cotton-covered it worked splendidly. I fancy I made it uctions given in "Buckmaster's Experi- hysics." Perhaps someone having that out of print) will be good enough to see if the quotation given by the querist und in it. Anyway, for the last twenty ave always understood "to rapidly mag- demagnetise, short cores and thick wires sed." If it is not asking too much, would anus Thompson oblige with his opinion portant question?—M.M.I.Sc.S.

]—**Oil Painting.**—I had excellent for my reply to this query. I am now ble to inform "W. D." that Mr. A. W. whom the information he gives relates, a picture of Ulswater, which was exhi- he Liverpool Academy about 1844; but s not so large as 18 by 10, and that, con- "W. H. H.'s" picture is almost certainly her.—W. A. S. B.

—**Indian Jugglers.**—A conjurer, who to know how the Indian basket trick was told me that two children, very like , are employed, and that the child who m out of the crowd is not the one that ut in the basket.—B. G.

— **Formula for Gradually De- Scale.**—I am exceedingly obliged to r his answer to my query. I will try xplain what I want to know by a very ustration:—Suppose I have a series of longest of which is 12ft. long; the next ft. long, the difference being $\frac{1}{12}$th of the i.e., $\frac{1}{12}$th of 12ft. The difference between and third poles will be $\frac{1}{12}$th of 11ft., and ere no mathematical formula to express PNEY.

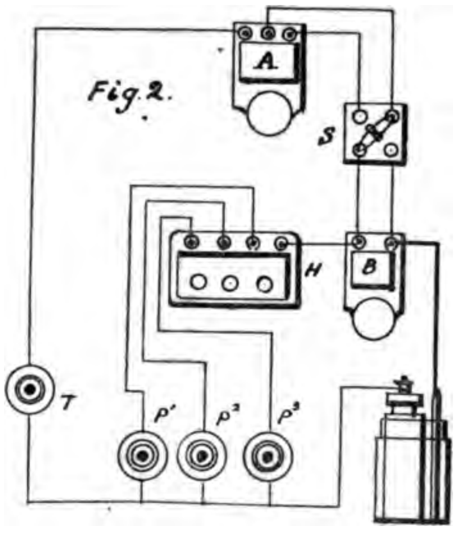


Fig. 2.

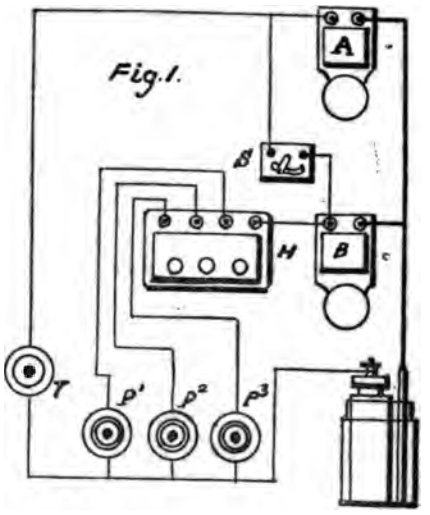


Fig. 1.

[65246.]—**N. Carolina.**—The climate is all that can be desired—never very cold nor hot. The people are hospitable, lazy, and extravagant. All labour is done by "niggers" and mules. If "O.B." will write me, I shall be glad to give him all the information in my power.—C. L. BAKER, High-street, Tunbridge Wells.

[65265.]—**Springs for Safety Valves.**—Cut a steel hoop of diameter = d and of thickness = S across one point in its circumference. Strain this cut hoop so that the upper corner of one cut end shall normally stand permanently touching the lower corner of the other cut end. Then this open hoop is like the first coil of your helical spring. Secure one end to a fixed support, and attach the weight = W to the free end. Is it not evident that the W exercises a leverage which (in comparing its effect on hoops of different diameters) is not as d, but as d^2? But the spring is not able to balance by its resistance the force of W till the free end of coil has yielded a certain distance. That distance or travel converts the initial area of force into the cylinder of force, so to speak, and thus implicates the third power of d, so that the effect of W upon one coil is in ratio to the d^3 of that coil, and the effect of W upon a number = N of coils exactly similar is as d^3N. The resistance of spring is as the displacement of the particles of its section, the extent of which displacement depends on the S^4, because S^2 expresses merely the initial area or leverage of resistance, and S^3 expresses also the displacement of particles in a right line of travel. But the actual line of travel of displaced particles is spiral, and this fact implicates the fourth power of S, so that the volume of resistance may be proportionally expressed in relation to constant C.—FRANK CAWS, Sunderland.

[65266.]—**Leclanche Zincs.**—Yes; though it is not usual practice.—W. PERREN-MAYCOCK.

[65271.]—**Steam-Moved Engine Valves by a Subsidiary Cylinder.**—As "W. M. J." has very properly adverted to the bad results due to the practical difficulty or impossibility of predetermining, by any theoretical process, the proper ratio of piston areas in subsidiary and main engines, perhaps I may be permitted to say, as I ought to have said last week, that by automatic relief valves, or "compensators," J. F. Thompson's engines are prevented from having, or holding, in their subsidiary cylinders more steam than they need to perform their proper function of working the main engine valves. These relief valves not only continually neutralise the effect of any constant excess of area of subsidiary piston, but also the effect of occasional irregularities and eccentricities of pressure due to causes beyond control of the engine builder.—F. CAWS.

[65277.]—**Carbons.**—Nothing can be done but by casting on fresh caps.—W. PERREN-MAYCOCK.

[65280.]—**Electric Bells.**—A loose or bad connection somewhere.—W. PERREN-MAYCOCK.

[65280.]—**Electric Bells.**—I think you will find a crack in the pitch on the top of the porous pot, out of which a moist paste of white-lead oozes. Replace this with a new porous pot, and you will find all right.—CHAS. E. GITTINS, 100, Fenchurch-street, E.C.

[65284.]—**Electrical.**—The sticking of the armature to core is due to residual mag. and to the spring not being tight enough. There should be no actual contact between them, a brass pin being inserted in one or the other with this intent. (See Letter columns, Ap. 20.) More sulph. acid wanted with bichr., about equal volumes.—W. PERREN-MAYCOCK.

[65285.]—**Electric Bells.**—You do not say whether it matters if the bell at the top of the house also rings when the pushes in the house are pressed in the daytime. If it does not matter, Fig. 1 will show you how you should connect up your bells. In both the diagrams A is the bell at the top of the house, H the indicator, and B the bell working in conjunction with it; P^1 P^2 P^3 the house pushes, and T the push at the hall door. When the arm of the switch S (shown in detail in Fig. 46, p. 569) is in the position shown, bells A and B will ring if the push T is pressed; but they will also ring if pushes P^1 P^2 P^3 are pressed. If the arm of the switch is moved over to the other side, push T will only ring A, and pushes P^1 P^2 P^3 only B. In Fig. 2, however, if the arm of the switch S is in the position shown, push T will ring bells A and B, while pushes P^1 P^2 P^3 will ring B only. If now, the arm of the switch is moved over to the other side, the other two contacts are connected, and push T will only ring bell A, while pushes P^1 P^2 P^3 will ring bell B as before. In Fig. 2 S must be a four-point switch, the working of which will be clearly seen from the figure, and the bell A must be of the form shown in Fig. 61, being an ordinary trembling bell with a third terminal fixed between the original terminals and connected to screw J on frame F (see Fig. 17, p. 425). When switch S is in the position shown, and the one in which it would be in the daytime, A is a single-stroke bell in series with B, which thus makes and breaks the circuit for it; but if the arm of the switch is in the opposite position, A is made a trembling bell, and B is cut out of its circuit.—F. C. ALLSOP, Brighton.

[65287.]—**Coil.**—You do not mention the battery power used; perhaps it is too small. The clapper should never come into actual contact with iron core: there should be a little brass stop pin. Again, you have over-insulated secondary: one layer of paper between each layer of wire is plenty, and the paper should be thin, but strong. See "Letter" columns, April 20.—W. PERREN-MAYCOCK.

[65290.]—**Direct Transformer or Induction Coil.**—TO MR. PERREN-MAYCOCK.—In a transformer, it is necessary for the primary current to be either alternating or intermittent in flow, and in order that the secondary may be steady enough for lighting purposes, these alternations or breaks must be very rapid indeed—several hundred a minute. The Grosvenor Gallery dynamos give alternate currents; therefore, to use a battery in conjunction with a transformer, the current must be passed through a special commutator, and made thereby either alternate or intermittent. The ordinary "make and break" attachment in an induction coil is not rapid enough for such purpose. You will see by this that the obstacle to such an arrangement as you propose lies in the fact that the reversing or intermitting commutator must be driven from a separate source of power.—W. PERREN-MAYCOCK.

[65296.]—**Chalk Marl.**—On the western bank of the Medway, south of Rochester, there are several large quarries where "Rhizopodist" can get what he wants. Walking southwards, he will be able, in a few hours, to examine seriatim all the divisions of the chalk formation. If he will advertise his address, I will send him some foraminiferous earth, which may interest him.—W. H. SHRUBSOLE, F.G.S.

[65298.]—**Science Exam.**—TO "SM."—Please furnish the sketch. I am well acquainted with Victor Meyer's method, but can't make much out of your description.—GATESHEAD.

[65298.]—**Science Exam.**—In my reply las week to this question there is a misprint. For 74·8 read 748. I overlooked the other part of the query referring to the molecular weight of a compound. If, according to Avogadro's hypothesis, equal volumes of gases contain equal numbers of molecules, we have a means for finding the relative weights of the molecules by determining the relative weights of equal volumes of the gases, and the numbers obtained will bear the same relations to each other as molecular weights. By taking the weight of some molecule as a standard, the others are expressed in terms of such standard—e.g., let HCl be the standard, with a molecular weight of 36·5. Determine its s.g., which is 1·247. The relation between these is expressed thus, $\frac{36·5}{1·274} = 28·65$; or, if d = s.g., and M = molecular weight, then $\frac{M}{d} = 28·65$, $M = d \times 28·65$. By experiments with other substances the number is found to be nearer 28·88. By applying this formula we get results sufficiently accurate to determine the number of atoms in a given molecule—e.g., take water. By multiplying the s.g. of water vapour by 28·88 we get 17·99, which enables us to decide between 9, 18, 27, &c., for the molecular weight.—SM.

[65806.]—**Base of Isosceles Triangle.**—As the querist desires information for finding the base by "ordinary arithmetic," it may be presumed that the algebraic and trigonometric answer of F. Caws will not much help him. The answer cannot be worked out without the help of a book of tables. The cheapest I know of is the "Mathematical Tables for the Use of Practical Men" (as it is called on title-page), or "Logarithms" (as it is lettered on the cover), published for the Scottish School-book Association by Wm. Collins, Sons, and Co. The price is only 1s. 6d. The way to use it is as follows:—Suppose the angle is 60° 30′. We must first divide the angle by 2; that will give 30° 15′. Then take the book and open it at p. 65, and look down the column headed 30° until we come in a line with 15 in the column headed M. We then find the decimal fraction ·503774 (which is the "natural sine" of 30° 15′). Twice the length of the side multiplied by this fraction will give the required base. The rule then is: Multiply twice the length of the side by the "natural sine" of half the angle.—F. S. S.

[65818.]—**Takigraphy.**—Takigraphy cannot be more simple than script phonography (shorthand on the slope of longhand), the elementary principles of which are easily committed to memory by any person of average ability in a week. I shall be happy to send you the address of the society if you choose to write to me.—G. MACBETH, 4, Grant View, Leeds.

[65818.]—**Chloride of Gold.**—Mr. Bottone has apparently made a discovery!—namely, that bleach liquor (the solution obtained by digesting bleaching powder with water) consists of a solution of chlorine. I was always under the impression that it was a solution of calcium hypochlorite. When the above solution is treated with an acid, chlorine or hypochlorous acid is evolved. Please note this, Mr. Bottone.—CHEMIST.

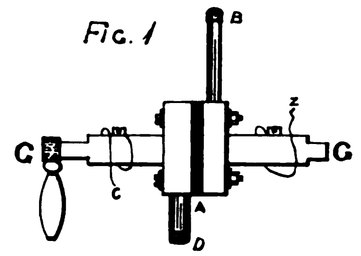
[65822.]—**Trigonometry.**—ERRATA.—In my reply, page 265, col. 3, after the words "let us start with the given identity," the formula following should be sin. $2x = 2$ sin. x cos. x. Again, in line 10 from bottom, after the words "two independent variables," supply "or else we might consider only one of them to be a variable and the other to be a constant."—VLADIMIR.

[65828.]—**Evolution and Transmutation of Blood.**—"Dens" says, p. 266, that "the transfusion of blood from a monkey, or any other animal, into the human subject, would bring on pyæmia and death." Is it permissible to ask for the authority for this statement? No doubt your correspondent believes what he ventures to write is true; but it would be as well, I think, to have "chapter and verse," as the saying is—that is, proof; because a man who is so ready to declare that a simple fact is "simply an untruth" is not likely, I am afraid, to pay much attention to truth. "Misty evolutionist metaphysics" looks learned; but it is doubtful whether the writer knows what he means.—NUN. DOR.

[65827.]—**Telegraph Needles.**—Make needles for your model instruments of watch-spring, and magnetise them by rubbing with a permanent magnet. You will obtain better results by using a coil to work them, made of No. 36 silk-covered wire than by using electro-magnets. Let needles work inside of coils. You will only require one wire and a battery at each end of circuit instead of, as you state, four and two sets of batteries.—W. A. M.

[65827.]—**Telegraph Needles**—Are usually magnetised by rubbing for a minute or two on a strong horseshoe magnet, one end on the S. Pole, other on N. Pole. The inner or magnetic needle *must be of hardened steel; the indicating needle may be of thin steel or brass. Coils* are usually wound with 35 B.W.G. s.c. wire up to a resistance of 200 ohms per pair; but for your model it would be best to use about a dozen layers of No. 28 or 30, as the circuit is very short. I send sketch of arrangement for drop-handle instrument, which will enable you to work with one battery. Fig. 1 is side view of cylinder which moves on an axis; it is insulated between D and B, shown by black line A; G is of brass; Z and C are flexible wires screwed to G, and lead to battery (see Fig. 2); B and D are of rod brass, and screwed either to the flange, as in sketch, or to spindle near flange; A may be of ebonite or hard leather; E E are steel springs screwed to base of instrument; F F should be so made as to act as a buffer as well as contact. Write again if not clear.—X.

FIG. 1



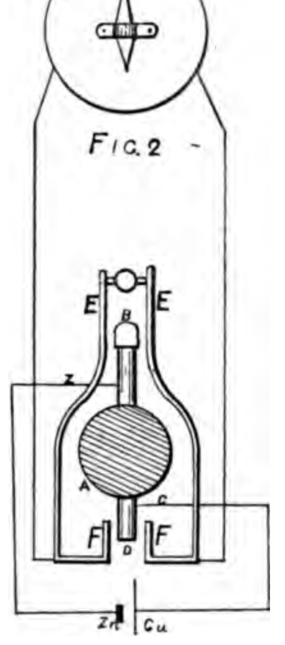


FIG. 2

[65829.]—**Radius of Gyration.**—I extremely regret to have hastily given radius of leverage instead.—F. CAWS.

[65829.] — **Radius of Gyration.**—There are one or two slight misprints in my answer to this question, probably due to similarity of letters. It ought to run: Let K^2 (not R^2) be the radius of gyration. The last two lines will then be—

$$K^2 (R - r) = \tfrac{1}{3} (R^3 - r^3)$$
$$\therefore \quad K^2 = \tfrac{1}{3} (R + Rr + r^2).$$—IGNOTUS.

[65831.] — **Strontium Chloride.**—Strontium sulphide, prepared by calcining the native sulphate with charcoal, and lixiviating, is treated with hydrochloric acid, when hydrogen sulphide is evolved, and strontium chloride produced; used in pyrotechny to prepare red fires; price about 2s., retail.—S. BOTTONE.

[65831.] — **Strontium Chloride.**—This substance may be made by dissolving strontium carbonate (Strontiamite) in hydrochloric acid, and evaporating to crystallisation. It is a deliquescent salt; 100 parts of water dissolve 66 of salt, boiling water 500, absolute alcohol 0·97. Its price retail is about 9d. per pound. This is the details of the commercial salt. The only use I know for it is for making red flames.—PRINCIPIA.

[65832.]—**Filtering through Charcoal.**—The way in which sugar refiners filter their syrup would perhaps answer—that is, by filling a large cylinder nearly full of charcoal, and passing the syrup through it.—PRINCIPIA.

[65832.]—**Filtering through Charcoal.**—If "A. E. F." would say what he wants to filter, he might probably get an answer. There i
culty in filtering through charcoal; but if
saccharine liquids, it is essential that th
be hot.—NUN. DOR.

[65333.]—**Hydro - Extractors.** — T
speed required necessitates the emplo
straps and friction wheels. Toothec
would make an awful row and soon l
machine to pieces.—B.SC., Plymouth.

[65334].—**Organ Building.**— I an
query at once. The querist states that
builder tells him that a bourdon should
in the middle," thinking that the afores
builder is quizzing him. Well, it may, o
just as you please; but it *must not be sm*
"bellying" of a pipe makes it more
Some bourdons are straight—those of th
class with high-cut mouths are an exam
old system was to cut the pipe up a q
breadth of the block and belly the bod
to it in a letter.—WM. ROBINSON, 14, H
Camden-town, London, N.W.

[65336.]—**Worms in Parrots.**—A s
improper feeding. I have owned a l
Indian paroquet for about fourteen yea
never been sick once. Birds having g
quire a plentiful supply of coarse, gravel
bottom of cage, oleaginous food, and no
messes. My splendid specimen only g
nuts or fresh Brazil nuts, with occasio
crusts of bread or plain biscuits, which
to his water tin and soaks for himself.
pepper (a saltspoonful) placed daily in
water. In their wild state they are such
of capsicums that they soon clear a p
Crack all the nuts for parrots, or their
soon wear out.—EOS.

[65339.]—**Oxidised Silver.**—This
plished by heating the silver in a s
potassium sulphide and other materi
forms a film of silver sulphide. It is,
rather difficult to get the articles the rig
it requires practice.—PRINCIPIA.

[65339.]—**Oxidised Silver** is a misno
dark colour is due either to a film of s
to the deposition of some other metal in
extreme division. To darken a silver ch
in a dish of hot water and add gradually,
stant stirring, a solution of some soluble
such as that of potassium or ammonium
the chain is coloured to taste, remove,
polish with leather.—SM.

[55340.] — **Simple Weighing M**
There is a machine made on the princi
"rider" of the chemical balance; in thi
rider is a large weight which slides on a
beam. The maker is Hinton, of Bedford
PRINCIPIA.

[65341.]—**Essences, Soluble.**—The
essences manufactured by "Soluble" tu
upon being mixed with water is on accou
spirits of wine being too strong, and con
taking up too much resinous matter along
essential oil; or, after they are manufact
the strong spirit, the essences are not de-
by him (a process for taking out the
portion of the matter that turns the wate
I presume he means by strong spiri
There are very few soluble essences inde
spirit of this strength. Without kno
class of essences "Soluble" wishes to
would be impossible to further advise hi
will state what essence it is he requires,
doubt I shall be able to assist him; or, i
advertise his address in MECHANIC, I
him.—GINGER.

[65343.]—**S.N. Telegraph.**—The ne
not stick if made perfectly free on th
North Pole pointing down and slightly
In the old form of dial the permanent
needles were soon found to be troubleso
to their loss of magnetism. Spagnoletti
this difficulty in his induced dial. In
needles are made in halves, as you will
upper fan and one pivot being brazed
lower fan and other pivot. They are of
and magnetised by the induction of
magnets at top and bottom of dial fra
teries, Fuller or Daniell.—W. PERREN-M
A.S.T.E.

[65348.]—**Mounting Photographs**
away your indiarubber solution and use
other people do.—B.SC., Plymouth.

[65348.] — **Mounting Photograph**
solution in question is probably a s
rubber in benzole. I have mounted a
hundreds of photographs, and don't thin
find a better mountant than good past
CIPIA.

[65349.]—**Antidote for Cyanide V**
The only safe way for conducting ex
with cyanides is to have a flue with
draught, or else perform them in the ope
mmonia is used, then the air will be

amonium cyanide which is formed, and which is bad as the vapours without any ammonia. A oth saturated with soda water would not be any od. I should advise you to be very careful in ndling these salts, or you will suffer in health, I have done; in fact, on one occasion, while aking hydrocyanic acid, I received such a dose at there were serious doubts of my ever getting er it; but this was some time ago, and I have arnt a little since then. I may perhaps mention at hydrocyanic (prussic) acid is the vapour which evolved by cyanides in contact with the air.—RINCIPIA.

[65350.]—**Optical Query.**—As "Astigmatic" es not give the declination of the sun at his .M. observation, I cannot offer more than a sug-stion in explanation of the difficulty; but that that the sun is low enough to cause a flattening the limb by refraction.—SM.

[65351.] — **Greenhouses.** — The velocity of aught varies as $\sqrt{}$ height from top of fuel to top chimney. The volume of draught varies as inimum area of vertical flue × velocity. When e min. area of flue = 1½ grate area, every square ch of flue only 1ft. high gives a consumption of out ·07lb. coal per hour. Taking "T. G.'s" imney top as, say, 8ft. above fuel, and area of e as $4^2 \times \cdot7854 = 12\cdot56$in., we have approximate nsumption = $12\cdot56 \times \sqrt{8} \times \cdot07 = 2\cdot49$lb. per hour. is supposes the bottom of vertical flue to be rectly connected with furnace. But "T. G.'s" e bottom does not receive the products of com-stion till they have travelled nearly 40ft. hori-ntally, and given up most of their caloric by the y. I think "T. G." should dispense with 4in. e pipe, build up 9in. square brick flue 12ft. high, d fit a damper to regulate the draught.—FRANK AWS.

[65355.]—**Chiretta.** — Stockholm tar, when ite fresh, is a viscid liquid, but soon hardens by eping. If you put it in water it will squeeze to a lump. About the size of a walnut in a glass ecanter it will impregnate the water for months -perhaps for years. All the large hardware shops d marine-store dealers keep it. "Tar water" an goudronnée of the French) long held a place in ngland as an antiseptic and vulnerary, internal d external. You cannot mix tar with water; he latter only absorbs a minimum of its resinous rinciple. Your disorder may arise from many uses; but plain chiretta infusion made fresh ery twenty-four hours may do you much good, may the tar water in addition; they can do no arm.—EOS.

[65356.]—**Gas-Engine.**—The valve in question probably the supply and exhaust valve, the nition being effected by the usual little flap lves at the side; is this so? The length of the lve depends on the length of casing, or chest, and e stroke; the shape depends on the position, &c., the ports or openings. Probably when the valve drawn out it admits the charge, when on the in oke it opens the exhaust, or it may be the re-rse of this. If you can give a sketch of valve-est, and say what the ignition apparatus is like, so what throw the eccentric has, I may be able set you going again.—ENGINEER, St. Mary urch, Torquay.

[65358.]—**Accumulators.**—The lamps can be rked from the dynamo at the same time that it is arging the cells, these latter being placed in unt with the main leads. If you run 48-volt mps on a 105-volt circuit, you will have to run em in sets of two in series to make them nearly ual (96) to the others, 105. But 25 cells will not ord sufficient counter E.M.F., so you will need a sistance between dynamo and cells. For full formation see Sir David Salomon's "Manage-ent of Accumulators," advertised in my list in Sale Column."—S. BOTTONE.

[65359.] — **Electric Tests.** — Through some biguity in wording, or some misprint, or per-ps because of my dulness, I fail to make any-ing out of the latter part of this query. The r is evidently used to short-circuit one or other the two coils, without detaching wire from the rminals.—S. BOTTONE.

[65363.]—**New Battery.**—This is no "foreign ibble," but a thoroughly untrustworthy British indle. I saw this in London, and, as I was not rsonally known, spoke to the representative ent, and got him to show it to me. I found on amination that it was a very ordinary chromic-id cell (sell), and would certainly not run for ore then three hours at a stretch to do any useful ork. When I showed my knowledge of the sub-ct, and expressed my surprise at the audacity of nturing to make such a statement as to durability d cost, I was told that "they sold very well, and e buyers generally concluded it was their own ant of knowledge as to proper treatment that used the failure; besides, there is such a demand for electric-lighting batteries, so we must y and satisfy the people."—S. BOTTONE.

[65364.]—**Bichromate Bottle Battery.**—Un-rew the nut on the top of the rod which carries the zinc. You can then slip the zinc, rod, and all out from below. Now unscrew the worn zinc plate, taking care to preserve the little square ebonite top, which prevents the zinc from touching the carbons. Give exact dimensions of plates in ordering. It will be also well to say whether you want the plates drilled and tapped, and in this latter case you must give diameter of hole, and number of threads to the inch of screw.—S. BOTTONE.

[65367.]—**Chiretta.**—In warm weather, stale chiretta is sure to ferment, and is therefore liable to cause griping and diarrhœa; make it as I do, fresh every 24 hours, and keep the jug in a cool place. Never take the mineral acids without medical advice, but a drop or two of pure sulphuric acid in the chiretta infusion might be beneficial, and would not hurt a child; besides, it is an antiseptic. "Too much of a good thing" is always hurtful. One wineglassful on rising and another on going to bed is the *quantum suff.* when once a torpid liver has been relieved. I have used chiretta with a minimum of hops in brewing table beer, admired by a clever doctor, who called it a "fine tonic."—EOS.

[65368.]—**Tungstate Toning Bath.**—Here is a formula from a good source, but I have not as yet tried it: Tungstate of soda, 20 grains; gold chloride, 1 grain; boiling water, 8oz. As soon as it is cool add the gold chloride, and it is ready for use. For using again, add 1 grain of gold and 1 grain of tungstate. The dark colour of the bath does no harm.—B.SC., Plymouth.

[65368.]—**Tungstate Toning Bath.**—Tungstate of soda 20grs., gold trichloride 1gr., boiling water 8oz.; use as soon as cold. Can be freshened up again by adding enough gold for one toning in hand with a grain or two of tungstate of soda to each grain of gold used. The tungstate should be obtained pure and of some reliable dealer: one quotes at 1s. 6d. per lb., another at 1s.—WALTER POTTER.

[65369.]—**Lime Toning Bath.**—Precipitated chalk, 10 grains; saturated solution of chloride of lime, 1 drop; boiling water, 8oz. When cool, add chloride of gold, 1 grain. May be used as soon as cool; but it is better to let it stand twenty-four hours.—B.SC., Plymouth.

[65372.]—**Recovering Gold.**—If the white powder is insoluble in water, it is probably oxide of tin.—SM.

[65372.] — **Recovering Gold.** — Collect the powder which is left from the solution of the plates, and boil it gently with a mixture of three parts of hydrochloric acid and one part of nitric acid (by measure); you will thus get a very acid solution of gold chloride. This acid solution is to be evaporated to dryness, redissolved in water, and shaken with whiting or chalk to neutralise the acid; it is then filtered and mixed with a strong solution of ferrous sulphate (green vitriol or copperas), when pure metallic gold will be thrown down in the form of a brown powder. The quantity of the sulphate required will be about four or five times the weight of the gold, but an excess won't hurt. The white powder which you notice is probably metastannic acid, due to a portion of tin in the brass. I don't think it will pay to recover the gold in this manner, unless the plates are pretty thickly gilt.—PRINCIPIA.

[65377.]—**Gas for Blowpipe.**—I believe Mr. Fletcher, of Warrington, makes a portable apparatus for use with benzoline.—SM.

[65377.]—**Gas for Blowpipe.**—Fletcher, of Warrington, makes furnaces for melting metals by means of benzoline and, where that is not obtainable, petroleum. The blower and generator could be applied, I am sure, to a Bunsen burner. Write to him.—B.SC., Plymouth.

[65375.]—**Calcium Chlorate.**—The reaction which takes place when chlorine acts on hot milk of lime is—

$$Ca(OH)_2 + 12Cl = Ca(ClO_3)_2 + 5CaCl_2 + 6H_2O,$$

From which you can see that it is impossible to obtain a pure solution of calcium chlorate by this reaction. Of course, in the preparation of $KClO_3$, the $KClO_3$ can be separated from the calcium chloride by crystallisation; with calcium chlorate this is impossible, owing to its solubility. The above reaction can be almost completed according to theory by the use of a large excess of chlorine. The only way to obtain pure calcium chlorate is to decompose the potassium salt with calcium-silicofluoride, in the same way that sodium chlorate is formed from sodium-silico-fluoride. The best way to perform this operation is to prepare hydrofluosilicic acid, and then treat this with a solution of potassium chlorate. The following reaction takes place—

$$H_2SiFl_6 + 2KClO_3 = 2HClO_3 + K_2SiF_6.$$

The clear liquid is decanted from the K_2SiF_6, and saturated with pure milk of lime, when calcium chlorate is formed. It is with difficulty crystallised, and is very deliquescent. A very practical method of preparing H_2SiFl_6 is given in Thorpe and Muir's "Qualitative Analysis." You must boil up your chlorate of potash with the acid, of course using as nearly as possible theoretical quantities. You may have difficulty in separating the K_2SiFl_6, as it forms a gelatinous precipitate. The best way is to settle and decant the clear liquor. The quantity of milk of lime to add may be calculated from the following equation—

$$Ca(OH)_2 + 2HClO_3 = Ca(ClO_3)_2 + 2H_2O.$$

—CHEMIST.

[65382.]—**Ruling Lines.**—Could not this be done with a camel-hair brush held against long ruler? I have drawn curved lines for drawings to illustrate a lecture thus with great success.—FELIX HOLT.

[65382.]—**Ruling Lines.**— Use a small paint-brush and a long ruler. I always use soluble aniline dyes for diagrams. Indian ink takes a lot of rubbing up. You need not be very particular about the neatness of execution—it is not appreciated at a distance. The bolder the lines the better, and give deep shadows when drawing solids. —SM.

[65382.]—**Ruling Lines.**—Cut a very small bamboo cane exactly the shape of a quill pen, and use with Indian or stencil ink ground up with water. There are pens made for edging tracings, &c., which are like a drawing pen on a large scale, the only difference being that they have double nibs. They may be obtained at Stanley's, or almost any large instrument maker's.—PRINCIPIA.

[65382.]—**Ruling Lines.**—You can purchase at any optician's double drawing pens which will rule your outside lines. It is very easy then to fill in between with Indian ink by means of a brush. For my own part, I would use an ordinary drawing pen: draw the two outside lines, and fill in with the brush. But "Diagram" may not have had so many years' experience with the drawing pen as I had.—B SC., Plymouth.

[65383.]—**Low Temperature.**—Before this can be answered in a scientific manner, it will be necessary to ascertain whether the winters have really become longer. Can A. F. Shakespear point out a longer and severer winter within these last thirty years than the one which took place between 1857 and 1858, and which, both by duration and severity, killed most of the vines in North Italy? —S. BOTTONE.

[65384.]—**Carbons for Leclanches.**—Cast on Make a mould with clay. The carbon is best coppered at the end, to insure good contact. In putting up a battery of any description, I first soak the carbon in paraffin; next give the end a coating of silver, which is afterwards coppered. The reason for using silver is that it resists better the action of any acid that may creep up, than does copper.—SM.

[65384.]—**Carbons, Lead Capping.**—See also reply 65277 at p. 262; the leads are cast on. Some makers copper the tops of the carbon by electrolysis previous to casting on the leads; but I find that if a little antimony be added to the lead, to insure expansion on cooling, not only is this unnecessary, but the result is actually a longer lasting contact. The moulds may be made in plaster, if for a few only, or in iron, like a bullet mould, if many are to be done.—S. BOTTONE.

[65388.]—**Tennis Shoes.**—Pipeclay your buckskin shoes as the soldiers do their belts.—B.SC., Plymouth.

[65388.]—**Tennis Shoes.**—A paste of pipe-clay, with a small proportion of size; brush off when dry.—SM.

[65388.]—**Tennis Shoes.**—Clean them with a sponge, soap and warm water, rinse, and wash well with a solution of oxalic acid. This will clean them perfectly; if you wish to have them very white, rub in a paste of pipeclay and water in which a small piece of soap has been dissolved.—PRINCIPIA.

Utilisation of Drill Holes.—A novel method of conveying power to mines is described in a recent number of the *Colliery Engineer* as being in use at the Shenandoah mines, Pennsylvania, in which, as the lower level of the Mammoth seam had been, in 1883, nearly worked out, it became advisable to develop new workings. To convey power to these, an 8in. hole was drilled from the surface to the seam, a depth of 244ft., and when finished this hole was lined with a 5⅝in. casing pipe, through which was passed a 1in. steel wire rope, transmitting the power required for hauling purposes below. A second borehole, 6in. in diameter and 118ft. deep, was also put down, and through it were passed two 2in. pipes to be used as a speaking tube and for a bell wire, to permit of communication between the engine-house and below ground.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

64773. Mineral Waters, p. 69.
64776. Mechanical Organ, 69.
64786. Double Star near Eta Orionis, 69.
64804. Encke's Comet and Faye's Comet, 69.
64811. Kites, 69.
64816. Time Keeper, 70.

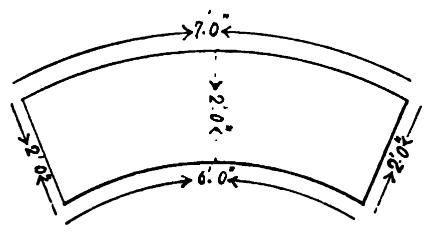
64999. S.E.R. Engines, p. 155.
65003. Rag Water, 155.
65023. Dew Point, 155.
65028. Microscopic Lithology, 156.
65035. Rifling and Rifle, 156.
65039. Recovering Tin and Zinc, 156.
65041. Persian Mystic Jewels, 156.
65047. Armature Velocity, 156.
65049. Dry Battery, 156.
65050. Violin Bow, 156.
65062. Great Western Railway, 156.
65067. Electro-Deposition of Carbon, 156.
65068. Electric Bell, 156.

QUERIES.

[65389.]—**Fibre.**—Which machines for the extraction of fibre from pineapple and plantain leaves can be specially recommended for efficiency and economy ?—GLAVE.

[65390.]—**Iridio-Platinum Gauze.**—Some 15 or 20 years ago I remember a description of the above being used to increase the actinic power of gas for photography. Can anyone give me the reference ?—ROSICRUCIAN.

[65391.]—**Trapezoid.**—Please tell me exact mean thickness or solidity of piece, as per sketch, and give rule for working same—5-16in. thickness top; ¼in. thickness bottom; regular taper throughout ?—P. R.



[65392.]—**Sunshade for Woodenette Perambulator.**—Would any reader be kind enough to inform me of an easy and cheap method of making above ? Please describe way to fix it.—MONA.

[65393.]—**Screw-Cutting.**—Will some kind reader give wheels to cut 20 threads in 6½in.? Leading screw 4 threads. I have tried all I can to cut it, and have not succeeded.—ANXIOUS.

[65394.]—**Grinding Glass.**—Can glass be ground by a persevering amateur in the lathe? I know how to fasten to centre, but do not know what it is ground with. —L. GUBBINS, Cappoquin.

[65395.]—**Fixing Charcoal Studies.**—Will some one of artistic experience kindly state the simplest way of fixing charcoal studies of heads, &c ? Is there a means of rendering them permanent by previously going over the drawing paper with a solution of any sort ?—SMUDGE.

[65396.]—**To Mr. Bottone.**—Would you look at the "Electro Motor," described in the "E. M." of 6 April, and say if the magnets might be of one casting, or in two halves, so as to join at the ends ? Would No. 16 B.W.G. answer for winding armature and magnet ? Is there any difference between American W.G. and B.W.G. ?—J. M.

[65397.]—**Wimshurst Influence Machine.** — Will some one kindly tell me of what material the brushes on the neutralising rods are made, and whether they have to touch the revolving plates, or only be set close to them ? —V. E. L.

[65398.]—**Hook Tools Again.**—To "COPEAUX."— Please help. I greatly need one or two hook tools for hollow work, but cannot make out how the tools illustrated by you cut. I thought I had it all right and got one made, but when I went to use it I was undeceived.—L. GUBBINS, Cappoquin.

[65399.]—**Power for Small Lathe.**—I have thought that there may exist a means of driving a small lathe by a contrivance of the nature of the weights of a clock, or such as the heavy weight, &c., of those machines for making gas from mineral oil. Can it be done, and with what success ?—L. GUBBINS, Cappoquin.

[65400.] — **Engine Formula.** — Would "T. C. Bristol," or some other, favour with a formula I believe to exist to check the brake H.P. of engines by weight suspended by belt across circumference of wheel of known diameter, velocity, and other moments ?—APPENDIX.

[65401.]—**Block Signalling.**—Will some of our practical railway men kindly favour me with the details of block signalling, description of instruments, and number of rings for "line clear," "be ready," "train entering section," &c. ? My knowlegde at present is rather hazy. —U. O. G. T.

[65402.]—**Electricity.**—Can any reader kindly give me an instance of any machinery being driven by electricity, *the generator being situated some* distance from works, say, 5 miles, with particulars as to power transmitted, voltage, and H P., actual loss in transmission, weight of cable, &c. ? Also if there be any textbook of tables, formulæ, &c., of electricity similar to "Molesworth."—J. T. P.

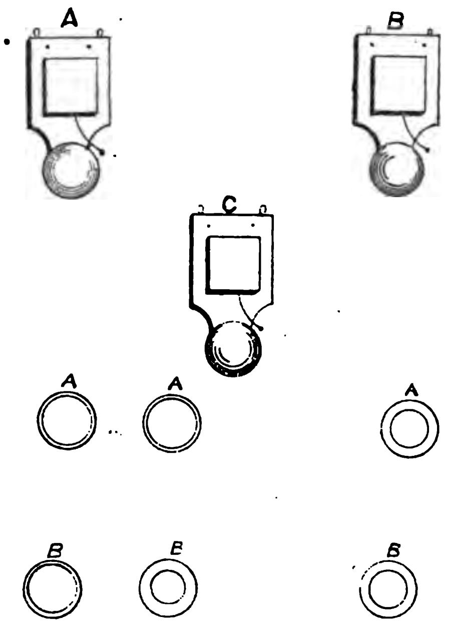
[65403.]—**Bicycles.**—A practical cycle mechanic's reply to the following queries is requested. How is a handle bar (hollow tube) attached to head ? How is it bent ? What tools are used, and how are handles fixed on ? How is a crank taken off which is keyed on ? What advantage, if any, have pear-shaped over T handles, as I notice that the straight handles are again coming into fashion, particularly in racing machines ? Has any book ever been published dealing with the construction or repairing of cycles that would aid ?—A BEGINNER.

[65404.]—**To S. Bottone.**—How is an electro-motor started, speed regulated, and stopped ? Kindly give sketch of arrangement on which brush carrier of Reckenzaun's ordinary reversing motion for motor is pivoted ?— EKOTS.

[65405.]—**Twist Drills.**—I have a number of twist drills for holding in a self-centring chuck ? How can I adapt them to a carpenter's brace made to hold square shanked bits ?—Z.

[65406.]—**Tampico**, sold in London as Mexican fibre said to be the produce of Agave heteracantha. Should be pleased to learn how this fibre is extracted, whether by machinery or hand labour.—GLAVE.

[65407.]—**Electric Bells.**—Will Mr. Allsop or Mr. Maycock kindly tell me the most certain way of connecting up bells and pushes, as shown on inclosed sketch?



Pushes A A A should ring bells A and C, and pushes B B B should ring bells B and C. I don't mind using relays and two batteries if that is better.—J. W.

[65408.]—**Developer.**—Will one or more of your able photographic correspondents give me a good formula for making up a concentrated developer for ordinary dry plates ? By concentrated I mean a developer which can be made up so that a mere addition of, say, four or five parts of water renders the mixture ready and complete for development purposes, without having several stock and other solutions on hand.—NEGATIVE.

[65409.]—**Automatic Switch.**—How can I make an automatic switch for use in charging accumulators ? To work this when the E.M.F. of the dynamo exceeds that of the cells, the switch will automatically connect the dynamo to the cells, and when the E.M.F. falls to zero the switch will break circuit (wound for 40 cells in series). Will Mr. Bottone, or "Electrician" help an old subscriber with plain directions ?—SWITCH.

[65410.]—**Tennis Balls.**—Can any reader suggest a use for old lawn-tennis balls ? As a rule those left over from last season are mostly useless for their legitimate purpose. Some are too soiled. Others, though clean, have become hard in the winter and have lost their spring, consequently they burst when used. It seems a waste to throw them away, and still they are no good. As trophies, or formed into ornaments for halls, or for sale at fancy bazaars, they might turn out to be of some good.—A. LLOYD.

[65411.]—**Tiles.**—I want to make some roofing tiles to be a good red colour after they are burnt; the clay I make them of will not burn a good red. I know there is some kind of composition used on the surface of them in some potteries to obtain the desired colour, and I should be very glad if "Potter" or some other reader could tell me what colouring I could use.—TILE-MAKER.

[65412.]—**Lerebour's Lens.**—To MR. S. BOTTONE.—I also have a ½-plate lens by the above maker and have eagerly perused your reply to W. A. Abingdon. The sizes quoted by him are the same as mine. Will you kindly say if my lens can be used for taking architecture without the walls appearing intoxicated ? The front glass is a plano-convex, and the back glass a concavo-convex separated by a brass rim from a double convex.—W. H. KINGDON.

[65413.]—**Waterproofing Straw Cardboard.**— Can any reader inform me how to render ordinary straw cardboard thoroughly waterproof ? They will be subject to heat arising from a composition composed of gelatine and glycerine which is poured on to the ca in a hot liquid state. I want the board so wa proof as not to allow the dampness from the to penetrate it. Oil paint will not do, as all be avoided.—COMPOSITION.

[65414.]—**Caledonian Ry. Loco.**—I seen what appears to me to be a new class o on this line. The cylinders — outside horizontally, having the upper guide bar piston rod, the wheels, six-coupled, are plac together, and the trailing axle passes in fro box. Could anyone give the dimensions a this class of loco., and say if it has any ad the ordinary type ?—J. A.

[65415.]—**Micro-Photography.**—In e in this branch of work I have found a grea getting a sufficient amount of light to illumin so as to obtain a good photograph. Whilst v 1in. objective I can obtain a tolerable result direct illumination from a paraffin lamp, but v with a ¼in. on some minute object the light and the object is wanting in contrast. Is t the objective being an inferior one, or to th substage condenser ?—W. H.

[65416.]—**Electric Gas Lighter.**—I Clarke's electric gas lighters, but the battery run out, and it is now useless. I have o battery and find glass tube in middle from v minal issues. This glass is surrounded wi tied round with thread. Outside this is a like Bunsen battery, this zinc is the other suppose it is a chloride of silver cell. I ha once of this form of cell, but shall feel mu some reader will tell me how I am to rem Must I open glass tube and unwind the threa perfect and acts with a bichromate cell. T is referred to in Vol. XXXV. p. 472.—A. B.

[65417.]—**Horizontal Engine** —Wo Bristol," or some other qualified mechanici form me whether there are any reasons why should not be placed about midway along the horizontal engine? I have charge of a cylinder engine manufactured by Robey, of has a grease-cock in centre of cylinder cover is not sufficiently lubricated from that positi disagreeable squeaking. Cylinder is not jacket perhaps grease-cock might be removed f cover and fitted into body of cylinder about op at half-stroke. Would the tapping hole be li trouble in the cylinder, such as edges breakin friction of piston, &c. ? No objection woul having to stop engine to oil the cylind DRIVER.

[65418.]—**Alteration in Colour of I** In 1886 I planted some scarlet Lychnis, wh freely and normally both in that and the foll This season the flowers of the same plants ar Cydonia japonica, planted in the autumn of 18 blooms in 1887 of a pale pink instead of the exp This year all the flowers on this shrub were crimson as those of the ordinary Pyrus. door neighbour had in 1886 a quantity of choic gloves. Last year the same plants produced p only. Similar variations were observed in the c williams and antirrhinums, in which diverse c times appeared together upon the same stem. C your horticultural readers give the explanatio facts, or refer me to any authority treating o of such phenomena. Soil is clayey, aspect sout walls red brick, locality—EALING W.

[65419.]—**Cape Colony and Emigr** should be glad of the opinion of some reader w to the above. I am a married man, 35 years o four children—three girls aged respectively 13 years. Also one boy 19 months old. I am wel working and repairs to colliery plant and mac and lathe work. What chance of success sho out at the Cape ? I am ready and willing, an of hard work. Am at present employed at a colliery in Yorkshire as turner and fitter, or c take the duties of engine driver and fitte having had 17 years' experience as general ha high- and low-pressure engines—chiefly high-WOULD-BE EMIGRANT.

[65420.]—**Optical Lantern.**—Will some give full instructions for making an optical l able for showing slides and performing exp optics as described in Vol. XXXII. by Lewis am quite ignorant of the construction of la what lenses are used, and want to know how in the cheapest effective manner, having very to spare. At the same time, I don't wish t on an affair too cheap to be any good. I hav a tinman's shop, and think I can do the w rackwork can be dispensed with.—F. W. S.

[65421.]—**Drying Stove.**—I am desirous a drying stove for drying timber, say, 25ft. by and I shall require to pass through it by me large quantities of warm air at about 10 correspondent inform me the best and chea obtaining this hot air ? I have a steam-engi My present idea is to have an outside ch steam pipes heated with live steam. Any d number of super. feet of steam pipes to hea air per minute to 100° will be of value. It considerable saving if I could pass the h peatedly through the stove till it was alm with moisture and would be useless to send i Can this be done to be of any benefit ?—J. W

[65422.]—**Chuck for Pointing and Wire.**—How best could iron or brass wire gauge, in lengths of 4in. to 6in., be pointed a drilled ¼in. deep at the other ? Could this b pin-making machine simply by substituting the heading tool ? Could any simple chuck doing the same work in lathe, wire to run in drel, and chuck be held on poppet and be for by poppet screw ?—J. C.

[65423.]—**Water-Pipes.**—The Water C now lot of pipes, substituting galvanised f Since then the water has been more or less wh to have some fine white powder in suspensio one tell me what this powder is and whether

No. 4 above. 2. The old single-needle alphabet, and the Morse.)—C. H. (Yes, or not dressed at proper time. Take it to a furrier and he will tell you if he can do anything with it.)—BARMOUTH. (They are produced from solutions of the salts. 2. The pots want cleaning by soaking in several waters. See indices.)—J. S. F. (What sort of battery do you want? You will find full instructions for making every useful variety in back volumes. See indices)

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Silvered Glass Specula.—A few of my choicest reserves only left. Exchange Scientific Apparatus.—WITH, Hereford.

Model Engines—A pair of first-class compound Horizontal Models, all made to scale, governors and boiler, pump to act, value £12. Wanted, good 52in. Bicycle.—M. J., 33, Market-place, Willenhall.

Wanted, 2 Manual-organ **Keyboard**, double Soundboard (about 6 stopped), bellows, &c., thoroughly sound and cheap. Exchange Musical Instrument, Cigars.—HOLT, Ormskirk.

For exchange for Rear-driving Safety, 8in. brass Theodolite, without stand. What offers?—DAVISON, Coombecote, Windsor.

Wanted, small Dynamo for plating. Will exchange CORNET complete, or 7-string Banjo, or Watch and Chain, or 2 Bassoons.—26, Parliament-terrace, Nottingham.

1 pair of back-geared **Lathe Heads**, 9½in. centre, and compound slide-rest. Exchange for Scrap Brass to £4 value.—SMITH, 107, Granby-row, Manchester.

Ram **Force Pumps**, various sizes, exchange separately for Scrap Brass, value from 5s. to £2.—SMITH, 107, Granby-row, Manchester.

Useful **Drilling Machine**, for power. Exchange Scrap Brass or anything useful.—SMITH, 107, Granby-row, Manchester.

52in. **Bicycle**, by Coventry Machinist Company, hollow forks, all latest improvements. Exchange for Half-horse Boiler or offers.—ROBINSON, 100, Stockwell-road, Brixton.

3in. achromatic **Object Glass**, 46in. focus, in brass cell. Exchange Microscope or offers.—BROWN, 79, Victoria-road, Clapham, London.

Marion's Academy **Camera**, for exposing 12 plates in rapid succession, 1½in. square. Wanted, ½-plate Camera or offers.—D., 58, Evington-road, Leicester.

Perfect set of **Screwing Tackle**, with four pair of dies, plug and taper taps, 1¼in., 1½in., 1⅝in., 1¾in., unused. Offers requested.—GARRETT, Towcester.

Cricket Bag, never used, quite equal to new, cost 30s. Exchange offers.—ERNEST ALLCOCK, care of R. Brittain, Oakengates, Salop.

Accumulator and small Lamp, Cylinder Machine, 11 by 6, and powerful Induction Coil, minus contact breaker. What offers?—G. R., 52, Bloomfield-road, Plumstead, Kent.

To Electrical Engineering Students.—Valuable Standard Works on Electrical Engineering, &c., in exchange for good Lathe or offers.—M., 59, Church-road, Homerton, E.

1½H.P. horizontal **Steam Engine**, in first-class condition. What offers?—A. IBBETT, South-street, St. Neots.

Will exchange good **Medical Coil**, 8 by 32in., for anything useful.—T. ASKHAM, 49, Market-street, Wellingborough.

Wanted, 50in. Bicycle. Exchange 8 hole **Indicator**, 3 Bells, 8 Pushes, and 3-cell Battery in box, all new.—As below.

Large **Medical Coil**, fitted with dial and switch for six powers, fit for in or out doors, all new. Exchange Safety Bicycle.—B., 3, Victor-road, Holloway, N.

Baby **Bassinette**, carriage springs, bicycle wheels, reversible folding hood, brass fittings, and straps, cost 3 guineas. What offers?—CORA, 6, Albert Villas, Clifton-road, South Norwood.

"**Newton's Principia**" with old subscribers' names, perfect condition. What offers?—PARKER, Fulham House, St. Leonard's-road, Norwich.

Dynamo, 60 candle-power, Siemens laminated armature, series wound, in perfect working order, equal to new. What offers?—C. A. BEAL, Westgate, Peterborough.

One horse-power vertical **Engine Castings**, with all forgings complete, pump, flywheel, bored, parts of castings planed, cost over £4. Wanted, View Lens for 10 by 8 camera, or offers.—C. A. BEAL, Westgate, Peterborough.

Perfectly new genuine high-class rear-driving Safety BICYCLE, never ridden, plated, balls, hollow throughout, latest 1888 improvements. Exchange Bicycle or Tricycle in part payment.—CYCLIST, 2, Ansford-road, Castle Cary, Somerset.

What offers for "**English Mechanic**," from July 1st, 1887, to February 17th, 1888, all clean. Exchange anything.—G. HOWARD, 55, Percival-street, Clerkenwell, London.

Will exchange **Air Gun** for good Parallel Vice, *weight about 15lb.* Air Gun no worse than new.—J. R. PYBUS, *West Burton, Bedale.*

Gas Engine, 1-horse, vertical atmospheric, by Crossley Bros., in good working order, with water tank and pipes complete. Offers.—W. HUTCHINSON, Liversedge.

Concertina, 32 keys, by Lachenal, London, cost 5 guineas, take 3 or exchange for good 12 by 10 Rectilinear lens.—NASH, 275, Causewayside, Edinburgh.

Wanted, Photographic, Optical, or Electrical Apparatus, &c., for exchange on commission. Repairs on the premises.—See below.

The cheapest house for **Scientific Goods**, &c., is the SALE and EXCHANGE DEPOT, 2, King-street West, Manchester, H. W. Harris, agent.

Quarter-plate **Lens**, by Lancaster, and 4 volumes of Year Books of Facts, rare, bound in good condition. Exchange camera stand.—JOHN GREATOREX, 71, Dale-street, Burton-on-Trent.

Two 5 doz. **Partition Wood Cupboards** for bottled wines, roller doors panelled. Large dining table, 13ft. by 4ft., suitable for board room.—WILKS, Burnley.

Hardy British **Ferns**, 24 varieties. Exchange anything useful. See Sale Column.—JOHN BURNS, Fellside, Kendal.

Hand Dynamo, laminated armature, quantity of Electrical Apparatus, Sewing Machine Stand, suit dynamo. Photo. offers.—A. LAUNDY, 62, St. Peter's-road, Mile-end, E.

New 56in. **Bicycle**, ball back and front, hollow rims, oval backbone; 2in. bore Oscillating Engine; Photographic Outfit complete; Carved Old Oak Chest. Offers invited.—7, Belmont-grove, Birkenhead.

Lawn Mower, 8in. grass box, complete, cost 50s., now worth 40s. Exchange Jewellery.—Offers to W. SMITH, Bilston-road, Wolverhampton.

Bicycle, 54in., ball bearings, hollow forks, part plated, new last year. Exchange for 52in. or rear-driving safety.—C. PENNY, North Cadbury, Bath.

Frictional Machine, quart Leyden jar, brass conductor, sliding rubber, mahogany stand, 1½in. spark. What offers in exchange?—PEARSE, 16, Thanet-street, London, W.C.

Wanted a **Lathe** in exchange for the following articles. 45ft. Leather Belt, Crompton Arc Lamp, a Reflecting Circle by Troughton.—H., 21, Westbourne Park-crescent, London, W.

Cruising **Canoe**, 11ft. long, 30in. beam, copper fastened, new, with paddle, masts, sails, rudder, &c. Wanted, Gas Engine, to give off ½H.P., or offers.—ANDREWS, 1, Tavistock-terrace, Holloway, N.

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4in. **Continuous Bell**, 2 batteries, 4 alarm contacts, 150 yards of wire, quite new. Exchange to value 15s.—S. LOUIS, 101, Wynford-road, Barnsbury, London.

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Advertisements are inserted in this column at the rate of 6d. for the first 16 words, and 6d. for every succeeding 8 words.

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Manganese Oxide specially prepared for Leclanche batteries; high strength and purity, greater E.M.F., constant action; been in use 15 years with immense satisfaction; 7, 14, and 28lb. packets. Prices on application.—GEO. G. BLACKWELL, 26, Chapel-street, Liverpool.

"**The Indispensable Bicyclist's Handbook**" By Henry Sturmey. Constructional details of every Bicycle and Safety Bicycle in the market, with all patented and other parts and designs. 400pp.; 400 illustrations. Post free, 2s. 10½d.—ILIFFE and SON, 98, Fleet-street, London.

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Wire.—Large quantity No. 18 double cotton-covered, for winding dynamos, motors, electro-magnets, &c., 1s. per lb.—GILLETT, 36, Red Lion-square, W.C.

Wire.—Quantity of No. 36 and 38 silk-covered wire, good condition, moderate lengths, 3s. 6d. per lb.—GILLETT.

Wire—Quantity of No. 34 cotton covered, good, suitable for winding telephones, bells, induction coils, &c., half maker's price, 2s. 6d. per lb.

Bells.—30 2½in. Electric Bells, in polished mahogany, plated domes, really good, 3s. each.—ERNEST J. GILLETT, 36, Red Lion-square, W.C.

Write for **King, Mendham, and Co.'s** (Bristol) new ILLUSTRATED CATALOGUE, 4½d. Acknowledged to be invaluable to amateurs.

"**Dynamo Building for Amateurs.**" By F. Walker. "How to Calculate Winding for all Sizes of Dynamos," illustrated, cloth 2s., postage 1½d.—ILIFFE, 98, Fleet-street, E.C.

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Milnes's Lathes are now on view at 17, Ba Farringdon-street, E.C. Inspection invited.

A Hall-marked silver-mounted square stem Bri Do., richly engraved, 1s. 5d. All carriage free.

A Hall-marked, Silver-mounted, French SCHAUM, in case, 24 stamps; ditto, richly engraved, 30 GEORGE.

Patent **Asbestos Pipe**, 1s. 6d. "Free an Pipe, 11d.; silver mounted, 6d. extra; engraved, 1s. extra

Inscriptions, monograms, and crests eng all kinds of Watches, Jewellery, and Plate.—GEORGE. 1860.

Meerschaum and Briar Pipes Rep mounted, or cased, ambers fitted.—W. GEORGE, 334, Islington, London.

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Toned **Sensitised Paper.**—Splendid p toning, only requires fixing. Sheet, 22½in. by 17½in., MEDLAND.

Matt Surface **Sensitised Paper**, artistic to chocolate to platinotype, sheet, 22½in. by 17½in., free, LAND.

Caution.—Avoid imitations of above splendi at cheaper rates. Original only of MEDLAND, Borough, 1

Job lot **Incandescent Lamps**. Batteries, S Cable, Porous Pots, Jars, cheap.—Apply, 35, Waterlo road, S.E.

Turning Woods.—Ebony, Rosewood, Vitæ, Cocus, Botany Bay Oak. Parcels, 5s. and 10s.— BROTHERS, Settle.

Purest and Finest American **Lubricants**.— American Compounds for heavy machinery, gearing, &c., per cent. Sample lb. for 1s. Pure gas engine oil, sampl including can, 1s. 6d.—75, Commercial-street, London, E.

Japanese Bamboo Fishing Rods, 6 or 1s. 6d. each, post free.—BRISTOW and COMPANY, Hull.

Strong **Lathe Castings** in sets, planed and standards, slide-rests, wheels, &c. State requirements.

Strong 3½in. back-geared **Lathe Heads**, planed, 15s. Particulars stamp.—JARRATT, Queen-street, L

Boiler, vertical, 1 H.P., complete with fittings, condition, cheap.—73, Stanley-grove, Longsight, Manches

Dynamos and Electrical Goods, secon Send for list.—KING, 13, St. John's-square, Clerkenwell, L

Magnificent litter of St. Bernard Puppi Champion Plinlimmon; the largest known dog in the w whom over £1,000 was paid. Can be sent on approval bef chasing. Write for full particulars.—Dunkeld Lodge, St. Herts.

Cheap **Foundry Patterns** and Core Boxes mates free. Send sketch.—CHARLES READER, 66, Plumst Plumstead.

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Before Ordering any of the above, send fo tions to STAMFORD WORKS, 26, Binden-road, London, W.

Grand **Musical Competition**, open to the Entrance free. See *Musical Bits*. 1d. All newsagents.

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Piles cured first application. Palmer's " Ointment," 13½d. (internal remedies included).—Chape West Auckland, Durham.

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Palmer's Compound Sarsaparilla **Blood P** Most infallible medicine known. Prescription, 13½d. b pills included, 2s. 6d.—Above.

Castings.—Cheap and perfect. New Ill Catalogue of every pattern Engine, Lathe, and Drilling Castings, 1 stamp.—TOMLIN, Engineer, Highfield-terrace, Yorkshire.

French Polishing, Painting, Staining, a nishing. 125 genuine Trade Secrets, with full instru details, post free, 1s.—TOMLIN, Highfield-terrace, Barns shire.

S. Bottone, Carshalton, supplies the f Electrical Books and Apparatus. Invaluable to Electrical an Engineers.

"**The Dynamo: How Made and How** 2s. 6d., post free. "The Gramme Dynamo," ditto; A 1s.

"**Electrical Instrument Making** AMATEURS." With 59 Illustrations. Post free, 3s. Every tive detail clearly given.

"**The Management of Electrical In** TIONS," including Accumulators, Engines, Dynamos, A Voltmeters, Lamps, Switches. Post free, 3s.

Four-celled Battery and Lamp, £1, w pact. Chromic Acid, post free 1s. per sample tin.

Punchings for laminated armature, from 8in. in diameter, from 4s. to 50s. per gross.

Dynamos of the Highest Efficienc 15s. to £20: for lighting, plating, cauterising, and exp work.

Dynamo Castings.—Beautiful sets fo Dynamos, finished ready for wire, 10s. each; warranted e

Castings, Siemens, Gramme, Manchester, 5s. to £10; also for Motor, described April 6th, 15s.

Ammeters, Voltmeters, Galvanomet each. Tangents, 10s. Standard Ohms, 2s. 6d. Bridges, 1½d.—S. BOTTONE, Carshalton.

e English Mechanic
WORLD OF SCIENCE AND ART.
FRIDAY, JUNE 1, 1888.

ROSCOPICAL ADVANCES.—XXXVII.

r. Royston-Pigott, M.A. Cantab., S., F.R.A.S., Memb. Roy. Coll. icians; Fell. Cambridge Phil. So-; formerly Fellow of St. Peter's ege, Cambridge.

ches in High-Power Definition—nuated Lines, Circles, and Dots.

: very beautiful tests of quality escribed in the last article are almost *herché* to be explained in a popular ; but the subject is so fascinating ttempt at explanation may be per-

n two mirrors (flat) are joined together in the same plane, a small beam of t causes Fresnel's celebrated inter-s to appear. The same thing occurs glass prism is used having an exceed-btuse angle. A black central band is hen the sky is free from haze or scirri. is formed of an infinite number of simal prisms, the first black band now he form of a black circle. In the case clefts the rays interfere, coming from nser, being reflected by the walls of ck; and accordingly clash or interfere, g the exquisite black test-ring before ed. This line is so incredibly thin as een only by the best glasses I possess, ably those by Powell and Lealand.

e are numerous other similar lines to covered where the rays interfere, unsuspected. A great many observa-ve shown them in ribbing of scales, Poduras, Lepismas, Macrotomas, and ales of the finer sort. They were first d as produced by the ribs on the ia scales.

imary novelty now to be adopted is he celebrated Podura markings are s, and exist only in an upper focus. lie the real structures. Interrupted argins to the ribs can be found re-g cylindrical shadows, which, like ca cracks, are on one side thicker and

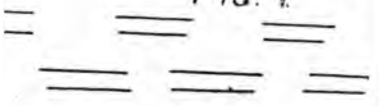


FIG. 1.

when the light comes obliquely (see

ery keen focussing and collar adjust-se marginal black lines behave pre-s cylindrical threads do; and, besides hen nearly vanished, a very thin black line parallel, but above them y appears as a most exquisite inter-phenomenon along the centres of the

like sweeping away the old land-Aloft lie the celebrated spines; at first start forth the black lines; till the interrupted shadows; eidolic d rich beading. All this is missed ssing solely upon the spurious spines, , as it were, aërially above all.

eration of ribbing and beading, when nd lower stringlets cross or interlace, ost common occurrence. In those ful scales of *Morpho Ganymede*, x after rouleaux appear to twist and low each other, and, then and there, ling vanishes, to reappear further on. xquisite structure, giving strength to fragility, besides endowing all with glittering beauty.

Seen with a low power, the famous watered-silk marks appear in the greatest perfection—sure signs of crossing structures intercepting the light.

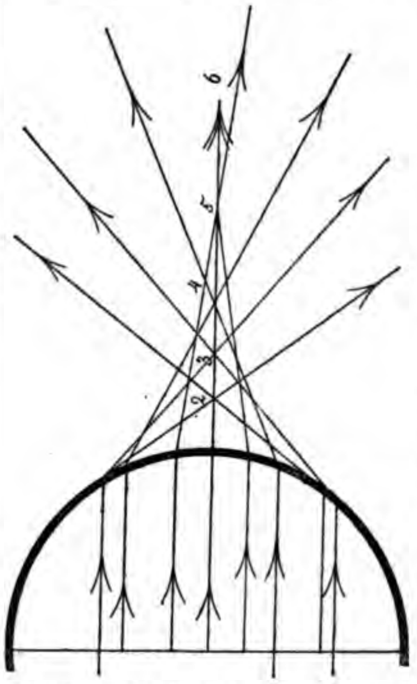
(1) **Attenuated Circles** are the most difficult enterprises of microscopical research. Perhaps it will interest the reader by descending from the exceedingly large to the excessively minute. An ordinary "bull's-eye" exposed to a small, brilliant beam of light under a strong lens applied to the focus displays concentric circles of interference when examined in the microscope, enriched with all prismatic colours. A small globe of glass emits also coloured rays, interfering and developing black rings. Eyes of insects properly managed do the same thing.

A convenient size is a lens of one-quarter of an inch focus secured on the stage by screwing it into a brass plate. Under a solar beam it shows a brilliant central disc surrounded with an intensely black ring, besides forty-eight others. But the results of this research are truly surprising. Very gradually raise the focal plane of vision—a series of black dots can be detected along the axis when superb glasses are employed,* as attempted in the diagram—the result of clashing shells of light.

Exactly the same thing can be often done with insect eyes and very large isolated spherical beads displayed by diatoms, which are also capable of producing double-star images of brilliant beauty.

To glance at these results:

Firstly, a small lens. Hollow conical shells of rays in series intersect along the axis, and form interference black points in different focal planes. Only the finest glasses can



detect them. Many kinds of rings surround them. The above figures both illustrate (1) and (2).

Secondly, a beetle's eye displays them all, also, with great perfection; but the management of the light is unusually difficult. Fig. 4. At last, after a great many attempts, my best ⅓rd objective resolved the rings completely (Baker's, of magnificent quality).

A very small hole formed by Iris diaphragm beneath a "quarter" objective condenser produced a delicate beam of light, the lamp being placed as near as possible, which intensifies the light inversely as the square of the distance. A variety of startling effects is developed. Slack's diaphragm eyepiece answered perfectly, reducing the field of view. Rings and red beads richly displayed. A short body, armed with Powells best ⅛th and a low eyepiece, exhibited brilliant effects quite unequalled by any other glass; double stars, by using a disc perforated with two apertures, were admirably distinct in the proper focal plane.

(2) **Diatomic Lenses.** — Widely-separated spherules, varying from 1-9000th to the 1-70,000th of an inch must be sought for. Here is a small list.

(*a*) *Stictodiscus Buryanus.*—Unfortunately this frustule has two sets of beading, one below the other. When the upper set are white, the subjacent are perfectly black and frequently overlap. The largest beads are 1-9000th in size. The intensely black ring—very thick and broad— appeared 1-45,000th thick. At the centre of the ring a most delicate secondary ring appeared accurately circular.

(*b*) *Navicula Californicus.*—Weak amplifier. Powell's ⅛th immersion. Two sets of very distinct beads, as before, each well shaded off. Size of beads, about 1-12,000th. The second set are nearly placed also 1-12,000th below the first set. A Ross 1¼in. glass of very fine quality was employed as condenser, together with a very minute hole formed by the Iris diaphragm. Rich central pearls appeared on an ivory ground. Delicate sapphire edged with black in the middle of the focal disc.

(*c*) *Stictodiscus Moronensis.*—Well separated spherules, double set of dots, some overlapping.

(*d*) *Cestodiscus Superbus* (Bardadoes).—Same kind of illumination. Powell's solid stop No. 1 and 1·28, oil-objective, two-thirds objective as condenser; image of stop black, and finely-defined in each spherule, of which there are about 10 widely separated, the largest 1-12,500th in size. The central dot is 1-120,000th, showing two dark rings. Gillet's condenser produced in a spherule an image of black stop and its two arms.

(*e*) *Actinoplycos Undulatus.*—Chequered beads 1-48,000th, one seen partly covering a black one. Here also is a double set, upper and lower. About six forms of interference circles and dots were detected.

It was on this very object that a conviction was forced upon me that an iris diaphragm produces an image-circle within the bead which varies in size exactly as the iris aperture does. Images of distant objects were now diligently sought for with gratifying success. A distant church-steeple had already been brought to a focus by a beetle's eye; it was then desired to search for images in diatomic beads. The vertical mullion of a south window offered great advantages; it is 12in. broad and 120in. from the microscope. Could the image be found, measured, and the sidereal focal length of the bead be clearly demonstrated?

First the mullion-image was measured, then by optical calculation the focus was found of a spherule of *Creswellii superbus.*

Image of mullion = 1-60,000th of an inch; focal length of spherule = 1-6,000th of an inch; miniature of mullion is reduced here 720,000 times.*

That the mullion should be 720,000 times larger than its minute diatomic image is a most extraordinary optical fact, and well worth the years of labour bestowed on this interesting problem.

---

* Inferior ones miss these things altogether. Powell and Lealand's glass surpass all others in displaying perfect rings and a series of extended dots.

*

Size of facet of eye of beetle	1-1,000th
It diminishes "mullion"	78,000 times
Size	1-60,000th
Sidereal focal length	1-600th

Very precise calculations on observed data demonstrate that the refractive index of this eye is very nearly the same as that of flint. A senior wrangler (my old tutor) to whom I sent the solved problem humorously writes—"So, after all, the beetle has a glass eye."

(*To be continued.*)

ON THE "E.M." AND OTHER TELEPHONES.*

By S. R. Bottone.

(*Continued from page* 138.)

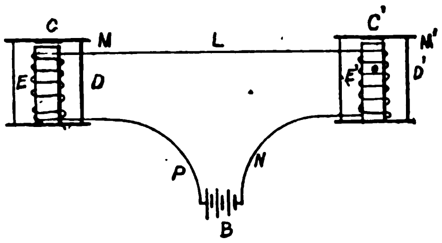
§ 5. THE next practical improvement in the telephone, and one which marks an era in telephony, since it embodies the first articulating telephone, is due to Prof. Graham Bell, who in 1876 demonstrated before the Massachusetts Institute of Technology, the possibility of conveying vocal sounds by means of ordinary telegraph wires, conjoined to special appliances for transmitting and receiving the sounds. As the adaptations to produce this result were publicly described both in America and England, and were published in England, in the pages of the English Mechanic before any patent was taken out, this particular form of the telephone is free to all, and was especially disclaimed by those who have secured the monopoly for the other forms of telephone by the aid of the decision of the Courts. From the fact of the description of this instrument having been published in the pages of the "E.M." at this early date, it has been pretty generally known as the English Mechanic telephone, and for the sake of those who may not be fortunate enough to possess the number containing this interesting article, the description therein given is here textually reproduced:—

"Two single-pole electro-magnets, each having a resistance of 10 ohms, were arranged in circuit with a battery of five carbon elements, the total resistance being 25 ohms. A drumhead of goldbeater's skin, about 2¼in. in diameter, was placed in front of each electro-magnet, and a circular piece of clock-spring was glued to the middle of the membrane of each drumhead. One of these telephones was placed in an experimental room, and the other in the basement of an adjoining house. Upon singing into the telephone, the sounds of the voice were reproduced by the instrument in the distant room; and if two persons sang simultaneously, the two notes were audible at the other telephone.

"At the time of the lecture an experiment was made to show the transmission of articulate speech, an assistant going into the adjoining building, where one of the telephones was placed. Prof. Bell then placed his mouth near the other telephone, and said, 'Do you understand what I say?' An answer was returned, and, according to the report before us, articulate sounds were heard proceeding from the piece of clock-spring attached to the membrane, which were alleged to be 'Yes, I understand you perfectly.' The articulation was, it is stated, somewhat muffled and indistinct, but, at all events, it was in this case intelligible. It is obvious, however, that any sentences of a common kind that might be expected, or that might have been agreed on beforehand, would be more likely to be heard than unexpected or unlikely questions; for just as it is possible to see things that we wish to see, so it is possible to hear words we expect to hear. Several familiar questions were, it is said, understood after a few repetitions; but a critical analysis of the effects produced leads to the conclusion that the vowel sounds alone are those faithfully reproduced. Diphthongal sounds and rotund vowels are readily distinguished, but consonants are generally unrecognisable. Now and then, however, a sentence comes out with almost startling distinctness, the consonants as well as the vowels being clearly audible. Prof. Bell stated that telephonic effects can be produced with three varieties of currents—the intermittent, the pulsatory, and the undulatory. The first are characterised by the alternate presence and absence of electricity in the circuit; the pulsatory current by sudden changes in intensity; while undulatory currents are by gradual changes analogous to the changes of density of air produced by vibration of a pendulum."

§ 6. The annexed cut, which did not appear in the foregoing article, will assist the comprehension of the details of the apparatus above described.

Two cylindrical drums, D D′, are each covered by a tense membrane of goldbeater's skin, M M′, so as to form a kind of tambourine. In the centre of each membrane is glued a small piece of clock-spring C C′. Just below these pieces of clock-spring are placed the coiled electro-magnets E E′, which are in electrical connection with each other through the line wire L, and are also connected to the battery B by means of the wires P.N.



It will be readily understood, upon examination of the above, that if any vibratory motion be imparted to the membrane at C, either by the voice or otherwise, it will perform excursions and incursions towards and away from the pole of the electro-magnet near it; and as it carries with it the piece of steel C, this will react upon the magnet and set up by virtue of this very motion amperian currents in the wire surrounding the electro-magnet. These currents, according to whether the motion be one of approach or of recession, will tend to strengthen or to weaken the existing battery current. Hence, the current flowing around the farther magnet E′ will be weakened or strengthened in like manner, so that the force with which this second electro-magnet pulls the piece of steel C′ will vary in obedience to every variation of the current strength. Consequently, as the piece of steel is free to move by virtue of the elasticity of the membrane to which it is attached, it causes this latter to perform vibrations, which vibrations are exact reproductions of the vibrations imparted by the voice, &c., to the membrane M. The vibrations thus reproduced at M′ are communicated to the air surrounding the membrane M′, and are then audible as speech, &c., to an ear placed near the said membrane.

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GEARING.—XVI.

Skew Bevels.

WE call these wheels by their popular name, though, in reality, they have little in common with the bevels except their general conical appearance. As a matter of fact, and of practice, the rims are frusta of cones, but in principle they should be frusta of hyperboloids; and their mutual action is based on that of the screw gears. They are rather difficult to construct, and happily are very seldom required, and then only, or almost, always for very light mechanism, where a little inaccuracy is quite inappreciable.

If we want to drive a pair of shafts A, B, situated as in the figures 112 and 113 respectively, in either case we can, as we said in Art. XI. p. 25, do so by means of screw gears suitably adapted and proportioned for equal or unequal velocity ratios. Or in Fig. 113 we can employ a worm and worm wheel. But in either case there is a vast amount of sliding friction developed, rolling friction being entirely excluded. The contact of screw gears can only take place at a point, the location of that point travelling from one side of the wheels to the other, as they revolve on their axes, and there is no means of evading this evil. But we can in these cases substitute a mingled rolling and sliding action for that which is purely sliding, by employing skew bevels as shown in Figs. 112, 113. The pitch surfaces of these skew bevels, which replace the pitch cones of ordinary bevel wheels, are in essential design frusta of what mathematicians term the "hyperboloid of revolution," which is a figure generated by the revolution of a straight line about an axis to which it is not parallel. As the line passes obliquely on one side of the axis around which it revolves, the section of the solid developed is that of a double curve (Figs. 112, 113, C, C). It is a portion of this curved surface which becomes the pitch surface in skew bevels; and if two such surfaces are rolled in contact, with teeth suitably inclined thereon, the wheels will correctly.

Taking Fig. 112, let us suppose we wa obtain the correct angles and diameters fo wheels D and E, on the crossed axes A a respectively. A and B cross at F at the a θ; but are parallel with each other in direction at right angles therewith, that the plane of the paper. Let the velocity of E to D be two to one. Project the A and B to G and H respectively, and d the angle G F H by the dotted line F J position inversely proportional to the vel ratio. Drawing J G, J H at right angl F J, $\frac{J\,G}{J\,H}$ is the ratio of the distance of point on the pitch surfaces from the a and B, corresponding also with the li generator C of the hyperboloid of revol This will represent the ratio betwee numbers of teeth in the wheels; but,

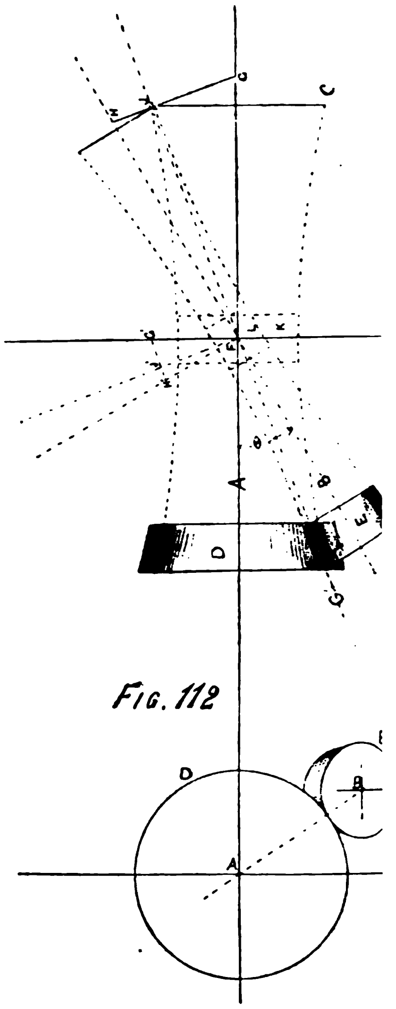


Fig. 112

spiral gears, it will not represent their diameters, which are governed, as in wheels, by their circumferential pitche obtain these, draw F J′ at right angles t F H′ at right angles to F H; F G′ at angles to F G. Draw G′ H′ parallel wit Then, reckoning F J′ as the normal F H′ will represent the circumferential of wheel E, and F G′ the circumferential of wheel D, from whence their pitch ci ferences and diameters can be obt F G′ and F H′, therefore, represent the between the diameters, and also betwe angular velocities of D and E respec J H′ and J G′ represent also the ame sliding of the wheels, F J denotes the surface of contact of the gears, and the or skew of the tooth flanks is determined joint position of that line and of the lin joining the centres of the shafts A B end view. The similarity in the funct these gears and that of the screw-wh represented in the figure, where K and I the pitch surfaces of screw-wheels, would transmit the same velocity rati tween these crossed shafts as the wh and E, but in which there would not be the rolling contact of plane surfaces which we obtain to a considerable extent in D and E.

In the next case, that of Fig. 113, in which the skew-gear usually occurs, the pinion alone is a frustum of the hyperboloidal curves, the wheel being simply adapted thereto. Practically, we may disregard the form of the primitive surface, and take the pinion as the frustum of a simple cone only, as in the previous example. Then, in striking out, proceed as follows:—Having the centres A B of the shafts, lay these down in position, decide on the pitch of the pinion, and thence deduce its diameter. As an example, let the shafts be 1⅜in. apart at C, the pitch of pinion ⅜in., and the number of teeth 12. The pitch diameter will, therefore, be fully 1⅜in., which we lay down on centre line B, and obtain *d* – *d* as the slope of a conical frustum, approximating closely to the hyperboloidal curve. This slope or bevel will also represent the bevel of the pitch surface of the wheel itself.

Looking at the figure, it is clear that the motion of the two wheels is not uniform, except in regard to their total action. In other words, the mutual action of the teeth is that of a mean between rolling and sliding; hence, there must be a similar distinction between normal and circumferential pitch that there is in the case of screw gears. In strictly bevel gears the normal and circumferential motions are identical; but here, owing to the eccentricity of the shaft centre, they are not so. Thus, the arrow 1 shows the direction of the motion of the pinion, and this, to a certain extent, is common to the wheel and pinion, and corresponds with N, the normal pitch, not precisely, owing to the slope of the teeth towards *g*, but sufficiently near for our purpose. But the sliding of the wheel tooth in the direction of the arrow 2 has to be taken into account, and the resultant of these two motions is that shown by the arrow 3; hence the distance C P represents the circumferential pitch of the wheel. In wheels of this class this difference is often neglected; but the evil due to such neglect will be intensified the farther the distance C at which the shafts are placed asunder. The distance C P can be obtained graphically by laying down the wheel radius approximately, then measuring the distance C P, and multiplying that by the number of teeth for the circumference.

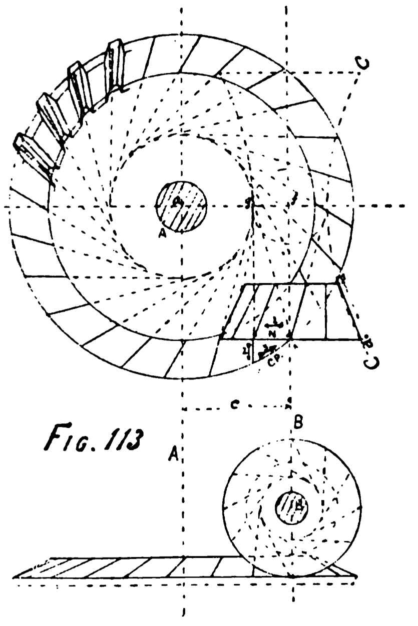


FIG. 113

The angle of the teeth should be at a mean between the ratios of the diameters of wheel and pinion, thus:—The line *af* is divided at *g* in the same ratio as the velocity ratios, and the point *g* is that towards which the teeth on wheel and pinion alike converge, and is therefore the locus of the pitch surfaces. The normal pitch would be at right angles with these centre lines. I think the two figures render the relations of the tooth centres and the pitch surfaces of the wheel and pinion so clear, that further explanation is superfluous. Such wheels would work if the pinion teeth were strictly radial like those of bevels—that is, if their locus was at *f*; but as this would impart a correspondingly higher obliquity to the wheel teeth, the practice is more objectionable than that shown in the figure. The shapes of the teeth are obtained by the same method as those employed for bevel wheels, as already explained, Vol. XLVI. p. 500.

J. H.

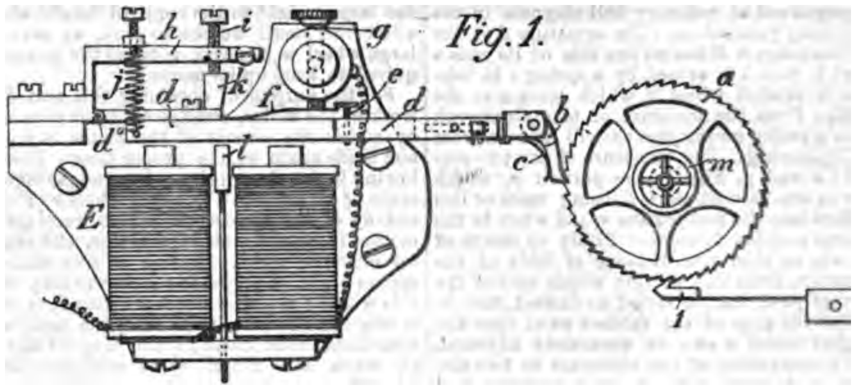
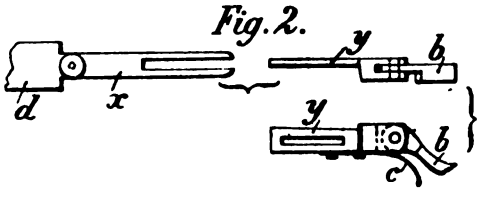


Fig. 1.

Fig. 2.



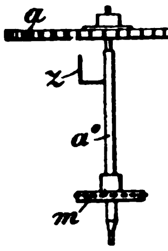
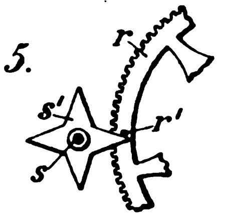


Fig. 3

Fig. 5.



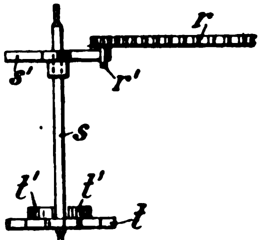


Fig. 6.

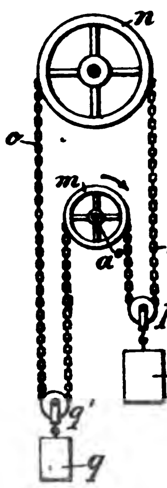


Fig. 4

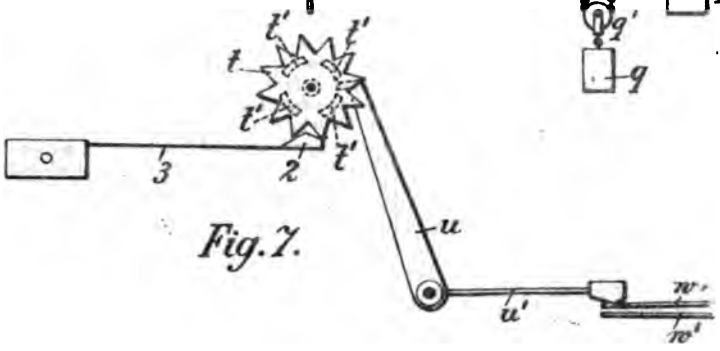


Fig. 7.

VIAU'S ELECTRO-MOTOR.

AN electro-motor for clocks and for other purposes where a small power only is required has been patented in this country by Senor M. Viau, of Bilbao, Spain, and a description may be of interest to our readers. Up to the present, says Senor Viau, for the purpose of working clocks directly by electricity, it has only been attempted to replace the motive power obtained by means of springs or weights by electricity only. For this feason, till now, the employment of electricity as a real motive power for working clocks has not been perfectly successful, because electricity requires, when it is applied as a motor, powerful elements, and in spite of this it gives only a proportionately small amount of power, which is also most unsteady. If electricity has not always the same constanc power, it has generally in exchange a superfluity of velocity or speed. This ve or speed being transformed into powe applied mechanically, the inconstancy electricity is made harmless to the wo and power is gained, which has no hitherto found, because it was sought the electricity itself. It is well know power can be transformed, by means of a or train of large and small gear wheel speed, and by the same means, but in the r order, speed into power. The construct the improved motor rests upon both of principles. From this motor is obtaine cient constancy and power for several ind purposes without creating much cost for tenance; again the powerful batterie hitherto which worked without interru are not required with the new motor. motor consists of an automatic inter (that is to say, an electro-magnet), the arn of which acts as an alternate make breaker of the circuit, and a so- Huyghens' pulley elevator, which is ac by means of a ratchet wheel operated motion of the armature.

Fig. 1 is a side elevation of the aut interrupter. This is different from the ol arrangement of ordinary bell magnets in the following particulars. The armature d of the electro-magnet E has on one side of its ends a pawl b, which is caused by a spring c to take into a ratchet wheel a, which transmits the motion from the armature, or to a clockwork or to a pulley mechanism as will be seen from the following. The armature d has two portions x and y, Fig. 2, the portion y, which carries the ratchet pawl b, being more or less pushed into the first portion x, and when in the desired position is secured firmly by means of screws, so that the distance of body of the armature from the portion which carries the ratchet pawl can be varied as desired, that is, so that the grip of the ratchet pawl into the ratchet wheel a can be accurately adjusted. The construction of the armature in two distinct parts enables the front (right) part of the armature to be insulated from the back (left) part by means of wood plates, or in any suitable manner, in the joint of the two portions, so to avoid the electrifying or magnetisation of the ratchet pawl and also the ratchet wheel and mechanism connected therewith.

In ordinary bell mechanism the armature has at its end a spring, by means of which it is either fixed to part of the base plate or to a projection on the base plate. The disadvantage of this spring arrangement is that it does not allow the armature enough free play of motion, and it is for this reason that in this automatic interrupter it is held by means of a hinge, d^o, Fig. 1, which enables the armature to have the required free motion. As it is advantageous for the armature always to move in the same curve and operate the ratchet wheel in a regular manner, it is necessary for the armature in its up and down motion always to go to the same points.

In coming down this is obtained by the screw e, which is screwed into the upper surface of the armature, the under surface of the head of which, the moment the armature is actuated, strikes on the end of interrupting spring f and always to a determined point. This spring f, when the armature is caused to descend, has a tendency to move in the reverse direction, but can only move until it catches against the head of the screw e, from which in one position it is held away by the screw g, so that the circuit is always broken at the same point, and it is therefore obvious that the armature by the striking away action of the screw e upon the spring f must always fall down upon the same point.

At the rising of the armature the same purpose is obtained by arranging a bridge h on the baseplate over the armature, which bridge carries a micrometer screw, i, for always stopping the armature at exactly the same point. Moreover, the armature is connected to the bridge h by means of a spiral spring j, which has a continual tendency to draw the armature towards it. For the purpose of damping the blow of the armature two indirubber blocks, l and k, are provided, against which the armature presses alternately in its motion.

The ratchet wheel a, moved by means of the armature of the electro-magnets, is prevented from moving in a backward direction by a stop or click carrying on the other end of its spindle a^o a chain wheel m, Fig. 3, which forms the lower wheel in the well-known Huyghens' weight elevator shown in Fig. 4. The upper large wheel n of this one is also constructed as a chain wheel, the weights p and q being carried by a Vaucanson chain o. The rollers or pulleys q^1, p^1, on which the weights hang, move freely on the chain. The chain wheel m is prevented, by means of a ratchet pawl thereon, from moving in the direction of the arrow, so that the free wheel n will be rotated by the weight—that is the weight resulting from half the difference of the active weight.

When the automatic interrupter is in operation and the ratchet-wheel a is rotated, it follows that the chain wheel m also rotates, and so the large weight p of the elevator rises and the small one, q, falls, unless during the raising of the weight the wheel n ceases to rotate. This wheel m is in connection with the train of a pendulum clock or of a balance clock and secures to the clock to which it is applied a perfectly regular motion.

Supposing the period of falling of the large weight is five minutes, the proper electrical motor need only be in activity for five minutes, *and only so long as is* necessary to again raise the large weight to the required height and to allow the small weight to sink, so that the large wheel n is never without the power required to keep up its motion.

For the purpose of obtaining this periodical work of the motor, arrangements must be made by which the circuit of the motor is broken and made again at the proper time. The following is the description of an advantageous mode of doing this. The first wheel r (Figs. 5 and 6) of the clockwork which receives its motion from the weight elevator, and makes, for example, one revolution in five minutes, carries a pin, r^1, projecting from the side. Next this wheel r is a star-wheel, s^1, with four teeth arranged on a shaft, s, so that the teeth of it sometimes must come in the way of the pin r^1, when the wheel s^1 is correspondingly rotated.

The wheel s^1 is moved and then again kept still, so that at the time of the passing of the pin r^1 one tooth of the star wheel s^1 has reached far into the way of the pin r^1 that it can only move the star wheel s^1 one-twelfth of a revolution. The motion thus given to the star wheel s^1 will be transmitted to the wheel t on the same shaft (Figs. 6 and 7), the wheel being provided on its periphery with twelve teeth and on its side with four circular ribs t^1 as shown.

These ribs t^1 allow a nose of a lever, u, or rather the left arm of it which reaches into the way of them, to ride out of the gap between two of the ribs on to the periphery of one of the ribs as soon as the wheels s^1 and t are moved one-twelfth of a revolution by means of the pin r^1. The lever u is in this manner so moved that its under arm u^1 presses together the ends $w\ w^1$ of the circuit conducting wires of the motor, which are arranged one over the other, and brings the ends $w\ w^1$ into contact, so that the circuit is thereby completed.

As long as the left arm of the lever u rests on one of the ribs t^1, the electric circuit will continue completed, and the wheel m of the weight elevator will rotate. But as soon as the weights of the elevator have arrived at their highest or lowest position the circuit must again become interrupted—i.e., the end of the lever end u slides off the rib t^1 and drops in between two of the ribs into a gap. This is carried out in the following manner:—The large wheel n, Fig. 4, of the weight elevator, makes (being put in motion by the weight) one revolution in five minutes, while the weight descends from the highest to the lowest point, and the small wheel m being only half as large as the wheel n, the wheel m has to make two revolutions for the purpose of again raising the weight; therefore, the electrical motor only has to work until the wheel m has completed two revolutions, and it must then immediately stop. For this purpose an angle or knee, z, (Fig. 3) is arranged on the shaft a^o, which is the axle both of the ratchet wheel a and of the little wheel m; the knee z reaches to the intermediate wheel t (Figs. 6 and 7), and can take into its teeth, so that when the wheel t has revolved one-twelfth of a revolution and the motor has commenced working, the knee z, after the first revolution of the shaft a^o, moves the intermediate wheel t the distance of one tooth and after the second revolution of the shaft moves it round a second tooth. Now, while the knee is moving the first tooth of the wheel t, the lever u remains resting on the rib t^1, which is opposite to it, and slides on its periphery, but as soon as the knee z moves the second tooth of the wheel t, the lever u slides by its own weight off the rib t^1 into the gap between two ribs, thereby releasing the contacts w, w^1, breaking circuit and causing the motor to stop immediately. At the same time a tooth of the star wheel s^1, Figs. 5 and 6, has arrived within reach of the pin r^1, and the before-described motions take place again after five minutes have passed.

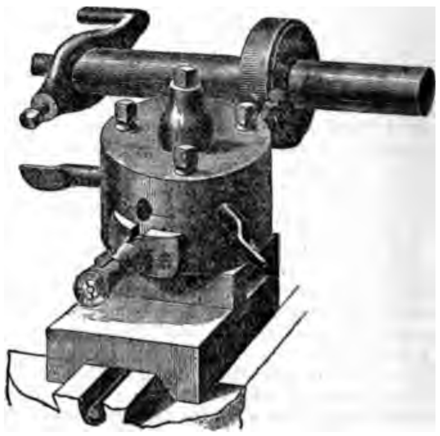
It is not always necessary that the pin r^1 on the wheel r (Figs. 5 and 6) should move the star wheel s^1 one-twelfth of a revolution, as it may be desirable, in order to avoid the disadvantageous stopping of the clockwork, that the pin r^1 on the wheel r should only move round the star wheel a little more than one twenty-fourth of a revolution, and that the necessary further rotation for the entire one-twelfth revolution may be executed by the pawl 2 employed to prevent the backward motion of the wheel t. To obtain these results the teeth of the wheel t must be made equilateral and equiangular, and the pawl 2, supported as shown by means of a strong spring 3, must receive the obtuse-angled shape as shown. Supposing the star wheel s^1 is caused to make a little more than one twenty-fourth of a revolution by means of the pin r^1, the pressure of the spring 3 will be overcome and the pawl 2 will be raised so far out of the teeth of the wheel t that the top of the pawl 2 will come together with the top of the next following tooth of the ratchet wheel t and then slide a little over the top. The force of the spring 3 will now move the wheel t quickly farther round until the pawl 2 snaps into the next space, whereby the left arm of the lever u has arrived on one of the ribs t^1, and so the circuit has been completed by means of the contacts $w\ w^1$. The rest of the operation is as before described.

The number of teeth and the size of the wheels can be varied as desired, the above being only given as an example. Moreover, the circuit can be made and broken by any other suitable means instead of by the lever u. The entire mechanism works briefly in the following manner:—The electricity causes the armature of the automatic interrupter to move to and fro; said armature moves the ratchet wheel, and this transfers its motion to the weight elevator, which transforms speed into power, whereby the mechanism itself controls or directs the electricity to produce a regular motion.

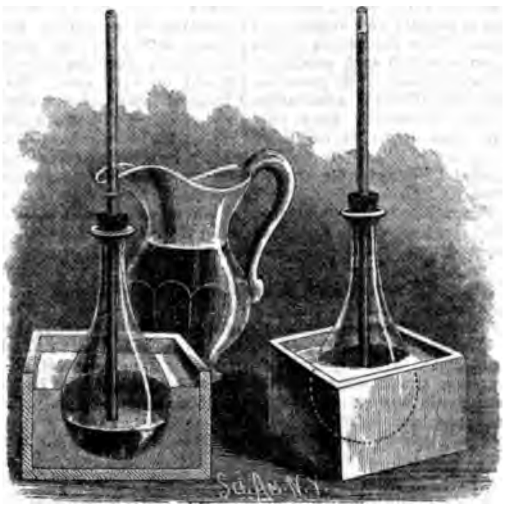
A ROTARY TOOL POST.

SOMETHING of a novelty in the way of a tool post is shown by the accompanying engraving, which, though called by the maker a rotary tool post, is really a turret arranged to go on to the tool post block, instead of the tail stock. Mounted in this way, the tools can be given all the motions, and used in the same way as ordinary tools, held in an ordinary tool post.

The lower plate has a tongue to fit the tool post block, and is secured in place by a square-headed bolt, which passes through to the top of the turret, where there is a nut by which it is tightened. This nut is covered by the sleeve nut shown on top, which, when tightened, prevents the turret from being turned. The tools are made of ⅜in. round steel, left rough, and forged into the desired shape. The turret is in two parts, which, when the tools are inserted, are held a short distance apart, so that when the three screws on top are tightened, they draw the two parts of the turret together, binding the tools in place. There are six holes for tools, and the stop by which the turret is indexed is wedge-shaped, to take up wear, and is forced into place by a spiral spring.



It will be readily perceived that the usual methods pursued in doing lathe work, which consists of a number of small pieces alike, and having a number of operations upon each piece, can be changed by the use of this device, often with decided advantage. Instead of removing the piece from the lathe after each operation, and going through the whole lot before changing, or, instead of changing and setting a tool for each operation, the piece can be left in the lathe, and, by swinging the turret, the various tools needed to complete the job can be brought successively into proper position. For instance, in turning gear blanks three tools could be used, a diamond point, and right and left-hand side tools, and the blank finished without the necessity for taking out or re-setting a tool. Work held in the chuck may be



ıd threaded in the same way, and there are
bs which will suggest themselves for which
t be used to advantage. The stop, when
ut, can be prevented from springing into
ain by turning a thimble which is on the
ınd when this is done the tools can be held
lesired angle by tightening the sleeve nut
ıf the turret. The manufacturer is John
ead, Mansfield, Mass.—*American Machinist.*

RIMENTS ILLUSTRATING CHE-
.L AND PHYSICAL CHANGE.*

ıe present time, when physics and chemistry
ɔproach so closely to each other, and may
said to overlap, it is very hard to furnish
ns that will really distinguish one from
ɜr. When the vexed ground of solution
ecular combination is reached, it is often
ɔle to characterise reactions as chemical
ıan physical, or the reverse. Perhaps the
inction is to consider chemistry the science
ɜ, and physics the science of molecules.
echanics is left as a heading for the science

'eneral indications of a chemical reaction
the production of thermic changes. If it
of combination, an increase of tempera-
roduced, as a general rule. Heat is always
d, but it may be marked by incidental
productive of cold. On the other hand, in
ɔal change, minor thermal activity, as a
ıvails.

ıtage is taken of the opposite thermal
ue to chemical combination and to lique-
in the experiment illustrated, to produce
nple of a chemical contrasted with a
change. In the first, heat is produced by
l combination; in the second, cold is pro-
r, more strictly speaking, heat is absorbed
act of liquefaction—a purely physical
ɪnon.

lasks, of about one pint capacity, are fitted
gly perforated corks. Through each cork
ube of about one-fourth inch internal bore
l, which reaches nearly to the bottom of
:. A little water, enough to seal the end
ıbe, is placed in each, and the corks are
home. This forces water up into the tubes.
ld be so arranged that when the corks are
the water will reach to the centre of each
The flasks thus arranged form delicate
ɔopes or indicators of a change of tempera-
'o render their indications visible, a little
g matter should be added to the water. A
ılphocyanide of iron, formed by adding
m sulphocyanide and ferric chloride
ɜ of iron) to the water, is an excellent
. It colours the water red, and, unlike
the aniline colours, does not stain the
For most experiments where water is used,
l be found an excellent substance for
g the water visible.

'oxes, which should be as near watertight
ɔle, and which should be large enough to
flasks, are next needed. In each of these
is placed. One is packed around with
ıe, preferably in somewhat small pieces.
er is embedded in crystals of nitrate of
ı. Water is poured into the two boxes, so
l them within an inch of the top, while
ıe fluid time to percolate through the mass
material.

uicklime has a strong affinity for water,
ɔombining with it undoubtedly suffers an
atomic change. The water and calcic oxide unite, and in a few minutes become very hot. The air within the flask is expanded by the head, and the column of water rapidly rises in the tube. If left long enough, it will overflow it. This illustrates a chemical reaction with evolution of heat.

In the other box the nitrate of ammonia rapidly dissolves or liquefies. This change requires the expenditure of energy, represented by the absorption of heat. As none is supplied from an artificial source, the dissolving salt absorbs it from the water, and cold is produced. The column of water in the thermoscope tube sinks rapidly, and soon is out of sight. This illustrates a physical reaction, the change of state from solid to liquid without any atomic change.

The water should be added to both boxes from one pitcher. Thus conducted, a very curious and paradoxical effect is produced. Water from the same vessel produces both heat and cold.

As regards the solution of the nitrate of ammonia, possibly an obscure chemical combination, heat may be produced by it. If so, it is overcome by the greater degree of cold which is produced by the change of physical state of the nitrate of ammonia from solid to liquid.

Other substances may be used. Thus anhydrous carbonate of soda may be used instead of the lime, and many salts used in freezing mixtures could be cited as substitutes for the nitrate of ammonia. Ammonic sulphocyanide is an extremely powerful refrigerant. But from its general innocuousness, the nitrate is to be strongly recommended.

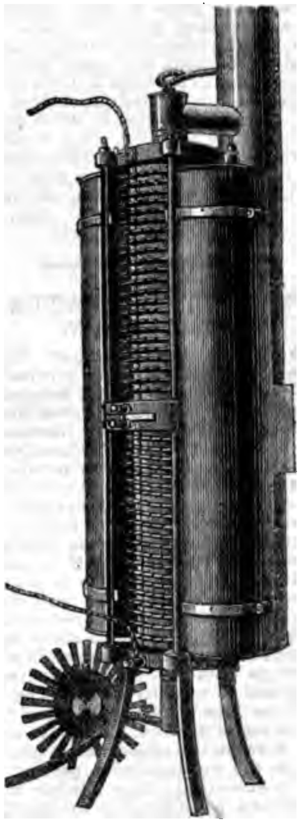
RAUB'S THERMO-ELECTRIC BATTERY.

FOR years it has been the endeavour of electro-technicists, in constructing electric generators, to devise appliances which should not merely surpass earlier models in simplicity, but should also be capable of converting any given power into electric energy in the cheapest manner, and which should, in short, perfectly meet all the demands made both by specialists and by the outside public. It is certain that in the future the direct transformation of heat into electricity will afford the possibility of generating electric energy in the simplest, cheapest, and most practical manner. Hence it is desirable and advantageous that as much attention should be given to the improvement of thermo-electric batteries as there has recently been bestowed upon dynamos.

An essential advance in this sphere has recently been effected by a new construction of a thermo battery devised by E. Raub, of Berlin. It is of prominent importance, since in it all the shortcomings of the old thermo batteries have been removed, and since it is applicable at a small working cost for many technical purposes, especially for electrolytic uses, and since the first outlay is very low.

As will be seen from the accompanying figure, the battery consists of two main portions: 1, the annular elements and the heating channel which they form; and 2, the refrigerator, which is applied separately. The circle shown in the figure behind the tripod represents a single element; the positive electrode is formed by a ring of an alloy cast around a copper heating ring, thus effecting a very durable and intimate metallic connection. Externally it is inclosed in a second ring of copper, with refrigerating projections arranged radially. The negative metal is soldered to the heating ring in three plates, and in such a manner that during working local currents at the points of contact are entirely avoided. After the elements have been built up, the negative metal of each is soldered to the refrigerating projections of the following elements.

A number of similar thermo elements, of any desired size, are insulated from each other by means of a fire-proof material, and pressed together between two cast-iron plates in such a manner that the several rings are superimposed concentrically, forming in this manner a firm, safe hollow cylinder which serves as the heating chamber. The heating is effected by means of any convenient source. For smaller apparatus like that shown in the figure a ring-shaped Bunsen gas burner is sufficient. For larger batteries a coal or coke fire is required. The flame of the Bunsen burner, screwed on to the lower end of the heating cylinder, comes in intimate contact with the heating rings of all the elements, and takes up its supply of oxygen within the conical flame. The heat is distributed equally to the elements by means of a slender cone fixed to the cover of the heating chamber and projecting into it. It then passes through a transverse channel into a wide stove pipe closed below and screwed into the supporting tripod and connected with a chimney having a good draught. The hot air ascending into the chimney draws fresh air into air pipes fixed below the point where the heating chamber vents into the main pipe, so that the external points of contact of the annular elements are kept cool by the draught. A valve is introduced for the regulation of the latter.



Great economy in working is effected by the application of annular thermo elements in combination with this forcible introduction of air, which admits of the greatest possible utilisation of the heat and the production of the greatest possible differences of temperature. Collateral advantages are rapidity and ease in starting work and a minimum requirement of space, since batteries to be heated by gas may be mounted upon a bracket. As valuable features must be mentioned the durability and firmness of the separate elements, as also the possibility of removing damaged rings either for repairs or for the substitution of new ones, which may be procured singly from the makers.

The three smallest models to be heated with gas, and suitable for the electrolytic production of metals, for galvanoplasty, &c., consume hourly 300, 500, and 900 litres of gas (or about 11, 18, and 30 cubic feet), having strengths of current of 10, 20, and 40 ampères with an electromotive force of 3 volts. For an hourly consumption of 1 cubic mètre these batteries give a useful effect of 80 volt ampères, while those of former constructions yielded at most 27.—G. BETZ, *Electrical Review.*

THE USES OF GLYCERINE.

FEW people realise the importance of the uses of pure commercial glycerine, and how it can be used and made available for purposes where no

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O'CONOR SLOANE, PhD., in the *Scientific* substitute is found that will take its place. As a dressing for ladies' shoes nothing equals it, making the leather soft and pliable without soiling the garments in contact. Where the feet sweat, burnt alum and glycerine—one of former to two of the latter—rubbed on the feet at night and a light or open sock worn, the feet washed in the morning with tepid water, will keep them during the day free from odour, so disagreeable to those persons who are sufferers. For bunions and corns Cannabis indicus and glycerine, equal parts, painted on the bunion or corn and bound around with Canton flannel, adding a few drops of the liquid to the flannel where it comes in contact with the affected parts, will soon restore to health. As a face lotion, oatmeal made in a paste with glycerine two parts, water one part, and applied to the face at night, with a mask worn over, will give in a short time, if faithfully pursued, a youthful appearance to the skin. As a dressing in the bath, two quarts of water with two ounces of glycerine, scented with rose, which will impart a final freshness and delicacy to the skin. In severe paroxysms in coughing, either in coughs, colds, or consumptives, one or two tablespoonfuls of pure glycerine in pure rye whisky or hot rich cream will afford almost immediate relief; and to the consumptive a panacea is found by daily use of glycerine internally, with the proportion of one part of powdered willow charcoal and two parts of pure glycerine. For diseased and inflamed gums, two parts of golden seal, one part of powdered burnt alum, and two parts of glycerine, made in a paste and rubbed on the gums and around the teeth at night, strengthens and restores the gums to health, provided no tartar is present to cause the disease, which must be removed first before applying. And finally, to the epicure who relishes a nice breakfast dish of fried fish, he will find "a feast for the gods" by frying the fish in glycerine to a brown, adding a small sprig of parsley when nearly done. — J. S. CHARLES, D.D.S., Omaha, Nebraska.

PERSONAL IDENTIFICATION AND DESCRIPTION.

AT the Royal Institution last Friday Mr. Francis Galton lectured on personal identification and description. He said he greatly felt the inadequacy of language to express form, when he was dealing with hereditary likenesses, with grouping human features into classes, and with many other topics. The present lecture was the result of the considerable pains that he had taken to overcome this difficulty. There proved to be many alternative ways of doing it, but as he had not yet satisfied himself as to the best, he would avoid details and confine himself to general remarks. It was perfectly possible to define and to measure resemblance, taking the least discernible difference as the unit for each degree of unlikeness. This simple principle could be easily applied to outlines such as those of silhouettes. It was better at first to go even further in the direction of simplicity, and to consider only that part of the outline of the face which lay between the brow and the parting of the lips. The least discernible difference between two silhouettes might be taken as equal to the one-hundredth part of an inch. Though an exceedingly large number of profiles might be drawn that differed by this small amount in some part of their outline, the number that differed by ten times that amount would be comparatively very small. We might aim at producing a collection of standard portraits, drawn with coarse outlines of one-tenth of an inch in width and then reduced to a small scale, to serve as standards of reference. No profile that fell wholly within the two edges of the coarse outline could differ from its centre by more than five grades of unlikeness. This would be a useful and a first degree of approximation; it would not be a likeness in any other sense than that of excluding the very large proportion of profiles that were still more unlike than those that fell within the specified limits. A mechanical apparatus, described further on, afforded the means of rapidly finding the standard or standards to which any given profile conformed. Individuals differed in a measurable manner in so many respects that a person might be identified with considerable precision by a statement of his measures. The lecturer explained the measurements that were most useful for this purpose, and how registers of them could most easily be searched in order to find whether those of a particular person were contained in them or not. Differences that might be measured, or otherwise clearly defined, existed on a small as well as on a large scale. The curious variety of imprints made by the inked finger-tips admitted of being classed and catalogued. They seemed to be singularly persistent judging from four specimens that were exhibited of the digit marks of Sir W. Herschel, made in the years 1860, 1874, 1885, and 1888 respectively. Though there was a difference of 28 years between the dates of the first and the last, no difference could be perceived between the impressions. The forms of the spirals remained the same, not only in general character, but in minute and measurable details, as in the distance from the centre of the spiral and in the direction at which each new ridge took its rise. Sir W. Herschel had made great use of digit marks for purposes of legal attestation among natives of India. Prisoners were now identified in France by measurements of their heads and limbs according to the ingenious method of M. Alphonse Bertillon. The measures of each prisoner were all entered on the same cards, and the cards were classified according to the successive measures they contained, just as words were arranged in a dictionary according to their successive letters. The classification did not take more note of the measures than by placing each in the category of large, medium, or small, as the case might be. Thus one measurement gave rise to three possible groups, two to nine, three to 27, and so on. The lecturer exhibited the rough working model of an apparatus he had contrived that could select by a single movement those cards out of many hundreds whose measures corresponded within any desired limits with those of any given person. It was free from the objections inherent in all methods of hard-and-fast classification such as that of M. Bertillon, and could act on a large scale and with great rapidity and simplicity. The apparatus consisted of a large number of strips of card, or of metal, pivoted through one of their ends by a common axis, while their other ends rested on a frame that turned about the same axis. When the frame was raised all the cards were lifted by it, when it was lowered the cards dropped each independently of the rest by its own weight. The lower edge of each card was variously notched to indicate the measures of the person to whom it referred. The key that made the selection was a board some 30in. of clear length, with wires stretched lengthways and supported by several bridges. The positions of the wires were adjusted by the same scale as that by which the notches were cut, and the wires were set to represent the measures of the given person. When the board was set crossways under the cards, and these were allowed to fall, they all were checked in their descent by the wires, except those few whose notches corresponded with them. The notches were made wide enough not only to admit the wires but also to allow for some inaccuracy of measurement and misfit. A key of the above length would test 500 cards at once and might be used in quick succession with any number of sets of cards. The profile of a face, he continued, could be measured with much precision on the sharp outline of a photograph. The observed differences in feature were severally small, but they were numerous and more independent of one another than the lengths of the various limbs. The best base from which to measure horizontally seemed to be the tangent line that touched the convexity of the chin and the concavity between the brow and the nose. When the chin was bearded, the position of the concavity must be guessed. A good unit of horizontal scale was given by the distance between the line just mentioned and one drawn parallel to it that just touched the nose. It was better to keep the unit of vertical scale separate, and to use for it the distance between the pupil of the eye and the parting of the lips, measured parallel to the above lines. One of the objects the lecturer had in view in the present inquiry was to discover measurable and independent peculiarities that would assist in hereditary investigations. He had some hope that by noting many of these it might be possible to trace in every person clear evidence of his parentage and near kinship.—*Times.*

EDER'S ORTHOCHROMATIC COLLODION EMULSION.*

I HAVE just been favoured by my highly esteemed colleague, Dr. Eder, with a paper containing a description of his new method of preparing collodio-bromide emulsion, which method he has now established at the new Photographic Teaching and Experimental Institute at Vienna, being under his able direction. This method, as Prof. Eder says, is exceedingly simple, and throughout certain. The emulsion is prepared in the following manner: A.—15 grammes of crystal nitrate of silver are dissolved in 12 c.c. of water, then 99 c.c. of alcohol (95°) are added, and then mixed with 150 c.c. of 4 per cent. plain collodion. B.—15 grammes of pure crystallised bromide of cadmium are, by application of slight heat, dissolved in 75 c.c. of alcoholic eosine solution (1·800), and then 150 c.c. of 4 per cent. plain collodion are added. The bromide solution is now in the dark room gradually added to the silver solution and well shaken, till of the bromide solution only 5 to 10 c.c. are left; then the trial is made whether the emulsion still contains an excess of silver nitrate. This emulsion, namely, will prove to be satisfactory only in cases where it contains still a small excess of silver nitrate, which leads to the formation of eosine silver. If
bromide be in excess, then the much less se
tising action of the eosine alone would be p
dominant, and the sensitiveness of the emuls
would be very low. To make the trial, a
drops of the emulsion are poured on a glass pl
allowed to settle, and a drop of a solution of yell
potassium chromate is poured over it. If there
still a great excess of silver nitrate, an extensiv
cherry spot will be formed (chromate of silve
in this case a little more of the bromide solut
is added, and then the trial repeated. As soon
but a feeble orange-coloured spot is formed,
emulsion may be used. An emulsion with a gr
excess of silver gives more sensitive and vigor
films, but unclean and often fogged ones; if, h
ever, the excess of silver is too small, the emuls
will become insensitive, and the orthochrom
action will be reduced. If this be the case
gramme of silver nitrate is dissolved in a f
drops of water, then 10 c.c. of alcohol are add
and the solution is gradually mixed with
emulsion, until it gives a good negative, if
exposure is made for a trial. (Emulsions c
taining much colouring matter will also stand
more nitrate of silver.) The emulsion can
used at once, but it will be better to employ it
before twelve to twenty-four hours. To the gl
plate to be coated with the emulsion, some in
rubber solution is applied around the edges, t
it is collodionised as usually, allowed to settle,
then immersed in a dish containing well-wa
where it remains until all greasiness disappe
By this the nitrates contained in the unwas
original emulsion are eliminated. It will be
to expose the coated plates while they are still
as they will become less sensitive after dry
The exposure will be about half as long as in
case of wet collodion plates, which are subseque
to be developed with iron oxalate. The m
paintings can be photographed without the us
a yellow screen if this emulsion is employ
dazzling blue may be subdued eventually by
aid of a yellow screen prepared with aura
collodion. The exposed plates may be develo
either with iron-oxalate, or pyro-soda, or p
ammonia; but the following formula serves
well:—

A.—Water	100	parts
Sodium sulphite	10	"
Potassium bromide	3	"
Citric acid	1	part
Pyrogallic acid	2½	parts
B.—Ammonia	1	part
Water	6	parts

Before use are mixed—

Water	100 c.c.
Pyro-solution (A)	10 c.c.
Ammonia solution (B)	10 c.c.

The picture comes out very soon, and will
developed after 30 to 50 seconds. They are fi
in the ordinary hypo solution. Should it happ
that the plates are fogged with this developer, th
6 parts of B, 12 parts of A, and 100 parts of wa
may be mixed. It seems to be deserving not
that, if the exposure is protracted too far, t
silver deposit of the collodio-bromide emuls
plates is of a reddish colour. After fixing, t
plates are washed, poured over with 50 per ce
alcohol, to remove the last traces of eosine, a
once more washed with water. Intensifyi
though being very seldom necessary, can be do
with silver and pyro and citric acid. Reduci
the negatives will be oftener necessary. For th
purpose the well-known mixture of hypo soluti
with red prussiate of potash serves well. T
emulsion will keep eight to fourteen days, but
the end of this time fog will always make i
appearance. If it is desired to have an emulsi
which keeps, it should be prepared with a slig
excess of bromide, to which the silver nitrate
excess is added only just before use. Good resul
are also obtained if the emulsion is precipitat
with water, washed, dried, dissolved in eth
alcohol, mixed with colouring matter and silv
nitrate, and then used. The first described meth
is, however, simpler, quicker, and less expensive.

AN IMPROVED FORM OF GAS APPARATUS.

THIS apparatus was constructed for use in t
chemical laboratory of the State Agri
tural College of Kansas, and was used in an
amination of the natural gases of that State
Prof. G. H. Failyer. As it embodies s
advantages not combined in any other appar
that has come under the notice of the write
description of it may not be amiss. It is essenti
a combination of Elliott's apparatus and Fra
land's apparatus for the analysis of gases incide
to water analysis, with important modifications
additions. The accompanying cut will make
construction clear.

A is a pressure tube graduated in millim

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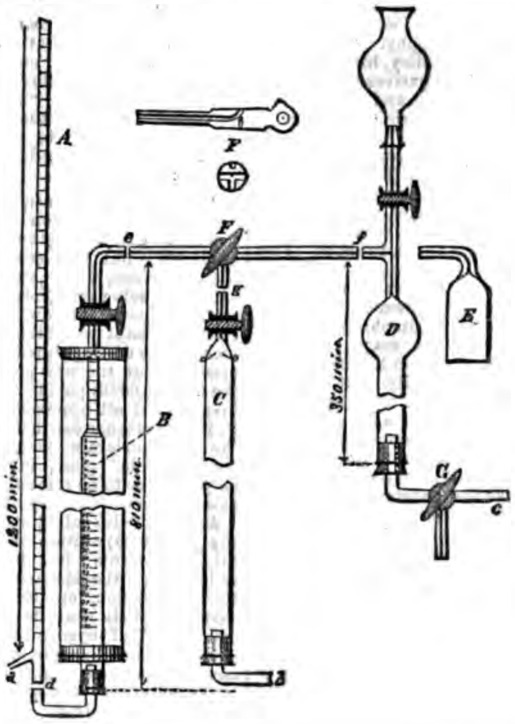
* By H. E. GUNTHER, in *Photographic News.*



measuring tube holding about 120c.c.,
vhich is graduated to tenths, beginning
opcock, F. Its upper parts is narrow,
tting accurate measurement of small
: gas as well as large. It is inclosed in
ket which must be provided with some
ɜcuring a uniform temperature through-
the explosion tube, and is ungraduated.
sorption tube, surmounted by a funnel
'oduction of reagents. E is a laboratory
ıe ordinary kind, which may be attached
D if desired. It is obvious that any
ɔsorption pipette may be attached at *f*.
D are connected by the stopcock F, a
ɔck shown in section above. By means
:k, the others being suitably arranged,
may be put in connection with either
rs or with the external air without dis-
other tube or tubes. G is an ordinary
cock. Reservoirs not shown in the cut
d to the tubes by means of rubber tubing
c. The ends of the tubes are closed by
pers, and the several parts are connected
ıbber connectors at *d*, *e*, *f*, and *g*. The
capillary tubes are ground squarely at
s, so that they come together perfectly.
.tus is firmly attached to a suitable sup-
ıs any one with a little ingenuity may
is essential that A and B be so sup-
their relative position shall remain un-
he apparatus was designed for use with
ıt water may be used. With water the
be would be unnecessary.

ng the mode of operating the apparatus,
eed be said. It is most convenient to
and's method of measuring, in which the
d upon is always brought to the same
to an aliquot part of the original volume,
ıg the pressure of the mercury in A.
the pressure tube corresponding to a
convenient volumes in the measuring
be previously determined with care.
ns exerted by varying amounts of gas
the same volume will be proportional
ınts of gas present. If the gas is brought
ıot part of the original volume, the
nd may be reduced to that correspond-
ɔriginal volume by a very simple calcu-

osion of the gases is performed under
ressure, according to the principles
ɔy Thomas. This method of explosion
antageous, and may be used with this
even if water is used in the tubes B
filling C with mercury. On lowering
r connected with C, any desired degree
on may be produced. It is convenient
rough scale back of C and extending
use in measuring the pressure under
;as is confined during explosion.
th way in the stopcock F is essential
harge of the reagents employed in D;
ɜd for the introduction of the gases. If
to preserve a portion of the gas in D
ıer portion is being measured and ex-
3 and C, it is necessary to close this
ning of F. This may be done simply
ly by filling the way with water or mercury from one of the tubes, and then slipping a short piece of rubber tubing filled with water over the end of the stopcock and closing it with a clamp.

I think no other details of manipulation need be entered into, as they are similar to those already described for other apparatus, or can be readily worked out by the operator.

The apparatus may be used for certain of the purposes to which the nitrometer has been put, such as the valuation of bleaching powder by hydrogen peroxide and *vice versâ*.

The apparatus described was made in most excellent manner by Mr. Emil Greiner, of New York.—J. T. WILLARD in *American Chemical Journal.*

TESTING LENSES.

IN the testing of photographic lenses there are several properties to be noted, classified, and compared. These we shall speak of *seriatim* without, at present, treating them exhaustively, a feat which could not be accomplished in one article.

Colour of the Glass.—In all cases it is desirable that the glass of which a photographic lens is made be as free from colour as possible. Some brands of optical glass are as pure in this respect as can be desired, while others, in other respects of great excellence as regards uniformity of density, freedom from striæ, tears, and similar defects, are yet characterised by the possession of colour in some slight degree. This is more particularly the case with some of the heavy flint glass now so much employed in the manufacture of lenses of the "rapid" type. To test a lens for this, unscrew it from the mount, and lay it, flat or hollow side down, upon a sheet of pure white paper, and observe whether there is any degradation of colour. It is better, when doing so, to have more than one class of lens thus placed side by side, in order that comparison may be made, regard being made to having them all as nearly as possible of the same thickness.

Surface Finish.—A lens ought to have its surfaces of a high polish. It would be foreign to the scope of this article to enter upon the comparative merits of the systems of polishing employed, or of the putty powder, rouge, or other powders utilised in polishing. The effect of imperfect polishing, as distinguished here from figuring, is that crisp blackness of image is not obtained. Some lenses have their surfaces polished so imperfectly as to show innumerable pits arising from the grinding with emery that have not been removed. This defect is easily discoverable by examination of the surface through a powerful magnifier.

Definition.—It is perhaps a little difficult to mention a subject or object on which to test a lens for definition, as much depends upon the range at command. If one is limited by the walls of a room, a well painted enamelled watch dial is probably as good an object as any. If this be well lighted, it should yield an image showing the fine markings of the seconds circle distinctly, also the vertical lines of the twelve o'clock and the horizontal ones of the three o'clock should be sharp and well defined. Should a distant object be preferred, a well marked brick house forms a subject not to be lightly esteemed. Such bricks should be well picked out one from the other with white paint. The largest diaphragm must be employed when testing for definition.

Flatness of Field.—It is not enough that a lens define sharply in the centre, for to be useful as a photographic instrument the definition must extend towards the margin of the plate. The points of best focal definition in lenses as actually constructed are on a concave surface, and it is well known that under certain circumstances of construction it is possible to have an oblique pencil remarkably well corrected; but, unfortunately, the plane on which such marginal definition is seen is found to be so much nearer to the lens than that of central definition as to be worthless for average photographic purposes. Hence it is the province of the optician to cause such an elongation of the oblique rays as to bring them to a focus on the same plane as those of the centre. In testing the lens, with full aperture, note to what extent an image sharply focussed on the centre of the plate can, by rotating the camera, be moved away towards the sides without a noticeable loss of sharpness resulting.

Astigmatism.—It is quite possible to make a lens that shall not only cover a flat field, but even one that is bellied. But apart from the latter, perfect flatness is with our present optical resources only obtainable at the expense of a modicum of astigmatism. With a lens having a hollow field and otherwise well corrected, an image possessing moderate sharpness is obtained at the sides of the plate by racking it in; whereas if the correction for flatness be too perfect, the point of maximum sharpness while on the same plane as the centre will be of an inferior quality. On examining the test object, when the vertical lines thereon are brought to their greatest possible sharpness at the margin of the plate, the horizontal lines will have in a large measure quite disappeared; and by refocussing to get the horizontal lines sharp, the vertical ones go out. This indicates astigmatism, and it is the province of the discreet optician to hit a golden mean between this fault and roundness of field. A little of both will still be present in a good lens; let them be minimised as much as possible. Of course, a small stop will work wonders, but in the testing of lenses recourse should not be had to this expedient.

Achromatism.—By this term we mean actinism, or the coincidence of the visual and chemical focus. It does not follow that a lens, having what is termed a chemical focus, is bad, but its employment is attended with more or less trouble in all cases in which studio work is concerned. With distant views, or even objects situated at an invariable distance from the camera, the ground-glass of the camera can be brought forwards or backwards so as to suit the case. But in practical working it is a fault, and ought not to exist in a photographic lens. It is easily discoverable by the optical test known to all opticians; but the photographer can discover it by placing a few books close together, each one farther back than the other, in front of the camera, and focussing sharply on the centre one, ascertaining whether, on the negative, the special book on which his focus was made comes out sharpest of all. If it be indistinct, and one on another plane of distance be sharp, it indicates non-coincidence of chemical and visual foci.

Flare Spot.—Many lenses which are otherwise truly excellent give a distressing flare spot on the centre of the plate, more especially when a small diaphragm is employed. It is more commonly seen when working out of doors than inside of a studio. It is not readily, if at all, discovered when testing a lens for other properties inside of a room, as its presence is only realised when an outdoor scene forms the subject of the photographer. A ready way of ascertaining its presence is to focus on a dark object—a mass of trees for example—which shall rather more than half-cover the plate, leaving a bright sky overhead to shine upon the lens. If the fault is present it will be seen by inserting a small diaphragm and examining carefully the centre of the plate for a circular space of luminousness, which, if present, indicates that the lens is unsuited for outdoor work, at any rate until it has been sent to the optician to have the fault rectified.

Rectilinearity.—This is so easily tested as only to require a few words. We premise that in landscape lenses or lenses intended mainly for landscapes, groups, or portraits, its presence is of minor consequence. Architecture and copying alone demand rectilinearity in its highest perfection. To test for it, let the camera be placed level opposite a perfectly straight vertical line, such as the side or corner of a house. Note that it is perfectly straight in the centre of the plate, and then rotate the camera so as to bring it close to the side of the focussing screen. If it prove still straight under these circumstances, then is the lens rectilinear or orthographic; but if curved in even the slightest degree, it is defective as regards this quality.

In the foregoing we have confined our remarks as much as possible to testing for certain defects of lenses by means within the reach of every possessor of a camera and lens, and have avoided discussing the means by which faults, where discovered, may be minimised or eliminated.—*British Journal of Photography.*

SCIENTIFIC SOCIETIES.

THE LIVERPOOL ASTRONOMICAL SOCIETY.

THE last meeting of the seventh session was held on Monday, May 9th, Mr. C. A. Defieux in the chair. Nineteen candidates were elected members, and Dr. Nicholas von Konkoly, Prof. A. S. Herschel, and Mr. W. H. S. Monck were elected Associates. The photographic slides presented by the Harvard College Observatory, and some stellar photographs presented by Mr. Sadler, were thrown upon the screen. The Harvard photographs included a portrait of the late Dr. Draper, views of the Observatory, and of the Draper Memorial buildings and instruments, and of the Nebula of Orion, Pleiades, the spectra of Sirius, Procyon, Capella, Vega, Deneb, Arcturus, and other stars photographed with the Draper Memorial instruments.

A paper was read by Mr. G. Knott, LL.B., F.R.A.S., on the variable star V Geminorum. Mr. Knott stated that this variable was discovered by the late Mr. Joseph Baxendell, F.R.S. (in whom we have lost an ardent lover of science for its own sake, and one of the first authorities on variable stars), on January 28th, 1880. The star is not in the D.M., but its place for 1855 is 7h. 15m. 2s. + 13° 21'·9. From the observations of Messrs. Baxendell and Knott the period of variation would seem to be 276 days, the star being about 8½ mag. at maximum, and below the 14th at minimum. Taking a maximum epoch at 1883, Nov. 15, the next maxima will fall on May 28th, 1888, and February 28th and December 1st, 1889.

Miss Brown remarked, in a note on the Polar Snows of Mars, that it was said that these polar snows were within the reach of small instruments. From her own experience she concluded that such was the case only during favourable oppositions, as during the present one she had only once been able to distinguish clearly the snow-cap on the northern pole. This was at the time of full moon on April 26th, confirming the well-known fact that certain objects are best seen in moonlight or twilight. While observing the snowy cap, which presented the appearance of a well-defined elliptical disc, she was struck with its apparent projection beyond the limit of the planet—an effect referred to in Webb's "Celestial Objects," and attributed to irradiation.

Papers were also read by Mr. W. H. S. Monck, M.A., F.R.A.S., on "Some Comets of the Last Century," and by Mr. J. M. Barr, of Ontario, on "The Phases of Mercury and Venus."

The following gentlemen were elected as President, officers, and council for the ensuing year:—As President, Mr. T. G. Elger; as Vice-Presidents, Messrs. W. F. Denning, J. Gill, J. Hartnup, and H. Sadler; as Editor and Librarian Mr. I. H. Isaacs; as Secretary, Mr. W. E. Rowlands; as Treasurer, Mr. W. H. Davies. Council: Mr. T. W. Backhouse, Miss E. Brown, Messrs. T. W. Clarke, J. L. Coxon, W. H. Davies, jun., J. F. Gore, G. Higgs, Major E. E. Markwick, Messrs. W. H. S. Monck, W. Sang, K. J. Tarrant, and Major Watson.

On the motion of Mr. J. Gill, seconded by the Rev. Chadwick Bates, it was decided to hold the annual meeting at Liverpool on July 9th, at 3 o'clock in the afternoon.

ROYAL MICROSCOPICAL SOCIETY.

THE eighth meeting of the session was held at King's College, Strand, W.C., on the 9th ult., the President, Dr. C. T. Hudson, in the chair.

The President said that on the occasion of his taking the chair for the first time, he desired, before beginning the business of the evening, to thank the Fellows very heartily for the honour which they had done him in electing him their President. He confessed that when he heard the news it filled him with a kind of fearful joy, because Dr. Dallinger's great services during the four years he had held the office had been so conspicuous as to add a distinction to the position which made it difficult to approach, much less to emulate. But whatever, under the circumstances, his own failings and shortcomings might prove to be, he could assure them that he should not fail in trying to do his best.

Mr. Crisp exhibited a form of camera lucida by Dumaige, of Paris, which was fitted in a box with a cover, which, when closed, kept the prism and mirror free from dust. Also, by the same maker, an adapter for rapidly changing objectives with spiral springs, and a portable microscope in which *the foot and stage* were in one piece.

Dr. Kibbler exhibited and described a new stand and camera, which, he believed, would be found very useful for photo-micrography. It had been made to his design by Mr. Bailey, his idea being that it was best not to take negatives upon a large plate, but on a quarter-plate first and afterwards to enlarge the pictures from the original negatives. Specimens of such enlargements were also exhibited enlarged about nine times from the originals. The great advantage of this method was in the amount of light gained for the purpose of focussing. If a good, sharp picture was produced, the gelatine plate would admit of considerable enlargement up to the point where the grain began to show. This quarter-plate size was also the proper one for lantern slides, which were so much in request at the present time for purposes of demonstration. In the ordinary forms of stand the diaphragm plate is placed immediately below the stage; but, for photographic purposes, this was, in his experience, entirely useless, because it only cut off the edge of the field without either improving definition or correcting spherical aberration. In practice, he had found that by removing the diaphragm plate a certain distance from the object, it then ceased to cut off the field, and began to reduce the light and to improve the penetration and definition. Opticians, he knew, were inclined to doubt whether this arrangement would do what he claimed for it; but he could only say that, with a good light, he could easily show that such was the fact. In cases where high powers were used this answered very well; but it would not work, however, with low powers unless the diaphragm plate was removed to a distance too great to be convenient in practice. He had now, therefore, devised the plan of introducing a short 1½in. condenser behind the stage, and about 3in. in front of the diaphragm plate, in this way throwing it out of focus. The effect of this was that the same improvement in penetration and definition was obtained, but on a much shorter distance. The use of the diaphragm was of the utmost importance in photography where the most perfect focussing and definition were required. Attention was also called to a method of clamping the object in position when the focus had been obtained; also to a plan for obtaining a fine adjustment by means of a tangent screw.

Mr. Beck said he did not usually like criticising matters of that sort, because he was one of those who had great doubts as to the value of photographic images produced by the microscope. Photography might produce what was seen by the eye; but in many cases they were frightful distortions. If they looked at the photograph of the proboscis of the blow-fly, they would see that it showed every hair as being double, an effect which he considered was due to the removal of the diaphragm having caused distortion by diffraction. If a diaphragm was of any use at all it was to cut off certain rays which caused indistinctness of focus, or to cut off the central rays, so that the circumferential rays could be used alone, and the object in photography should be to get rid of all those inaccuracies which a diaphragm, when it was properly used, would get rid of. He did not wish to criticise the apparatus before them, which seemed to be beautifully made, except that he thought there was rather an inconvenient distance to stretch out in order to reach the focussing screw.

Mr. Teesdale said he had practised photography more or less for the last thirty years, and had never found it necessary to pay the slightest regard to the diaphragm, although he might have occasionally used a temporary one. In the case of photo-micrography, the place for it was certainly behind the lens. The chief difficulty in focussing was due to want of light. Focussing should always be done with as much light as possible, and then having used the whole aperture, the light should afterwards be reduced to sharpen the object. To insure success, extremely accurate focussing was necessary, and to obtain this it was well to put a plate on with some object mounted upon it—say, some diatoms. This was easily obtained by pouring a little water containing diatoms upon the glass and letting it evaporate, when the diatoms would be left adhering to the glass; then focus and get an aërial image. He quite agreed as to the value of the ¼-plate size. It was undoubtedly the most useful for lantern plates and for enlargements, and he entirely concurred as to the benefit to be obtained from taking negatives first on a smaller scale and enlarging afterwards; but he had very decided opinions as to the uselessness of diaphragms behind the object.

Dr. Kibbler said as regarded the hairs, he could only say that the image of the object when seen on the ground glass appeared very much worse than in the photograph, each hair showing as if composed of three or four. The photograph was not taken with a small diaphragm. It had an exposure of ten minutes with an ordinary paraffin lamp. If he had a good light he could demonstrate to anyone in the room the use of the diaphragm plate in improving the image when used in the way he had
described. With small objects like bl
diffraction images appeared.

Mr. Crisp said that since their last
various London and provincial papers
lished a most astounding piece of rubbish
ence to an alleged "new glass just
Sweden." Many of the Fellows and o
forwarded cuttings to the society, one
would show the ridiculous character of
graphs:—

"A new kind of glass, which is to rev
scientific investigation, has been in
Sweden. Ordinary glass is composed o
gredients; but this compound contain
than fourteen, chief among the new s
employed being phosphorus and boron. F
scopic purposes, the power claimed for thi
glass is almost incredible. 1-400,000th p
inch can be distinguished by the stronge
present; but the new glass will, it is sa
the 204,700,000th part of an inch. If the
invention at all approaches what is pro
it, its importance can hardly be exaggera
the very moderate performance of the
'unbreakable' glass, invented a few y
may warn us to be somewhat sceptical in
new wonders in the way of glass."

Mr. Crisp also called attention to the
the 14th (1888) edition of "Heather's M
cal Instruments" had been issued, wit
scription of the Microscope, which was
the first edition, unaltered and uncorre
particular, it is made to appear that the
fying lens" of bygone days is with the
field-lens, and objective, an essential part
pound microscope, while a whole page i
to the reflecting microscope, none of wh
been made since 1840.

Mr. Mills's note on "A Sponge with S
Spicules" was read by Prof. Bell.

Mr. Crisp referred to some comments w
recently been made in America upon the ad
of the method of tilting the stage of th
scope as a means of obtaining a very ec
and simple fine-adjustment. This idea w
any means new, as might be seen by an
tion of the various microscopes upon the
each of which it had been carried out in a
way.

Mr. J. Mayall, jun., said his main obj
this form of fine-adjustment was that
powers it was not possible to properly u
denser. Focussing by tilting the stage
involved the movement of the object in re
the objective, but also in relation to the
condenser. Under such circumstances he
it was hardly possible to carry on a delicat
scopical investigation satisfactorily.

Mr. Beck said that to allow the stage to
any direction except parallel to its plane
destroyed all delicate effects. Let them t
an object as a *Podura* scale, and they w
that if they moved the stage in any deg
ever slightly, which was not parallel, the
ance of it would be materially altered. A
which interfered with the parallel positio
stage must be destructive of true definitio

Mr. J. Mayall, jun., said he agreed ve
with Mr. Beck in the remarks which he ha
but he thought if they took objection to th
ment upon the ground stated, they must
jection also to the "Bausch and Lom
adjustment, where the body tube was hun
parallel pieces of clock-spring, and w
assumed was a movement in arc, althoug
not alter the relation of the object to
denser.

Mr. Beck said that the movement was
movement and not a tilting movemen
Bausch and Lomb arrangement was not
thing at all as the other, because the san
lelism was maintained, whereas in th
pattern they had the optical axis throw
line perpendicular to the object.

Mr. J. Mayall, jun., said that as he u
it, the Bansch and Lomb movement c
them to see a different portion of the surfa
object with every change of the focal adj

Mr. Beck repeated that although thi
parallelism was maintained. Some discus
place as to whether the movement of the
not in reality in arc; but it was ultima
ceded that Mr. Beck's view was correct.

Dr. A. C. Stoke's paper on "New Infus
ellata from American Fresh Waters," conta
scriptions of twenty new species, was rea
Bell. Messrs. H. W. Burrows, C. D. S
and G. Bailey's paper on "The Foram
the Red Chalk" was also read by P
Mr. Karop called attention to the recent i
tions by Dr. W. Pfeffer, on what he te
"Chemotaxic" movements of Bacteria, F
and Volvocineæ, meaning by "chemota
phenomenon exhibited by these organis
presence of certain substances which at
dispersed them according to the natu
stimulant material. A given substance
upon one organism, but not upon anot

dextrin excites *Bacterium termo* to an extraordinary degree, but not *spirillum*.

Prof. Bell called attention to a paper recently published by Mr. Wray, giving an account of the structure of a feather, which, though not entirely new, was very useful. By means of a diagram Prof. Bell then explained the general structure of a feather. In flying birds the barbules of the feather are connected together so as to form a continuous membrane when the wing is extended. These barbules were of two kinds. The proximal barbules consist of a kind of elongated parallelogram which suddenly tapers off towards a point; the attached half has a kind of ledge standing out from it. If, instead of examining a proximal barbule, they took a distal, they would find that on the lower edge of the parallelogram, there were five hooks. In no textbooks was the exact position of these stated, and Mr. Wray had pointed out that every proximal barbule was so arranged as to lie exactly under the distal, and that every distal barbule overhung five proximal barbules, so as to make a continuous sheet. The three dog-tooth indentations shown in his drawing were for the purpose of allowing one-half of the proximal barbule to be folded almost at right angles to the other, without causing any wrinkling of the surface.

The limits of the *Journal* did not admit of a reproduction of the paper, but he thought the observations were of sufficient interest to mention at a meeting of the Society.

USEFUL AND SCIENTIFIC NOTES.

Mathematical and Drawing Instruments.—Mr. W. F. Stanley, of Great Turnstile, Holborn, W.C., has just issued the eighteenth edition, improved and enlarged, of his catalogue of mathematical, drawing, and surveying instruments, and we commend it to the attention of those readers who ask where such and such instruments can be obtained, or what instrument can be used for effecting this or that purpose. The list of contents is full, and anything wanted can be found in a moment. We need say nothing of the quality of Stanley's instruments—that is well known.

Long Distance Telegraphy.—It is a matter of considerable pride to the old operators of the Western Union Telegraph Company in San Francisco, says the San Francisco *Alta*, that the feat of transmitting clock signals through 7,200 miles of line and communicating directly through that line has never been equalled. The occasion of this feat was the telegraphic determination of the difference of longitude in time between the United States coast survey station in San Francisco and the observatory of the Harvard University at Cambridge, in the year 1869. In order to determine the time of transmission of a signal either from the clock or from the operator's key over the given length of the line of 3,600 miles, three different methods were devised. One of these was original with Prof. George Davidson, who had charge of the observations. Through the liberality of the management of the Western Union Telegraph Company, a double circuit of line was looped at Cambridge, so that there extended from the San Francisco observatory 3,600 miles to Cambridge, and the return from Cambridge by a somewhat different route of nearly equal length. The two "earths" were under the San Francisco observatory, distant from each other not more than ten feet. The line was first opened by an operator in the observatory, and when the fast connection was made at Cambridge, the San Francisco operator was considerably astonished to get his own message back within one second of time. Then the astronomical break circuit clock was thrown into line, and made its break on a pen recording upon a revolving cylinder of paper in the San Franciso observatory, and after this break had traversed the line to Cambridge, it returned and made a break upon a second pen moving parallel with the former, in about eight-tenths of a second of time. This was continued every second for several minutes, and was repeated upon several nights, and when one of the twelve batteries in this long circuit was removed, the wave length time was reduced to only sixty-five hundredths of a second. Communication was, of course, carried on at the same rate of speed. This feat over a line 7,200 miles in length has been unrivalled up to the present time, both as a practical working exhibit and a scientific success.

LIGNUM VITÆ has long been used in the stern tubes of steam-vessels and for other bearings exposed to considerable pressure. M. Stockhardt, of Leipsic, however, has recently patented a process of treating ordinary soft wood so as to be fit for those purposes for which lignum vitæ has hitherto been almost exclusively used. The soft wood in question is first impregnated with oil, after which it is subjected to great pressure, causing a considerable increase in the density of the material. Thus prepared, the artificial is said to have all the properties of good lignum vitæ.

SCIENTIFIC NEWS.

THE death of William Lloyd Birkbeck, M.A., Q.C, Master of Downing College, and Downing Professor of Law, is announced from Cambridge. The deceased gentleman, who was a bachelor, was born in 1807, and will be long remembered as the founder of what are known as Birkbeck Institutions, or Mechanics' Institutes, for the development of popular education. Mr. Birkbeck was entered at Trinity College, Cambridge, so long ago as 1826, and graduated as ninth wrangler in 1830. He was called to the Bar in 1833, and for twenty years held the post of Reader in Equity to Lincoln's Inn. In 1860, on the death of Prof. Amos, he was elected Downing Professor of Law at Cambridge, and continued to discharge the duties of that office until a few months before his death.

M. Hervé Mangon, President of the French Meteorological Councils, and a member of the Paris Academy of Sciences, died recently at the age of sixty-seven. He had been Minister of Agriculture, and was an authority on agricultural improvements.

Dr. Schwarz, of the Dorpat Observatory, announces through the Director of the Russian National Observatory at Pulkova that, between the 20th and 22nd May, Sawerthal's comet increased in brightness by two or three magnitudes. Discovered on February 18 at Cape Town, it was just visible to the naked eye on March 25, according to Mr. Brooks, of Phelps, New York. The comet has been observed several times at many observatories, and Prof. Lewis Boss, of Albany, New York, concludes that it is one of the periodic class, the period between successive returns being, he suspects, more than 2,000 years. The spectrum has been examined on many occasions and found to be continuous, crossed by three bands corresponding to the well-known carbon bands generally seen in the spectra of comets. Prof. Boss gives its position on June 3, Greenwich midnight, as R.A. 30m. 26·1s., N. Dec. 40° 40′ 25″.

New minor planets are discovered so frequently nowadays that some confusion arises. M. Borrelly, of Marseilles, is said to have discovered No. 278 on May 12, and Herr J. Palisa discovered another on May 16, which is also for the present called No. 278—probably it should be 279.

The Annual Visitation of the Royal Observatory, Greenwich, takes place to-morrow, June 2.

The conversazione of the Linnean Society was held last Saturday, when all the memorials of Linneus possessed by the society were exhibited. The centenary celebration was held on Thursday, when the Linnean gold medal was presented to Sir Joseph Hooker and to Sir Richard Owen, as representative botanists and zoologists. In future years the presentation will be alternately to a botanist and a zoologist.

The fourth session of the International Geographical Congress will be held at the University of London, Burlington House, in the week commencing Sept. 17. About 400 geologists have arranged to attend, of whom nearly 200 are foreigners.

It has been settled that the Biological Laboratory at Plymouth shall be opened on Saturday, June 30th. The Fishmongers' Company will, it is said, entertain the Council and various friends and members of the Association at lunch on that day, and it is hoped that there will be a large gathering of those who are interested in this important undertaking. The state of Prof. Huxley's health will prevent the President of the Association being present on the occasion. The annual meeting of the Association will be held at Burlington House on Wednesday, June 27th.

The *Rapport Annuel* of the Paris Observatory, by Admiral Mouchez, has been received. The supplement, or appendix, is a remarkable chart of the Pleiades, reproduced, *par la gravure*, from a photograph by the MM. Henry. It contains 2,326 stars, from the 3rd to the 17th magnitude.

A paper presented to the Paris Academy of Sciences by M. Perrotin, of Nice, has given rise to some funny paragraphs in the newspapers about "Men in Mars." M. Perrotin describes his observations of the canals in Mars, and says that important modifications have taken place in their appearance since they were first observed by him in 1886. The triangular continent, somewhat larger than France (the Lybia of Schiaparelli's map), which at that time stretched along both sides of the equator, and which was bounded south and west by a sea, north and east by channels, has disappeared. The place where it stood, as indicated by the reddish-white tint of land, now shows the black, or rather deep blue colour of the seas of Mars. The Lake Mœris, situated on one of the channels, has also vanished, and a new channel, about 20° long and 1° or 1·5° broad, is now visible, running parallel with the equator to the north of the vanished continent. This channel forms a direct continuation of a previously existing double channel, which it now connects with the sea. Another change is the unexpected appearance about the north pole of another passage, which seems to connect two neighbouring seas through the polar ice.

Mr. N. O'D. Parks, a medical man residing at Ashton, Rhode Island, treats diphtheria with an alcoholic solution of cyanide of mercury, with inunctions of oleate of mercury in benzoated lard, and alcoholic beverages ad lib. This is "heroic" treatment, but success appears to justify the means.

The fifty-sixth annual meeting of the British Medical Association will be held this year at Glasgow on August 7 and three following days. The President-elect is Prof. W. T. Gairdner, M.D., LL.D. The address in medicine will be delivered by Dr. Clifford Allbutt, of Leeds; the address in Surgery by Sir G. H. B. Macleod, M.D.; and the address in physiology by Dr. J. G. M'Kendrick. A special address on "Recent Investigations in Surgery" will be given by Dr. W. Macewen.

In his annual report to the Science and Art Department of the Privy Council General Festing, states that the working expenses of the electric light at South Kensington Museum amounted to £1,224. If gas had been used the cost would have been £2,845. It would be interesting to hear more of this matter, for if the figures are correct electric lighting must be cheaper than gas—and that remains to be proved.

A Bill has been submitted to Congress for the construction of a railway from the northern boundary of the United States through British Columbia to a spot on the southern coast of the Alaskan Peninsula, where a harbour will be formed.

Prof. Wolpert, of Nuremberg, has devised an ingenious indicator for determinining the amount of carbonic acid present in air. The principle of the apparatus is that when the red solution of sodium phenolthalide is acted on by carbonic acid it loses its colour. A drop of this liquid is allowed to trickle down a thread, behind which is a scale. If carbonic acid is present it loses its colour as it falls, and the distance passed over before it becomes completely colourless depends upon the amount of the gas present.

The Commander-in-Chief is prepared to receive range finders for competitive trial, and other things being equal, preference will be given to those instruments which will indicate the range up to 2,500 yards with the greatest rapidity, but with an error not exceeding 100 yards, and also require only one observer.

The anniversary meeting of the Royal Geographical Society was held on Monday, when the medals were presented as follows:—The Founder's to Mr. Clements R. Markham, and the Royal to Lieut. Wissmann, according to the awards previously announced. The scholarships and prizes were then presented, and the ballot for officers was declared, General Strachey being re-elected president. The list of Fellows shows a total of 3,391, the society having lost more than it has gained during the year. The total income for 1887 was £8,007, and the net expenditure £8,943. The president, in the course of his address, spoke of the importance of travellers preparing themselves by a course of study in astronomy, surveying, geology, zoology, and botany, and it is satisfactory to know that the society itself has helped to prepare no fewer than 20 travellers by providing instruction in astronomy and surveying, while it has by grants endeavoured to improve geographical education at middle-class and higher schools. The president then reviewed the geographical work of the year, and announced that a reception would be held towards the end of June.

The Navy is being gradually strengthened by the addition of fast, well-armed cruisers, and the direction in which the new types are going can be seen by the announcement that the *Barracouta*, to be built at Sheerness, is to have a displacement of 1,580 tons and engines of 3,000 horse-power. She is to be built of steel and armed with six 36-pounder quick-firing guns, four 3-pounders, and four torpedo tubes.

The *Arcadia*, which arrived in the Albert Docks the other day from Belfast, is, with the exception of the *Great Eastern*, the largest vessel that has ever entered the Thames. She is about 6,500 tons register, and has engines of 7,000 horse-power which drove her from Belfast at the rate, at times, of 17¼ knots an hour. She is one of the subsidised armed cruisers, and will be employed by the P. and O. Company on the Australian mail and passenger service.

News received from Tasmania states that Sir Thomas Brady has arrived at Hobart, in the *Kaikoura*, with the salmon ova for Tasmania in splendid condition, less than 1 per cent. having been lost out of 400,000. They were in insulated cases in a special ice-house. Sir Thomas Brady has been unremitting in his attention on the way out. He has hatched several of the ova, and has many young fish alive and vigorous on board. He also took several larger fish with him, but they died in the Tropics, owing, it is stated, to his having deposited them in London water. If he had their native Irish water, he considers he could have saved them.

A method of recovering the tin and solder from cans, &c., patented by Mr. J. Woods, consists in immersing the tins in a boiling solution of caustic soda or potash until the paint, grease, &c., are dissolved and converted into rough soap, afterwards collected. The cleaned tins are then immersed in melted caustic soda, nitrate of soda, and peroxide of manganese. The solder falls off to the bottom of the vessel, and the tin is converted into stannate of soda, from which the tin is recovered by precipitation.

The discourse at the Royal Institution on Friday, June 8, will be by Prof. Dewar on "Phosphorescence and Ozone."

The Rabbit Pest in New Zealand.—The United States Consul at Auckland in a recent report describes the extent to which New Zealand has been economically injured by rabbits, and the cost incurred in endeavouring to exterminate them. Nothing, he says. could so overrun a country since the locusts of Egypt. The rabbits have so eaten out the ranges that the capacity for maintaining sheep has greatly lessened, and the flocks have fallen off in numbers. At the Stock Conference of 1886 it was stated that rabbits reduced by a third the feeding capacity of land, and that the weight of fleeces had decreased by 1lb. to 1½lb. each. The number of lambs decreased from 30 to 40 per cent., while the death-rate increased from 3 to 13 per cent. Since 1882, when the Rabbit Act became law, Government has expended £7,000 on Crown lands alone, and it is estimated that during the last eight years private persons have spent £2,400,000 in extirpating rabbits. The methods generally in favour were fencing, poisoned grain (generally phosphorised oats), and ferrets, weasels, and stoats. Large numbers of men have been hired from time to time to make war upon the rabbits, and it is said that these "rabbiters" encourage the vermin in every way, and had been caught killing the stoats and ferrets. The bonus system has been found objectionable and expensive. Notwithstanding all that has been done, in some localities the rabbits have continually increased and the damage has continued. It is hoped, however, that as the country becomes more populous, and the large tracts of land are occupied and cultivated, the numerous herds of rabbits which now roam over the land will disappear.

A SCHEME is under consideration in Mexico for tunnelling the volcano of Popocatapetl through the wall of the crater, in order to reach the immense sulphur deposits inside the mountain. A narrow-gauge railway will connect the tunnel with the town of Amecameca, which, in turn, will connect with the Morelos road leading to the national capital.

LETTERS TO THE EDITOR.

◆

[We do not hold ourselves responsible for the opinions of our correspondents. The editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, *332, Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

⁂ *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

◆

THE SOIREE OF THE ROYAL SOCIETY ON MAY 9th—CONVERTING R.A. AND DEC. INTO LONGITUDE AND LATITUDE—THE AMERICAN "NAUTICAL ALMANAC"—THE ZODIACAL COUNTERGLOW—AN ATTEMPT TO COMET TOO STRONG—A QUESTIONABLE WAY OF BRINGING DOUBTERS ROUND—EVOLUTION—SIMPLE WEIGHING MACHINE—DISTORTED IMAGE OF SUN IN SEXTANT—DIALLING: LED WORSE BY LEADBETTER—FORCE AND ENERGY—MATHEMATICAL PARADOXES.

[28784.]—IN connection with the paragraph in your "Scientific News," on p. 254, concerning the recent soirée of the Royal Society, I should really like to have the opinion of some spectroscopist at once competent and unbiassed (say Prof. Dewar) as to the character and origin of the spectra exhibited there by one of the lights from Brompton. There is a veracious old proverb which alleges that "one story is good until another story is told." I am a little surprised, too, to find no mention of the exhibition of Roberts's writing telegraph—to me one of the most striking things shown there. It was positively "uncanny" to see the little pencil of the recording instrument reproducing in autograph and lineatim, the writing of the operator at the other end of the line.

Since writing the concluding paragraph of letter 28740 (on p. 255) I have received the "Report for the Year ending June 30, 1887," of Prof. Newcomb, the superintendent of the American *Nautical Almanac*, in which the following passage occurs—"Tables were also constructed for changing the sun's longitude to right ascension and declination," which entirely confirms me in my belief that no tables for the transformation of those co-ordinates previously existed. Speaking, by the way, of the American *Nautical Almanac* suggests to me to observe on the remarkable activity in the office whence it is issued, as indicated in Professor Newcomb's interesting report. I gravely fear that it will be a long time ere a similar one proceeds from Verulam Buildings.

Another interesting communication comes, too, from the United States in the shape of a paper on the Zodiacal Counterglow, by Prof. E. E. Barnard, of the Lick Observatory, in Gould's *Astronomical Journal*. This remarkable phenomenon (which has seemingly attracted but little attention and been but rarely observed in this country), was first remarked by Brorsen (who named it Gegenschein), and later by Backhouse, Mr. Barnard, in total ignorance of their observations, having independently discovered it in 1883. This remarkable apparition first becomes visible in the autumn, as a roundish mass of diffused light, some 10° or so in diameter, situated in or close to the Ecliptic, and is situated as nearly as may be 180° from the sun. Later, after it crosses the Vernal Equinox, a Zodiacal band becomes visible, and the counterglow, so to speak, flattens out, the band increasing in distinctness, until finally at midnight this band is seen connecting the evening and morning Zodiacal lights, and the counterglow proper diminishes to a mere swelling. Here, then, is a most interesting field opened to the naked-eye observer, and all who wish to take up a practically new astronomical investigation should obtain and read the record of Prof. Barnard's painstaking work. The number of the *Astronomical Journal* in which it appears is 24, of Vol. VII. for 1888, March 23.

Oh dear no, "E. L. G." (letter 28755, p. 258),

"Decortications of the golden grain,
Are set to allure the aged fowl—in vain."

I think it a pity that Mr. Moy (letter 28757, p. 259) persists in quoting Scripture to prove the rotundity
of the earth. Every impartial and unprejud
reader of the Bible must see at once that
ancient Jews believed that the earth was flat,
a "firmament" supporting a reservoir of w
separating it from the waters of the ocean;
that they further, in their ignorance, imagined
the sun, moon, planets, and stars were all cre
for the benefit of the inhabitants of the insignifi
little plain upon which they conceived themse
to be moving about. To attempt to read the sc
tific knowledge of the nineteenth century into
records of this old Hebrew nescience is onl
invite ridicule and contempt.

Let me thank "Nun. Dor." for his exceedi
kind and courteous reference to me in reply 6
p. 259. To insinuate that a man is an athei
simply a very spiteful and ungentlemanlike me
of indicating that he differs from the person
ploying these tactics. As far as I personally am
cerned, such an insinuation is as absolutely fal
it is offensive; but when I find people in
grossest ignorance of what "Evolution" m
dogmatising on it, and covertly abusing those
really do know something about the matter, I th
it better and more dignified to leave them seve
alone.

[Since these lines were written, I have
reading that very able and thoughtful w
"Natural Causation," by Mr. Plumptre, in w
the superstitious spirit is defined "As the tend
to embrace a statement with little or no inv
gation, and having embraced it, to endow it
spurious infallibility." Surely no more accu
description than this could possibly be penne
the mental attitude of people who write such h
less nonsense as "Dens" and Co, Limited (
65328, p. 266). Who was this "lecturer," and
and where did he see the experiment performe
the transfusion of simian blood into human ve
The whole story is absurd, and absolutely incred
upon the face of it. I wonder what these ge
say to the operation upon Prof. Fleischl, descr
in your "Scientific News" on p. 278, in w
nervous tissue was transferred from a rabbit
disparate an animal as man, into whose fran
was at once incorporated. Surely, ignorant
"Dens" obviously is of the very rudiment
comparative anatomy, he must have some g
mering of the enormous gap which separates
rodentia from the primates and man. Were th
medical journal, I could say something which w
prove that the popular definition of "species"
applied to man in contradistinction to the hig
apes has been broken down. Possibly "Eos"
others who have been in the East will gues
what I am hinting; but it is as impossible a
would be improper to speak more plainly here.
real truth is that the odium theologicum is at
bottom of the whole matter, and men will adva
absolutely supposititious operations—or anyth
else—as arguments in defence of what they c
ceive to be orthodoxy, which they would utt
scorn to employ in polemics in which even t
own personal reputation was concerned.]

Why does not "W. H. N." (query 65340, p.
buy a spring letter-balance? They are ch
enough.

I wonder whether it has ever occurred to "As
matic" (query 65350, p. 267) to have his sext
tested by some one with normal vision? The det
with which he supplements his question poin
his own eye as the probable source of error;
for aught that appears, it *may* reside in a wav
bleb in his index glass, or possibly in the teles
of his sextant. No one can give him an ans
worth reading without seeing the instrument it

I strongly suspect that "Leadbetter," to w
"Embryo Diallist" refers in query 65371 on p.
was more knavish than foolish, and wrote the
posterous rubbish quoted "to make good
trade," as workmen say. The variation is in
compass itself—not in the true meridian, whic
fixed and immutable.

I must admit the justice of the argument
vanced by "Dubliniensis" in letter 28773 (p.
and am sorry that anything I have written sh
be susceptible of being interpreted as a defenc
the misuse of terms to which a perfectly defi
connotation is attached by men of science ge
ally. At the same time, borrowing an illustra
from your able correspondent, I would say tha
Sir Robert Ball or Mr. Proctor were to define
distance between two stars measured on the a
a great circle, as "parallax," I should attribu
rather to perversity than to "ignorance."

I am delighted to see the assault of "Wol
büttel" (letter 28779, p. 284) on the pangeom
cal vagaries of Beltrami, Helmholtz, Lobatsc
sky, Riemann, and Co. For the lines of t
space, albeit curves, can have neither tangents
normals, radii nor chords. We may juggle
words as we will; but, after all, our final
fundamental conception of space is that of *exten*
and nothing else. Riemann's "*n*-fold exte
multiple" muddles up an algebraic multiple a
spatial magnitude—which are about as compar
as the Freedom of the Will and toasted chees

A Fellow of the Royal Astronomical Soc

MARS—JUPITER.

[28785.]—AN interesting sketch of the planet Mars appeared with Mr. Mee's letter (28742), and the appearance of the snowy north pole could not have been better described. "So bright," he says, "was the polar cap, that it seemed to project from the disc." The polar cap and markings on the planet were exceedingly plain as seen on the evenings of April 26 and 29, and again last night between 8h. 30m. and 9h. 30m.

The transits of No. III. satellite skirt very closely the Northern limb of Jupiter, but on Thursday, the 24th, the planet did not get clear of the heavy mist above the horizon early enough to see whether III. was visible the whole time of transit.

After the 31st no transit of III. will be visible, at any rate for some time to come. The telescope used was a Dollond 3¾in. aperture. The powers used on Mars, 107 and upwards.

Hendon, May 28. **P. F. Duke.**

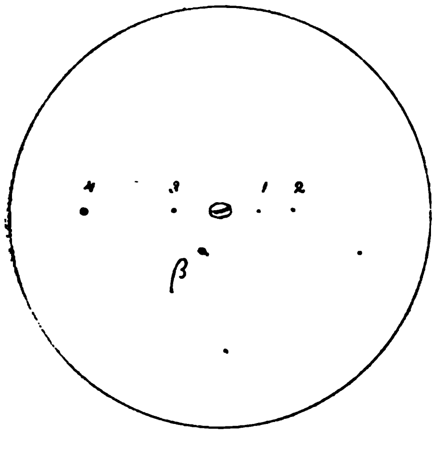
CONJUNCTION OF JUPITER.

[28786.]—MANY of your astronomical readers have, no doubt, already enjoyed a view of the very interesting phenomenon visible in the south-eastern sky during the early nights of this week—I allude to the conjunction of Jupiter with the fine double star β Scorpionis.

At midnight on May 20 the planet and the star differed in declination 2′ 17″, and in R.A. 3 seconds only, and the contrast between the belted planet, with its four satellites, and the brilliant colours of the star and its *comes* was exceedingly pleasing, the general effect being increased by the presence of smaller stars in the field.

The planet is moving but slowly, and those who have failed to obtain an earlier view may not be too late to secure one when your next issue appears; but the moon, full on 25th inst., and in conjunction with Jupiter on the morning of that day, will have to be reckoned with.

I append a rough sketch, not to scale, as seen in



an 8½in. mirror, power 100, on the date and at the time previously mentioned.

Birmingham, May 22. **Fred. Wm. Nash.**

THE AFTERGLOW.

[28787.]—AFTER a long intermission, during which the afterglow—first seen in 1883—has been invisible, or nearly so, it was resumed with much vividness. During the last two sunsets the colouring was quite equal to that of some of the finest early displays of this phenomenon.

Charles Rous-Marten.

Wellington, N.Z., April 20.

CONTINENTAL ORGANS.

[28788.]—I HAVE lived some years in Germany, and can endorse what your correspondents say about some of the organs which one finds in the large churches. The Germans seem to me to be aware of the weakness of these instruments, as they always have an orchestra when anything extra is to be given. A few years ago I was fortunate enough to meet one of the seven brothers Walcker, the organ-builders of Ludwigsburg, near Stüttgart. He had just returned from Riga, where he had erected the large organ in the cathedral of that town. He maintains that it is larger than any existing organ. This gentleman was just finishing a beautiful instrument for the church in Neuwied on the Rhine; he has two in this small town. I have played them both myself, and must confess I never touched or heard sweeter instruments. If Mr. John T. Lawrence, M.A., or "C. R. O." are anywhere in the neighbourhood again it is well worth their while to inspect any of Walcker's works. One finds them now in many towns in South Germany. They have lately put a small one in the English church in Baden-Baden, and generally tune the Freiburg organ once a year.

John Place.

67, South-street, Greenwich, S.E.

WATER-WHEELS AND TURBINES.

[28789.]—HAVING, with much interest, read the letters of "Engineer, Govan," "Millwright," and others with regard to water-wheels and turbines, I beg permission to lay before you and them a few details with regard to their working capabilities, &c. Probably before this letter reaches you the subject will have been well thrashed out, and these remarks will be superfluous.

In No. 1,197, letter 64382, your correspondent, "Millwright," is very much down on turbines. Almost in spite of myself I have been convinced, from experience in a number of cases, that the turbine and water-pressure engines are greatly superior to any form of water-wheel yet constructed. By the term "water-wheel" is meant the overshot, undershot, and floating wheel. I am acquainted with wheels constructed with two-part and three-part buckets, these buckets being sometimes straight-sided and sometimes curved; also with the ventilating bucket—in the particular case the spaces for ventilation were 1¼in. wide. The smallest wheel I have known was about 7ft. in diameter, and the largest an iron one, which may still be seen standing at Magg's String and Twine Works, near Zeals, in the Gillingham district of Wiltshire. I believe the diameter of this wheel is 150ft., and it is said to be the second largest in England. Will "Millwright" please state the probable cost of such a wheel 150ft. in diameter, with 3ft. breasts, and compare it with £103, the price in Port Elizabeth of Thompson's patent vortex turbine, which, with 100ft. fall and 353c.ft. of water a minute, will give 50H.P. with 629 revolutions of its shaft. Of course, in calculating the price of such a wheel, the cost of spur, &c., gearing, and countershafts to obtain 629 revolutions per minute, must be included.

"Millwright" says the turbine has yet to be made that will do the work of his water-wheel. With due submission to him, I do not think so. Such a turbine was at work as far back as 1864, and may be still. It had about 11ft. of fall, under circumstances not unsimilar to "Millwright's." Your correspondent has only to visit a certain Reddish Paint Works, near Stockport (I cannot be more explicit for obvious reasons), where he may yet see this turbine at work as well as two others subsequently erected. All three are by the same makers, and said to be doing excellent work. I could name three firms at least who would guarantee him 20H.P., if not more, with the water he is using, and probably more with the water he has at command.

Allow me to make ten statements which my own experience has shown me are sufficient cause to place the turbine first:—

1. If the turbine be made to suit the circumstances of the case, there is no waste of water.

2. Turbines can be placed in positions where it would be impossible to place a wheel; always in place of existing wheels.

3. High falls with small quantities of water can be economically managed; with a waterwheel this is not possible.

4. Their use is more effective where low falls have to be used.

5. Taking theoretical horse-power as 100

Overshot wheel will give	68
Undershot " " "	35
Turbine " " "	75*

(* This is understated. Molesworth states water-pressure engines at 80 per cent.)

6. Price.

7. I know a place well where a turbine has worked day and night for *ten years*, the only repairs needed being the replacing of step of lignum vitæ. This turbine is in Wiltshire, in a stream often flooded, and the water is often charged thickly with gritty matter. It replaced an overshot water-wheel 18ft. by 11ft. It now requires less water to do the work, and more power is got out of said water than formerly. Countershafts are done away with. The fall given to this turbine is about 8ft. and the H.P. 50.

8. The turbine is lighter, takes up less room, and requires less foundation.

9. It is *self-governing*, and cannot "run away," whereas as soon as the strain is taken off a wheel and the water not cut off—the wheel "runs away" at once.

10. A great argument in favour of overshot wheels is that they cannot get out of order; sticks, grass, stones, &c., make no difference. All these things are met and separated, and held back by the grids in the turbine pen-trough. All lubrication in a good turbine is practically automatic, and requires far less attention than the lubrication of gudgeons, cogs, and countershafts of a waterwheel.

I am at present engaged in removing one of the largest, and possibly the finest, water-wheels in South Africa, and replacing it with a turbine. The wheel has stood four years. A special turbine has been made in Belfast, and with very little further work beyond setting masonry for foundations and cutting a tail race, we are in a position to obtain some 60 or 70H.P. where formerly we obtained about 15 or 16H.P.

This turbine is self-governing, can be stopped at once, has a speed of 400 revolutions per minute, and will use about 850 cubic feet of water per minute. I cannot state precisely the cost of this, but in this part of the country a 50ft. diam. wheel with 6ft. breasts would cost nearly £1,000, including spur-gear, &c., whereas a turbine which was made specially, including transport over 600 miles of country, &c., &c., will not cost us half that amount. One cause of the wooden wheel's untimely end was the fact that it stood high and dry for nearly a year under a South African sun. This would not affect a cased turbine. This new water-pressure engine will be used to drive stamps and other gold-extracting machinery, and will have to bear with equanimity the addition and subtraction at odd times of as much as 10 to 15H.P. at once, and this can be done without inconvenience automatically. I am aware this governing valve is somewhat of a novelty; but it is an inestimable advantage where stoppages often have to be very sudden.

I do not want "Millwright" or any other correspondent to think I am blindly prejudiced. It is simply a case of the survival of the fittest, and this latter is what I deem turbines to be.

Since I have been in this country I have designed two overshot wheels for private friends who own much timber land; but turbines could have been put in at a less cost even then. When my attention was first turned to turbines, I must confess it was some time before I was convinced in their favour, and until a man has actually seen what a turbine can do (for "Mr. Millwright" will not condemn the whole lot because he knows of one bad one) no one will blame him for not believing.

A little extra mechanical skill may be required to look after a turbine, and keep it in running order; but surely a man who knows enough of mechanics to look after his mill will soon learn the little needed in connection with a turbine. And if anything should go seriously wrong, the manufacturers will always send a man; or, better still, why not employ a fitter in the neighbourhood? Some men hate any kind of mechanism above a sewing-machine. These men, when they look for the first time on a set, say, of triple expansions moving a big steamer, are lost as a rule, and wish to go back to the old side-paddle system. Can it be that "Millwright" looks upon a turbine with the same kind of wondering incredulity, and goes away and prefers his cumbersome water-wheel, for the same reason that the other men prefer a ride in a penny steamboat—viz., because they are used to it, and don't like new-fangled ideas! But that cannot be. I fancy there will always be sufficient work for good water-wheels under certain circumstances; but the turbine will beat them out of the market in time. It is the old story of "Coaches v. Railway." You will remember, Sir, one of Stephenson's great obstacles was the celebrated "coo" (cow), and there is always a "coo" to obstruct anything a little novel. One thing is certain: that, in spite of the "coo," railways do exist; and *so do coaches, but how many in comparison?*

V. I. A.

Transvaal Gold Exploration and Land Co.,
Pilgrim's Rest, Transvaal, S. African Rep.

TURRET-CLOCK MAKING.

[28790.]—I BEG to thank "Vulcanite" for his good-natured offer to give me the number of teeth in the wheels of his clock; but it is not in that direction I want information—it is in the design: size of wheels, their axils and journals—in fact, general dimensions. This would be a help; but it is too much to ask from anyone.

To "Tuebor" I also would express my thanks for information as to character of Reid's book. Why I asked about it was that it is given as one of the text-books on clock-making by "the City and Guilds of London Institute for the Advancement of Technical Education." I therefore thought it probably would be more a practical than a theoretical instructor.

I read Beckett's book some years ago with a view to future use, as I was not then ready to undertake work. Since then I have not looked at it. My recollection of it made me wish and hope that there might be some new book which would lay down the road to success more clearly.

When I undertake anything I do not care to have it show the amateur stamp too plainly. I might make a clock like my grandfather's that would perhaps go fairly well; but I wanted to get a little nearer to modern work; but now, on looking into Beckett, I find there is more in it to help than I had thought. What Mr. Marson says is no doubt true; but does he not think that, with all the help he can get, an amateur's difficulties are already sufficiently great when, without anyone to advise or any patterns to follow, he ventures for the first time on the extensive and expensive undertaking of making a turret-clock?

Fredk. Carre.

TURRET CLOCKS.

[28791.]—As Mr. Fred. Carre asks for titles of books about clock-making, I can recommend him, if he reads German, "Leitfaden für Uhrmacher Lehrlinge," by Hermann Siefert, Berlin, 1884. He will find in it a description and two designs (front and side view) of a "regulator," according to the best modern principles, by the late well-known Grossmann, of Glashütte, near Dresden. The chapter contains many useful hints how to make the different parts—for instance, the Graham escapement, the measures of which are obtained by trigonometrical calculations; this gives a preciseness of measure far beyond any design.

As Mr. Carre observes, it is a very nice work for us amateurs to make a clock. With a wheel-cutting machine, which I made according to Northcott's design ("Lathes and Turning"), and the excellent wheel-cutters from the Brown and Sharpe manufactory, I was able to cut all the necessary wheels, and achieved my clock in a very satisfactory manner. In the above-quoted book nothing is said about turret clocks.

San Remo. **W. van Eys.**

THE ENTELECHIASCOPE.—A VERY OLD FORCE IN THE GUISE OF A NEW MOTOR.

[28792.]—BEING much interested in the subject of "Force," physical or otherwise, from the human organism, if such exist, I have been, for a period of upwards of 40 years past, engaged in work with the object of ascertaining, if possible, what facts there may be in regard to this matter more demonstrable than any of those with which I have been hitherto acquainted, and which have always seemed to me to be of a more or less questionable character—so far, at least, as my experience extended.

Up to the beginning of 1885, however, my efforts were crowned with little success; but in January of that year it seemed to me that I had, at last, made some progress in the direction of these inquiries, and, perhaps, found the true key to the lock behind which has been hidden for ages the many mysteries connected with the actions and functions of life, as exhibited more especially in the physical and mental constitution of man.

Much has been said, and not a little written, in the past, with respect to certain forms of force termed odyle, mesmerism, spiritualism, science cure, mind cure, *et hoc genus omne*; and in regard to most, if not all, of these, it has been averred that the phenomena as shown by certain practices or manipulations were the outcome of some inherent force or forces, emanating from the human body when brought to bear upon certain subjects or objects.

That many of the facts, or alleged facts, or effects, proved to be true enough on being properly examined could hardly be disputed by any unbiased person; but in the absence of a direct physical demonstration, such as that of the celebrated Oersted, in regard to the connection between magnetism and galvanism, the only explanation of them that could be reasonably accepted by the scientist was, that the results, or alleged results, arose simply from the action of strong minds upon weaker ones, or the effects probably of diseased nerves acting upon excited imaginations.

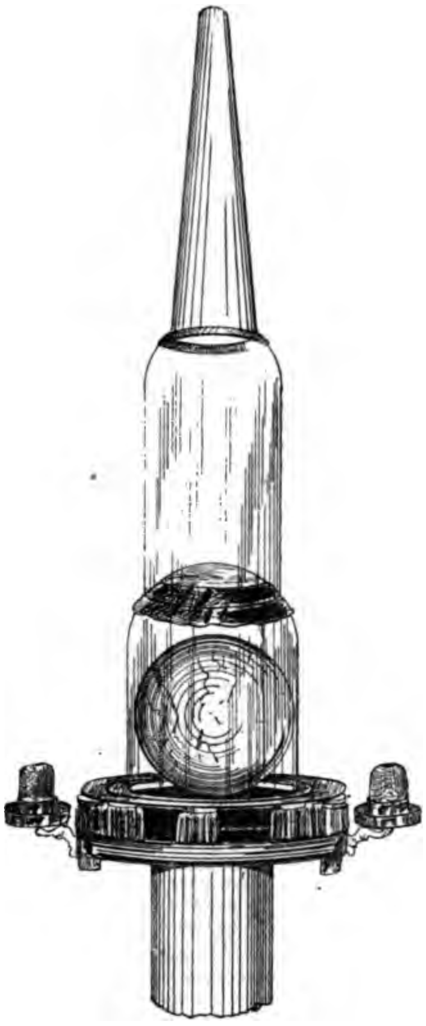
It was under these circumstances, then, that as I could not doubt the reality of many of the phenomena adduced—being indeed the evidence of my own senses—I concluded that there must exist some cause, some form of force more or less dynamical, it may be, in its character, which, if ever discovered, would become the key to the mystery; and, furthermore, I laid down for my government in these investigations that, granting the existence of such a force in the human organism, no proof of such existence could be accepted as conclusive that did not demonstrate that that force could act upon inert or what is called "dead matter" at a distance; and that too, unconnected of course with any immediate conductors in the shape of wires, or with galvanic batteries, magnets, or other media of a similar kind between the operator and the matter, person, or thing operated upon. In short, that to establish the fact that the human body possessed the powers or forces contended for, nothing less than the demonstration of that power on inert or dead matter, without contact of any kind whatever, and at distances more or less definite, and through the medium of the air alone, could be accepted.

The present communication claims the discovery of a mode of demonstrating in a plain, simple, and unequivocal manner, not only the fact that there is such an emanating force from the human body, but also that that force can act as a motor upon inert or the so-called "dead matter," at a distance varying, so far as my experience has extended, from a few inches to many feet.

Up to the present time, however, my experiments have been chiefly confined to the operating on inert matter in weight from 11gr. up to 2oz., beyond which they have not been fairly carried from the want of the necessary time at my disposal for such investigation.

I have not thought it expedient to extend this letter at this time to a minute description of the instrument by which the phenomena to be presently stated are produced; but should the subject be thought a matter of interest, I shall be glad to do so in a future communication.

I inclose, however, a photograph I have taken of the instrument as at present in use; and will only add on this point that the instrument is about 7ft. in height from the pillar, or support, on which it stands. The disc seen inclosed in glass is 14in. in diameter, and in weight 2oz.; it is suspended in a very large glass dome 16in. in diameter, and carefully protected from the possibility of all external air currents. It has no fixed zero point; the conditions upon which its action depends varying from moment to moment.



I now proceed to describe a few of the phenomena exhibited by this instrument, which I have named the "Entelechiascope," provisionally at least, until a more suitable one is found:—

1. The disc works under a closed glass dome in common atmospheric air. The disc is influenced on exposure to diffused light, producing rotation of the disc over arcs of more or less extent.

2. The direct or reflected rays of the sun, or even rays of a condensed light from a common lamp at a considerable distance, can produce rotation of the disc; and, in the case of the sun, vigorous rotation when exposed to his direct rays.

3. The disc is often put in rotation over arcs of varying extent during electrical storms or high winds.

4. The disc is influenced to rotation by a person within many feet of the instrument, the extent of that influence being shown by the rotation of the disc.

5. Depending upon the state of a person standing at the distance of, say, a foot from it, the disc will revolve over an arc of 90°, sometimes much more, sometimes less.

6. A person standing at a short distance from the instrument the disc commences to rotate. shifting his position correspondingly as the rotates, from time to time, the disc can be i enced by the operator under favourable condit through four or five revolutions, and this is ac plished, as has been stated, without any a contact whatever of the operating person, or nection with the revolving disc inclosed withi glass shade and rigidly excluded from the ext atmosphere.

7. Any person entering the room in which instrument is fixed influences the disc to motio a greater or less extent.

In dealing with the manifestations of for exhibited, I have found the interpretation of t not unattended with difficulty. I venture to t that the evidence obtained already is sufficie establish the fact that the singular—not to extraordinary—motions of the disc are at t fraught with significant, strange, and far-rea revelations in science, and that, too, perha the not very distant future; and I must add it appears to me, if the phenomena shown do furnish the true key, the connecting link bet physical and psychological science, they go at le very long way towards it.

Were I asked at the present moment if I c designate by name the force by which the mo and rotations of the disc take place, I should that it was most likely a form of force corre with most, perhaps with all, of the hitherto k forces—such as light, heat, magnetism, electr &c.—distinguished, however, by being of a more refined, complex, and probably comma character, if I might so express it; and I d know that I could describe in more approp language the idea that presents itself to my than by quoting the following extract from a entitled "Vital Motion as a Mode of Phy Motion," by that gifted physician and writer, Radcliffe, of London. He is speaking of electr and says:—"What is called electricity is o one-sided manifestation of a single, central, mical law, which, when fully revealed, wi found to rule living and lifeless bodies alike, n entombing spirit in matter, but by transfig and spiritualising matter; a law which, wi confusion of substance, binds all things tog in the very closest communion; a law which m the old belief of multiety in unity, and uni multiety, a sober fact," and with these grand w as I venture to deem them, I must close this munication. **W. H. Eva**

Durban, Port Natal, April 25.

DYNAMO BRUSHES.

[28793.]—I AM obliged to "Vulcanite" fo ceding to my request. The experiment gives u knowledge. The probable reason why the brush worked best is because the spark is br up amongst a number of points, and so does damage to each individual point. Brass also i "greasy" nature, and so causes less friction. are quite right not to put more than *just* en pressure on them to prevent jumping. The d of putting a spring on end of spindle I con highly ingenious. It occurred to me the day, when considering how best to cause collector to slide under brushes, which, as I t I told you, is of great service in preventing ru of collector.

As to lubricant—vaseline is all right; b would most strongly dissuade you from blacklead as a lubricant. Being an excellent ductor, it is very apt to cause a short circuit, a you use much of it, or if it gets imbedded bet collector bars, you are almost sure to have tr before long. Have you tried "French cha It is of an exceedingly greasy nature, and by a flat slip you can easily apply it just where wanted—viz., wherever you see bright rings ing. Do I understand that your brushes pre on, as in most modern machines?

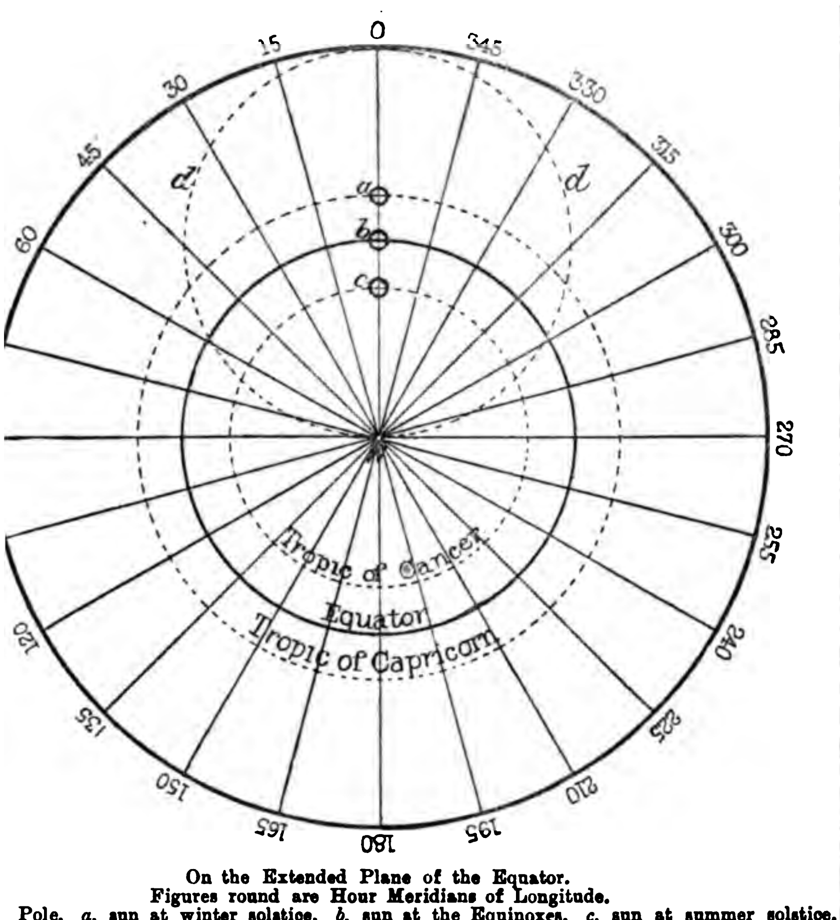
Engineer, Gov

HINTS TO INVENTORS.

[28794.]—As so many of your readers are inventive turn of mind, perhaps some of the answer the following queries:—

Fruit-growing must become a national ind before we can hope to see our farmers agai manently prosperous. The future of British culture is to be in the hands of small cultiv as it is on the Continent. Fruit-growing h still in its infancy, and, except for producing and perry, apple and pear-growing has nev been attempted in this country on any very sive scale.

There are, however, two objections of a re practical character that can be solved grad probably by mechanical appliances. The that fruit-blossom is frequently destroyed frost, and a year's crop is thus lost in a throughout a whole district for the want of easily-applied, cheap, and effective protectio our early spring frosts. The second ma national moment is that of preventing the



On the Extended Plane of the Equator.
Figures round are Hour Meridians of Longitude.
Pole. *a*, sun at winter solstice. *b*, sun at the Equinoxes. *c*, sun at summer solstice. *d*, boundary of light, or day. All the other part of plane, three-fourths, darkness, or night.

ring our cherry-trees, &c., before they can
ed, and (by similar methods, probably)
the fruit-buds from the small birds
e autumn and winter. Not only our bush
e currants and gooseberries, but plums
s, are very seriously crippled by small
this way. Until we get the natural
the "divine dexterity of the hawk" re-
d and restored by the abolition of game-
we must get artificial substitutes. Herti-
as so far in these two matters reaped no
rom the advance of engineering skill or
tions of applied mechanics. To get fruit-
in our orchards protected from frost we
back upon natural protections like jute
agging," as it is called, which can be got
square yard. Probably a much cheaper
an be suggested, and the best way of fix-
aterial to prevent the damage from winds
dealt with. The keeping off flocks of
be done by means of noise, or by in-
ebs of thread, or by windmills that would
flocks of starlings and also smaller birds.
e practical application of some such pro-
s these that I would especially invite the
of inventors. These evils are real and
all familiar with fruit districts. Who-
give us any real patent remedy will be a
benefactor. **W. S. Manning.**
ands, Vanbrugh-hill, Blackheath, S.E.,
May 21.

FLAT EARTH IMPOSSIBLE.

]—SOME years ago, when holding a public
with the late "Parallax" at Penge, I
on a large size, a copy of the above
He could do nothing with it—it quite
d him, and all he could say was, "it was
I have said nothing in my reply to him
ing to his theory as is said on this leaflet.
t liberty to publish it (it never has been
lic), and I think its publication would do

opounders of the Flat Earth theory,
that the sun's light does not extend
° from the equator at the time of the
s, are obliged to keep his illuminating
in those limits. The world, it is well
always half-enlightened, and that the
nds 4,000 miles all round from the point
sun is vertical. Not so on a plane of
s in diameter. With the North Pole in
of this plane, the extended south 4,000
n it, and the Equator midway between,
of light cannot reach farther than 2,000
m the point where the sun is vertical;
tly only one-fourth of such a plane can be enlightened at one time. The area of a circle whose diameter is 4,000 miles contains but one-fourth the number of square miles that another does whose diameter is 8,000 miles. On the surface of a sphere, such as the earth, the number of square miles is 200,000,000; but on a plane of the same diameter, there are only 50,000,000 square miles. To contain the same area as the world, the plane should be 16,000 miles in diameter, and 50,000 miles in circumference. As, then, this circle of light of 2,000 miles radius takes 24 hours to complete one circuit, there must be two days and two nights, each of about six hours' duration, every 24 hours on a flat earth! The earth flatteners say that "the sun's altitude at all seasons of the year is 900 miles, and that it sets by means of perspective." This cannot be true, for the sun's apparent diameter is not diminished when setting, and, further, the sun has been seen again the same evening after it has set. They also assert that "the sun travels from east to west 900 miles an hour, and that it enlarges or decreases its orbit, north or south, 900 miles in 60 days." The whole increase, therefore, in 183 days (the time between the longest and shortest days), is 2,745 miles, consequently the sun is more than three times further off in midwinter than in midsummer. Of course, it ought to be much diminished in size; but it is not. It is actually larger. Its motion must be vastly augmented; but no, this is not the case. Within a few seconds per day, it is the same in winter as in summer. The earth cannot be a plane.

Spratton, May 18. **J. Dyer.**

FLAT EARTH.

[28796.]—IF "Sigma," "E. L. G.," and other of my opponents can condescend to exhibit such pitiful cowardice as only to address themselves to those journals which they know will be closed against my replies, how can they wonder that modern science is being daily more and more regarded with angry derision and the most unbounded contempt by every honest and impartial truth-seeker? And those periodicals that lend themselves to such unjust influences, or allow themselves to be bullied by such cowardly correspondents, are a disgrace to British journalism, and have no right to call themselves Englishmen. I cannot understand such mental slavery. Why does not the "E.M." say at once it has no sympathy for anything but knavery and lies. No editor, unless he had forfeited all self-respect, could lend himself to such dastardly behaviour. This is not the first, or second, or third time the "E.M." has been guilty of this offensive and ungenerous behaviour. Very many who do not sympathise with my view have expressed themselves surprised and indignant at it.

John Hampden.

[This is the last word we will insert on this matter. We have—much against our own convictions and the repeated remonstrances of numerous readers and contributors — allowed Mr. Hampden space once again—not in the hope that he would be convinced, but that, by the exhibition of his own inability to answer a plain question, any ignorant people who are liable to be influenced by his balderdash might be warned. As usual, Mr. Hampden, driven into a corner, slinks off, vomiting a torrent of foul language.—ED.]

THE ISOSCELES TRIANGLE.

[28797.]—IF "L. S." (letter 28766) understands the differential calculus, he will see this worked out by another correspondent—"J. R. C.," p. 284. The figure given appears to be correctly drawn and the working correct. He will there find that an equation is obtained from which we can find the value of the half angle at apex—it is $\sin.^2 \theta + \sin. \theta = 1$. By solving this quadratic, we get $\sin. \theta = \frac{\sqrt{5} - 1}{2}$, which gives an angle of 38° 10′ 22·1″, and the angle at base will be 51° 49′ 37·6″. I have had to quote this from "E. L. G.'s" letter, "Cheops and his Pyramid," p. 279, as my tables do not go near enough. If "L. S." cannot work the calculus, and will draw two triangles, one with the above angle at base, and another with the angle 60°, he will find that if he takes the sloping side a yard long, the radius of the inscribed circle in the former triangle will exceed that in the latter by more than one-third of an inch.

Bath. **M.I.C.E.**

"FORCE" AND "ENERGY"—ORGANS —EVOLUTION — SPACE OF FOUR DIMENSIONS.

[28798.]—I READILY accept the disclaimer of "F.R.A.S.," page 255, as to the meaning of his remarks on page 218; but neither Mr. Clodd, nor anyone else, is justified in defining well-known terms incorrectly, for any purpose whatever, and, as "Dubliensis," page 282, very pertinently remarks, no one would object more strongly to incorrect definitions of astronomical terms than "F.R.A.S." himself. Force and energy are things having certain physical dimensions, and Mr. Clodd has no more right to define them in other ways than I have to define an ellipse as a curve generated by a point on a circle rolling on a straight line. I have been favoured with some extracts from Mr. Clodd's book, which show that he is utterly ignorant of mechanics. He says: "Energy is that which produces or quickens motions separating, and which resists or retards motions binding together, two or more particles of matter, or of the ethereal medium." This definition, to put it mildly, is incorrect; and, to put it strongly, is absolute nonsense.

I read with much pleasure the letter from Mr. J. T. Lawrence, page 256, and note that foreign organs are not all so good as we have been led to suppose. It is said that a child, reading the nice inscriptions on the tombstones in a churchyard, asked her mother where all the wicked people were buried; and on reading the specifications of different organs, I have often wondered where all the bad organs are placed. The organ in St. Jaques, Brussels, is a remarkable instrument; it is very rare to find seven 16ft. stops out of 25 total. The absence of any mixtures from the swell organ seems rather unsatisfactory. There is a stop called the Pyramidon described in Hopkins: has any correspondent of "Ours" ever met with a specimen? Its peculiarity was the production of notes of low pitch from short pipes. The organ in the Presbyterian Church, Baltimore, described in letter 28774, is very deficient in the pedal department; three pedal stops are far too few to form a proper bass for 30 manual stops. More pedal stops and fewer mechanical contrivances would have made the instrument much more satisfactory.

"Satine" (letter 28769) has given an exceedingly neat summary of the views held by different correspondents of "Ours" as to creation. The first view rests, as far as I know, only on the legends of a small nation, the members of which, according to their own account, were steeped in superstition, and had at least some ceremonies which find a counterpart in the practices of some savage tribes of the present day. All scientific research is dead against the theory of a separate creation of each species; and there is no more real reason to assume the existence of a special principle of life, than to postulate the existence of a special principle of sweetness in sugar, bitterness in quinine, or sourness in acetic acid. Science has produced compounds, the artificial manufacture of which was formerly regarded as *impossible*, and there is no vestige of a reason to draw a fresh line at protoplasm.

I scarcely agree with "Wolfenbüttel" (letter

28779) in his ridicule of the advanced men in mathematics. It is no doubt true that we are (at least, I am) incapable of forming a definite idea as to space of four dimensions; but then it is tolerably certain that creatures living in space of two dimensions would be utterly incapable of grasping the conditions of existence in our ordinary space, and so our incapacity to conceive the fourth dimension does not really prove anything. In solid geometry the "traces" of lines are points, the traces of planes are sines, the trace (commonly called section) of a solid is a plane, and it may be that our solids are, so to speak, the "traces" of things existing in four-dimensioned space, but what these things are we do not know, nor are we likely ever to know. It is a pity that "Wolfenbüttel" has seen fit to make fun of the terms used by the advanced school in mathematics. It may be that he does not know what an "octodecadic skew invariant" is; but that is no reason why he should ridicule it. The little knowledge I have of science has at least taught me not to make fun of the branches I do not understand.

Wm. John Grey, F.C.S.,
Newcastle-on-Tyne. Analytical Chemist.

IMPOSSIBILITY OF MANKIND BEING DERIVED FROM ONE COMMON ANCESTOR.

[28799.]—PEOPLE who believe that all mankind are descended from one common ancestor—namely, Adam—have one great difficulty to overcome, which I give below. If you take a pair of pigeons, or rabbits, or any animal, and breed them, pairing their offspring generation after generation without the admixture of any foreign family, the progeny become small and stunted, and finally their reproductive organs wither up. This is the effect of too close interbreeding. The same applies to plants. If the stigma of the flower has received only the pollen from its own anthers, then the seedlings are poor. This does not include those extraordinary fast breeders, rats and guinea-pigs. But slow-breeding man could not have come from one common parent; Adam's progeny would have become pigmies, and finally have withered up. But when we consider that man assumed his form by gradual improvements on some unknown progenitor, then there would be no necessity for close interbreeding; but each one would have a choice of many slight varieties to pair with, and so a cross would be produced, the outcome of which would be a family of strong young. **Satine.**

EVOLUTION.

[28800.]—I HAVE always thought the Evolutionists hold the strongest side. How few of their opponents have ever seen a real live Bushman, in all his primitive repulsiveness?—a species of Homo, nearly extinct, by his own unmitigated savagery in the destruction of Dutch cattle and their owners; his deadly envenomed arrows, prepared from snake poison, proving inferior to the white man's leaden missiles. Again, have many men studied the connecting links in the physiology of man and the anthropoid apes? I cannot venture on so delicate a subject in these pages beyond hinting that the periodic functions and sexual diseases of both closely correspond—alone, I believe, in the whole natural kingdom. Our savoury esculents and our favourite flowers are the much-changed offspring of combined culture, selection, and adaptability to soils and climes—most men know this fact.

Years ago I met with a very interesting book by an American author called (if my memory serves me) "The History of Man," a work which gave me many new ideas on ethnology. **Eos.**

[28801.]—THE want of evidence to show that mankind were ever in anyway different from what they are now applies with equal force to all living nature, so that it is hard to see where the evolution comes in, and still harder to see of what benefit it would be supposing it did, as practically speaking it is this very stability that enables men to pursue their business avocations with confidence.

The "hairy ancestor" will have to take a "back seat," as even his friends are now beginning to be ashamed of him. I don't know where "Satine" got his cock-and-bull story about the hairy fœtus; it's a story that has been refuted over and over again; but if he wishes to have a very full, clear, and reliable detail in regard to facts in this and other cognate matters connected with man and evolution, "Satine" will find it in the "Law of Species: an Exposition of the Fallacies of Evolution," by Edward Poulson, Licentiate of Midwifery, of the Rotunda, Dublin. It will give him a solid basis upon which to work. People born now and again covered with hair are always more or less edentulous, whereas all other animals have their full complement of teeth.

The difference in the hair of a man and all other *animals is so marked and distinct* that the dealers in hair, fur, wool, &c., have no difficulty whatever in telling which is which, as also what part of the world it may have come from. In regard to the four specimens of hair and "Satine's" query, I could not give him any better answer than is supplied in his own sketch, as he cannot but see that although the "bowls" form the basis in each, the arrangement of the "bowls" and length of tube are radically different in all four, and as this difference is permanent in each, it follows that experts with the microscope in the study of hairs, &c., can give their evidence in a court of justice, and it would make all the difference if evolutionists could do as much with their theory. I quite agree with "Satine" as to his "three sets" who write to "Ours"; but his third has a remarkable likeness to the old doctrine of chance, and his saving clause of "a law as yet undiscovered," don't make it any better. A study of Herbert Spencer's "First Principles" would do no harm. **Dens.**

OLIVE TREES, AND EXTINCTION OF THE FITTEST.

[28802.]—I DID not insinuate, as "J. R." thinks, p. 282, that Noah's dove finding a leaf proved "some land had not been submerged." Can nobody see that *deluged* and *submerged* are two things? What I have insisted is that nothing implies any land now dry to have been submerged since Glacial times, unless Moel Tryfan and similar upheavals quite local. All countries that the Flood submerged I hold to be still sea-beds; and that Armenia rose a few months later, probably for the first time (but perhaps not).

Such "submergences" as "Sigma" invents, sudden enough not only to drown animals, but extirpate whole species, may be just conceivable, but unproven and highly improbable; and yet far more so to extirpate, as we find to have happened, the majority of quadruped species everywhere, especially all the biggest, and in most islands (as "Sigma" says in New Zealand) every species whatever. Indeed, poor Darwin's denial, at the end of the "Origin of Species," that any catastrophe, in all geologic time, ever "desolated the world" in that absolute sense, or any larger land than New Zealand, may even some day be demonstrable.

Whether olive trees can live under water (and sea-water) 197 days is quite a separate question. "J. R." should have corrected my "164th day," as Genesis makes it the 197th when the leaf was brought, or at least 195th, if we assume, as I do, that the ark floated really only 148, or five exact lunations, but the first few score hours, being totally dark, were mistakenly held to have been two days more than really elapsed. The Hindoo account dwells on those dark hours as a "whole night of Brahma"; while Gen. viii. 22, by promising that "day and night shall never cease," implies that they lately, as well as "seed time and harvest, and summer and winter, and cold and heat," had been interrupted. The dates of grounding and the dove's first and second flights are important if no others, because these three were prophetical. The ark grounded the 17th of Abib, the day that, after more than 31 centuries, was to be the first Easter (day also that Moses crossed the Red Sea), and the two later, though no noted days with the Jews, were to be so to us. Noah was aground 40 days when the raven went, he having perhaps, as all other accounts tell, sent various birds, but this was the first to stay away, on either the 40th day or 41st. This is either Ascension Thursday or the day after it, both equally fitting (Acts i. 3). On the dove's return that evening, Noah waited "yet other seven days," so that her second return with the leaf was either 47 or 48 from the grounding. Now, the most natural sense of Acts ii. would date the events of that chapter the 50th day from the Crucifixion, or only 48 from Easter. St. Luke nowise hints at its being a great Jewish feast, the 6th of Sivan, falling that year on a Saturday, and the way they acted almost implies it was not their Sabbath. Our calendars assume it the day after, but the Friday before is more likely—namely, "the fiftieth" of those days, "the third" of which had been mentioned as that of Christ's rising. Noah grounded on what would now be the third day of the Hebrew Passover, parted with the first saved animal on the 43rd, and received the leaf the 50th. Christ rose the third day of the Passover, ascended visibly the last time on the forty-third, and sent the gift of tongues the fiftieth.

As for "Sigma" assuming the torrents continued violent "many days," not a word implies the whole downpour may not have fallen, as the Izdubar tablet makes it, in six days, or in two. The less the time, the greater the denudation, whose enormous effects we see; and the prediction, "I will cause it to rain 40 days," was hardly so much a warning as a promise that by the 40th day all disturbance would be over and calm restored. The 42nd they saw a new moon, and this we find in Sir J. Herschel's "Outlines" (Art. 926) the day Abulhassan Kuschiar (whose chronology he had some good reason for choosing) fixed as the Deluge era. It is probably about then that the juniors, if not all those in the ark, first saw a rainbow; for I hold it pretty certain that the spot where it had been built was where Ham afterwards founded Thebes, where people may now live to his age without seeing one, as the last recorded shower was in 1837. "Sigma" may call that more "cool omniscience," but it is not a bit more knowable how many poles the earth has, or whether this or Australia be the bigger land, than whether our climates would, if there were but 90 per cent. of the present fluids, be glacial or not.

If he don't like the phrase, "obvious non-survival of the fittest" quadrupeds "on any land disconnected from Asia," why not tell us the land so disconnected where he thinks the fittest survive? On Australia, according to Etheridge, Wood, McCoy, J. B. Clarke, as well as America and all islands by other authorities, those that throve best, or now do when re-introduced, are found indeed; but instead of alive, only fossil in the drift-gravel or in bone-caves.

As he asks to be informed why the Flood carried the poor Asiatic mammoths (like timber, &c.) northwards, a glance at a globe or map (not Mercator's) will show him that all the waters of most of Asia now reach the Polar circle. Why should diluvial ones flow a different way? The globe was, as he says, "immersed in condensing vapour," but not condensing by cold, only by gravity, and equally on cold or hot parts; and even were it not so, the water would not flow up-hill. Things swept within the Arctic circle (and some far within), but 22 days before its midwinter, whether by cold or hot water, sunk in mud that quickly froze, and has never since thawed. **E. L. G.**

NATURE OF MOLECULES.

[28803.]—A MOLECULE is said to be indivisible by mechanical means; it is said also to have magnitude, for someone, I think, has calculated that if a drop of water were magnified to the size of the earth, the molecules in it would appear of the size of cricket balls. Magnitude and indivisibility are directly contrary to one another. I, for my part, cannot conceive anything so small that it cannot be divided: it must be infinite—i.e., there is no end to dividing it. I have been thinking [illegible] upon this lately, and have arrived at the following theory:—There are, by the way, many correspondents who object to theories, and cannot see the [illegible] of them. A theory tries to account for a certain class of natural phenomena. Next week, or [illegible] year, comes another theory which annihilates [illegible] old one because it can account for a larger [illegible] facts. This goes on until a theory comes [illegible] accounts for every fact in that class of things, [illegible] then it becomes a law; but if unopposed, [illegible] theories become at length absurd. It is [illegible] practical opposition that theory-mongers want. [illegible] go on to my idea, which, to some, may seem [illegible] absurd; but there is, I think, no impossibility [illegible] it, and it also is a mean between molecules [illegible] magnitudes and their being infinite.

As stronger and stronger telescopes are [illegible] made, so more and more stars become [illegible] therefore we may safely conclude that the [illegible] is infinite. At any rate, taking the stars up to [illegible] eleventh magnitude as constituting the [illegible] even then the earth is, in comparison, but a [illegible] dust speck; while if we go on to the stars [illegible] twentieth magnitude, then the earth [illegible] into the size of the traditional molecule. [illegible] going still further to the thirtieth [illegible] then the whole solar system becomes [illegible] molecule. Thus what the solar system is [illegible] universe, including only that portion of [illegible] is visible through extraordinarily good [illegible] may not a molecule in the same manner [illegible] earth? I see no difficulty in conceiving [illegible] state of affairs. The only difficulty is the [illegible] for it seems strange that a lump of clay, [illegible] stance, should contain millions and [illegible] worlds—many, probably, inhabited. But [illegible] pigmies these inhabitants must be to us, [illegible] their worlds—nay, their solar systems—[illegible] seen separately to us! Many will think this [illegible] in the extreme, and worthy only of a [illegible] dreamer; but it is no more extravagant [illegible] thinking our world is the only inhabitable or [illegible] habited one among the millions we can see [illegible] fine night. On the other hand, we may go [illegible] the gigantic, and try to conceive that our [illegible] but a molecule of one huge, immense world, [illegible] which the whole visible universe is but a drop [illegible] water or a grain of sand.

Now for the second part of my theory. I [illegible] mentioned above that a solar system [illegible] molecule. What, then, constitutes an atom?—[illegible] a world! Thus, then, in my theory, [illegible] affinity resolves itself into gravity, molecular [illegible] being merely the force which keeps the stars [illegible] But many will object that an atom is an [illegible] and cannot be made up of two or more things.

Well, most of the worlds in our solar system [illegible] one predominant element in them, thus the [illegible] has oxygen predominant, the sun hydrogen; [illegible] fore, the earth would act as an atom of [illegible] and the sun as an atom of hydrogen. The [illegible]

h our solar system is a molecule, is
complex, having as many atoms in
planets. The planetoids probably
o act in any way on bodies outside
vhether chemical or physical. The
element would either consist of two
more probably of one central sun
several smaller planets revolving
h, taken together, make up about
s as the central body or atom, but
lanets having the same element pre-

e condition of the universe visible
y the giants, of whose world ours is
, is that of a glowing liquid, for the
lf-repellent as the molecules of a gas
ey close enough to constitute a solid,
also glowing; therefore, I imagine
rse is in the state of melted iron,
ly getting cool.
le or solar system to be magnetic it
have all the axes of its worlds, or at
hem, parallel, and also all the poles
isation, say, that of the north, point-
ame direction; so, then, our solar
magnetic to outward things. There
s which have occurred to me since
ove. I give them below.
that in the sun hydrogen preponder-
y not be so, for we have never seen
de of the sun is like, nor can we
t what we can see is, that the pre-
nent in the sun's outer casing or
hydrogen. The inside has no action
jects, just as when a ball of zinc is
llow sphere of gold, and immersed
, the zinc has no power of decom-
.
nt is that of two atoms of an ele-
gether. Here the two worlds would
generate immense heat, but appre-
selves only, and by this heat would
ic explosions, and thus the second
uld be reached—namely, that there
central atom or sun, and revolving
ragments, hurled out of its body by
existing as planets.
ave come to the end of my theory,
n up, will help to anihilate man's
king that everything was especially
ed for him, and him alone. If we
infinitely tiny our world is com-
s mass of the visible stars, I don't
can persist in the notion that ours
abitable and inhabited world in the
, as I believe is generally considered

pologise for suddenly appearing in
the "E.M." under a new name with
theory; but I can say in excuse
old correspondent under a nom-de-
ought that such a theory would be
if it bore my real name.
ood. **E. H. L. Schwarz.**

N AND FORCING FANS.

taking the water-gauges at inlets
calculating the volumes of air pass-
y from or according to these gauges,
at in both passages the air is not in
e of density, or, say, of 29·922in. of
9ft. of water column. In the inlet
d, and in the outlet compressed—
kindly say how, in each case, reduced
rdinary atmospheric volumes? Let
ge, for instance, show a depression
ter (0·5098in. of mercury, or 0·25lb.
ch), area of passage 1sq.ft., then
e air entering this passage will be
t per second = 10,191ft. per minute
ches), and volume = 10,191c.ft. per
s so conditioned (attenuated) air.
discharge-passage of the same fan
ession in the air of 2·31in. of water
ercury, or 0·083lb. per square inch),
ssage being 0·78sq.ft., and the velo-
calculated by same rule as above,
inute, and volume 4,588c.ft. of this
(compressed) air. Only very short
ing—about 1½ft. in each case—is
oss-sectional contractions. The fan
n the one side, and expels freely on

difference between the entering
volume is therefore 10,191 − 4,588
It is evident that this must be
in part, to the difference of density
r the two conditions; but can this
large falling-off of outlet as com-
t quantity?
the volume at inlet is larger than
nospheric density, and that at out-
hat I wish to know is, how to reduce
common standard of atmospheric
uld, by so doing, the difference, as
nade up (and it seems to me doubt-
be), I want also an explanation of
the delivery being less than the aspirated quantity, and what has become of the aspirated air not accounted for by the difference of densities, and the measured or calculated discharge.

N.B.—I should remark that the fan disc is completely closed in by air-tight casing, and that there is no escape of air except at the proper outlet.

M.

THE RAILWAY-SIGNAL RETURNS.

[28805.]—THE Board of Trade Return, c. 5,389, relating to the signal arrangements and systems of working on the 31st December, 1887, has now been published, and it is satisfactory to find that considerable progress has been made, as shown by the following tables:—

THE INTERLOCKING SYSTEM.—SUMMARY NO. 1.

	Number of cases in which any passenger line is connected with or crossed on a level by—				Number of cases in which the usual requirements of the Inspecting Officers of the Board of Trade have or have not been complied with in the following respects:—					
	Any other passenger line.	Any goods line.	Any siding.	Any cross-over road.	Concentration of signal and point levers.		Interlocking of signal and point levers.		Addition of safety points in cases of goods lines and sidings.	
					Have.	Have not.	Have.	Have not.	Have.	Have not.
England and Wales	4,226	1,467	18,158	6,986	28,527	2,310	28,748	2,089	18,230	1,395
Scotland..........................	767	237	3,181	1,073	4,210	1,048	4,192	1,066	2,871	547
Ireland	425	110	1,307	284	1,131	995	1,185	941	766	651
Total, United Kingdom...	5,418	1,814	22,646	8,343	33,868	4,353	34,125	4,096	21,867	2,593

The requirements of the Board of Trade have, therefore, to a very large extent been complied with; but still the levers require "concentration" in 4,353 cases, and "inter-locking" in 4,096 instances; also that 2,593 pairs of safety points are requisite.

With regard to the adoption of the block system, it appears from the summary that the total length of line open for passenger traffic on 31st December, 1887, was 18,556 miles, of which 14,842 are reported as being worked upon the absolute-block system. There are 397½ miles of single line, upon which only one engine at a time, or two coupled together, are allowed, thus leaving a balance of 3,316 miles, which are still worked upon inefficient principles, and require the introduction of the absolute block system.

THE BLOCK SYSTEM.—SUMMARY NO. 2.

	Total length of railway opened for passenger traffic.		Distance work'd on the absolute block system.	
	Double.	Single	Double.	Single
	Miles.	Miles.	Miles.	Miles.
England and Wales	8,718½	4,334½	8,485	3,520½
Scotland	1,175½	1,632¼	1,148¼	1,131½
Ireland	591½	2,103¾	173½	383½
United Kingdom...	10,485½	8,070½	9,806¾	5,035½
Total	18,556		14,842¼	

During the year, the use of the "Train Tablet System" for working single lines has been further extended: instead of one train staff for each section there are two "tablets," one at each end, electrically locked, so that only one can be taken out at one time. The system doubtless saves considerable delays, but great care must be taken that by some unfortunate mistake or failure both "tablets" are not taken out; the recent failure of the Spagnoletti system of electric locking, and the collision which followed at Devonshire-street on the Metropolitan Railway, will probably lead to greater care and attention being given to electric apparatus.

Clement E. Stretton.

Consulting Engineer, Associated Society of Enginemen and Firemen.

40, Saxe-Coburg-street, Leicester, May 28.

GEOMETRIC CHUCK.

[28806.]—"AMATEUR" (letter 28713) bears deserved testimony to the excellence of the Ibbetson chuck; but its superiority is mainly due to the perfection of the workmanship of Messrs. Holtzapffel and Co.

There is something to be said in favour of the Hartley and Cooke plans. If the former were altered in two respects—(1) its normal velocity changed from three, as now, to two, as Ibbetson's, and, (2) if another plane of wheels were used in the trains—there would remain little choice between them, and this choice would be a question of position. When used on a table (axis vertical), Hartley's, having the wheels above and in sight, is more convenient, and as generally now made, with long curvilinear mortises, fixing wheels is an easy matter.

But even were these changes made, there would remain the objection of driving too small a wheel (in transferring motion from one "part" to another), a serious fault in curve turning. This is alluded to in the "Notes on the Epicycloidal Cutting Frame," pp. 167, 185, &c.

A similar objection may be made to the "Cooke" plan, of driving a small wheel by a large one, where the transfer of motion from back to front is made, and wheel teeth cannot last well under such stress when a crown and spur are geared together. I have designed what I consider an improvement on this gear. The power of reversing that the "Cooke" chuck has, and also the Hartley, would be valuable if possessed by the Ibbetson; it is quite practicable to make reversers to the other parts of the "Hartley."

In the "Cooke" chuck, the wheels are behind the plate, as in Ibbetson's, but badly arranged for table use. The plan alluded to in my letter, 28621, is an improvement on that plan, the wheels being always in sight, but not on top of the plate. I cannot make it clear without drawings, and have not time now to prepare these, but hope to do so later.

Mr. Howland's accessory train (described 28621) may be applied to all three chucks, and as it causes circulation of (an integral) curve, will be found a desirable addition.

I saw the first Cooke chuck, made about 1881, and have now a pair of photos, back and front, of one in which the "crown" and pinions are better constructed, but not yet what they might be.

I often use my little (Howland) chuck mounted on a table instrument, the latter made on a principle described in the *Quarterly Journal* of the Am. Mech. Soc., Nos. 21 to 24; but my instrument differs widely in form from that one, and, besides the movements of that one makes a transverse stroke and an ellipsoidal figure. Any of these may be distributed over the curve made by the G. C.; this produces effects often not to be distinguished from lathe work, when the E. C. F. and spiral train are used.

If "Amateur" reads my letter, No. 28120, in "E. M.," 18th Nov., 1887, he will see that I also use the Ellipse cutting frame (I do not possess the Epicycloidal) and spiral train, and even without the G. C. produce a wide range of curves by the action of the surface slide, carrying the E. C. F.

When the G. C. is put on the lathe, then the united effect is often very curious and interesting.

The saddle was added to my lathe for the purpose of insuring true cylindrical and surface work, it being my intention to make a geometric chuck on the "Cooke" plan, but with several improvements. The little chuck I have ran out of truth all ways, and I spent three months in refitting it; a work, from its small size, more arduous than would have been making a new one; I had to discard nearly all the wheels, and the best I could buy, of dealers here, were not entirely satisfactory, and it is for the reason that good wheels are not to be had, except at great cost, that I have not yet commenced the work. I have seen no really satisfactory wheels but Holtzapffel's; the smooth and even action of those of the chuck used in producing the curves in the "Index" literally left nothing to be desired. As large a set as I require would cost too much for my pocket, and so the work waits.

"Amateur" does not describe the 50-year-old chuck very clearly. I think it had a fixed (crown) wheel, like Bergeron's "machine epicycloide;" but, unlike that, drove a pinion, mounted at the opposite end of the "eccentric" chuck to the screw-handle end, and a screw placed at side of front wheel (which was a worm wheel) drove this through a connecting wheel or two to vary velocity, the latter on the end of tangent screw, and the intermediates gearing to this and the crown-wheel pinion. It made high numbers of loops only, and, I believe, was made by Holtzapffel and Deyerlein.

If "Amateur" will favour me with his address I will send him a print of my table instrument and some curves, which may interest him (I shall not betray his incognito). It received flattering commendation from the amateur who made its predecessor.

I intended making a set of drawings of this instrument for the pages of the "E.M."; but the task is too formidable for my time or health now, and there appears to be felt so little interest in this subject that it might be time and space wasted.

F. N. Massa.

Fort Lee, New Jersey, May.

PRICE'S UNIVERSAL LATHE.

[28807.]—THIS is no doubt a convenient little lathe. As it is not intended to be a screw-cutting lathe, the smallness of the bearing for the apron of the slide-rest may be considered to be of little importance; but if the owner of such a lathe ever contemplates converting it into a self-acting lathe, he will be grievously disappointed at the rapidity with which it wears untrue.

The canting of the heads brings the whole weight of cut, and also the outward thrust of tool, on the narrow surface of top V, which will be very severe when lathe is used to its full height of centre.

Its convenience for the execution of a great variety of work, without spending much time in making the change from one class of work to another, is its chief recommendation; but, except for a hand lathe, its design is against its general acceptance. **Fredk. Carre.**

SOME LITTLE KNOWN PLANTS OF THE FLORA MEDICA.

[28808.]—ORDER, *Convolvulaceæ*; genus *Phorbitis, P. Nil.*, is an elegant climbing weed, with beautiful sky-blue flowers, abundant in all the hedgerows and bushy waste lands of Northern India. The seeds are collected and sold as a purgative drug under the name of *Kaladana* (or "black seeds.") There is abundant testimony to its value by English medical men. I used to gather my own supply annually, and prepare the alcoholic extract to reduce the inconvenient bulk of the crude powder, as used by the natives. I found it a very useful purgative. I quote from the *Bengal Materia Medica* as follows:—"This seed has been made the subject of numerous experiments. The powdered seeds in doses of 30 to 40 grains act as a quick, safe, and pleasant cathartic. In 100 cases when it was given in the Police Hospital of Calcutta, it proved purgative in 94, occasioned vomiting in 5, and griping but in 15, acting on an average 5 times in 2½ hours. The operation generally commenced in an hour, and in all the experiments was never delayed beyond four hours. The alcoholic extract, which consists of resin and oil, is deep brown, ductile, of excellent pilular consistency, and keeps well. In 10-grain doses it produces all the effects of jalap with certainty and speed; the taste is scarcely perceptible. It was tried in many other hospitals, and reported on most favourably. The seeds used to be sold at 4lb. for the shilling, sometimes cheaper. These will yield from 15 to 20 per cent. of alcoholic extract, and the spirit may be recovered by distillation. The plant may frequently be seen in our British hothouses, as an Indian *Ipomæa*, flowering freely, but rarely seeding under such artificial culture. In Indian gardens, where it is much cultivated for its floral beauty, a single plant will produce from 2oz. to 4oz. of heavy seeds, black and angular, averaging half a grain each. **Eos.**

APOCRYPHAL ORGANS.

[28809.]—THE error into which your correspondents have fallen respecting the "new organ" for Cologne Cathedral evidently arises from Hopkins' and Rimbault's work. On p. 354 of the "Specifications" a description is given of the present unsatisfactory instrument, and on page 438 is an account of one that has been "projected by A. W. Gottschalg." An error of this description is simple enough to understand; but what shall we say concerning other specifications given in this bulky and expensive work? During a residence of a year and a half in Dresden, and whilst studying there with Gustav Merkel, I had frequent opportunities of playing on and examining the principal organs in the city. Turning to Hopkins and Rimbault, I find, on pages 391-4 *the following remarkable* misinformation:—The "Royal Church of the Evangelists" does not exist, nor, consequently, its organ. There is, however, a two-manual organ of somewhat similar dimensions in another important church that is not mentioned, the "Drei Königs Kirche" (Church of the Three Kings), p. 393. "St. Mary's" is obviously the "Frauen Kirche," although no one in Dresden would know it by the former title. A tablet on the organ bears the name of Gottfried Silbermann, and date of building, Nov. 25, 1736.

The organ occupies an unusual position—viz., towering up above and behind the Communion in an elaborate case of white and gold—a favourite style of decoration in Germany. The organ in the Church of the Holy Cross (Kreuz Kirche) is not built by "Jagermann, of Dresden," but by Wagner Brothers, and restored by Jehmlich. It is the largest in the city, and the description is otherwise correct. None of these old organs in Dresden have as yet any composition pedals, and the keyboards are coupled by sliding one out about ¾in. The touch is heavy and laborious, and the keys with the white and black for naturals and sharps reversed. The sliding mechanism for coupling can, however, be effected whilst playing by a firm pressure of the fingers. Had your correspondents gone on to Dresden they might have heard any Saturday at the Kreuz Kirche "Vespers" singing quite equal to that of our very best English cathedrals. Long and difficult motetts for double choir (usually unaccompanied) are rendered by the Kreuz Kirche boys with perfect intonation and attack. The new concert house at Leipsic is a magnificent building, and contains an organ with modern improvements by Walcker, of Ludwigsburg. To my great regret, I had no chance of hearing it. The blowing apparatus, as in most large German organs, is by a series of six or eight treadles, and in this case they are placed with the bellows in a separate room at the back. In the new St. Peter's Church, Leipsic, I heard a very powerful and brilliant-toned organ; but the tone of that in the Nicolai Kirche did not please me, though the singing was good at the "Vespers" or "Motetten," as they are there called. The church of St. Thomas and its organ (Bach's Church) were both being partly rebuilt. This was in 1886. Possibly the work is not finished yet, as these matters in Germany proceed slowly, and I have seen no account of the reopening.

In your last issue a correspondent has a hit at the "so-called music-loving Germans"; but it must be remembered that church-going there does not occupy the place in the people's life that it does with us, and in towns where good operas and good symphony concerts may be heard nightly there is the less need to glorify the organ.

In the interesting account of Roosevelt's organ the new mechanism for controlling the stops appears to offer an admirable solution of the difficulty of bringing the instrument under better control. It is curious that to the German mind (at least, in the more conservative musicians) the facilities so familiar to us in the shape of combination pistons and composition pedals present a questionable advantage and a new danger. The German antipathy to the swell is well known, though Merkel and other German organists I was acquainted with fully appreciated its advantages.

In the "Neue Zeitschrift für Müsik" for Jan. the 4th, in an account for a new organ to be built for the Berlin Philharmonic by Schlag and Sons, of Schweidnitz, under the direction of Herr Dienel, the writer, after enumerating the twenty-three combination pistons, nine composition pedals, coupling actions, two manuals in swell-boxes, &c., goes on to say: "Possibly all these modern necessaries may serve art less than other purposes, in bringing the splendid art of Bach more and more into decay, for with all the combination pedals, swells, &c., the player cannot possibly think so much about the pedal, and still less be absorbed in the spiritual contents (or inner meaning of the work, for this he will have little time), yet it would not be right should one not acknowledge progress in the art of organ building." The writer certainly overlooks the important fact that Bach was the most progressive spirit of his time, and would have hailed all improvements gladly; for, according to Forkel, he brought out many novel effects, and prepared such combinations of stops that other organists were frightened, and declared they never could blend.

With regard to swell-boxes, it is certainly desirable to have in every organ a swell complete with 16ft. and mixtures. It is also desirable that a solo organ should be in a swell, or, failing that, the choir organ, for the sake of the solo stops it contains. Further, it is often a good plan, as some builders have done in this country, to put the great organ reeds in the swell-box for protection, as well as to be able at will to tone down their comparative roughness. But the Americans are surely going too far in boxing up the whole of the great with the exception of the two stops needed to form the front. It is well known, as other correspondents have pointed out, that flue-pipes become considerably muffled in tone when in a box,
when the box is fixed open they lack
and commanding character of a free
great. The one weak point in the Roose
(as in so many of our church instrumen
the pedal: three stops only in a three-m
strument that has a swell of twelve! Th
be at least a 16ft. reed, a quint, and an
cipal to balance the instrument properl
playing on the full organ the pedal shou
able to enter with a dignity and impress
its own.

In conclusion, may I ask if the Amer
template at some future period pro
enormous swell-box for the pedal stops?
St. Austell. **J. Mat**

THE BOEHM FLUTE.—II

[28810.]—THE new flute which was br
by Boehm in 1846 was a great advance
vious attempts, and was immediately recog
approved by scientific authorities, and
number of the best players then took it u
exhibited at the London Exhibition in
was awarded a gold medal; it also gain
at the Paris Exhibition of 1855. Since t
undergone some slight changes and impr
Boehm published a pamphlet on "Flute a
playing" in German in 1873; he invente
bass flute in G, about 1867, and died, a
1881. Meantime, Mons. Dorus adopted
flute in 1834, but changed the open G shar
its old shut form. Next came Mess
Siccama, Pratten, Radcliffe, Carte,
Briccialdi, Tulou, and others, who ch
key mechanism, altered the sizes of
other details, making more or less improve
1862 Messrs. Clinton gained a prize med
London Exhibition for the, Equisona
which was practically on Boehm's model
mechanism adapted to the old style of
and the holes graduated in size, this
novelty, and based on the principle "that
pipes the diameter of each must be reduce
as the length, if equality of tone is to
tained." Next comes Mr. Rockstro, wit
improvements on Boehm, ranging from
1865, and which are described in his
published 1884. Next we have Mr. Carte
1851 and 1867 patents, and lastly, Messrs
produce a double-hole flute about 1881.
then, for the history of improvements an
tions. Let us now consider briefly what
important of these are, as it is impossi
into all with minuteness. If one adopte
acknowledged advantages in key mechanis
flute would be by far too complicated for
use. Extra levers are convenient, but they
a player, and add weight to the instrume
increased number of sound-holes spoil t
and are difficult to keep air-tight. Ve
sound-holes are apt to weaken the co
of a player when taking large interv
rapidity; so that although extremes have be
there has always been a reaction. Six
years ago players thought that the wood
body could not be too thin, while to-day th
impression is that they ought to be rath
Of Messrs. Ward I know nothing, nor c
out exactly what they did to improve th
ment. The Siccama flute was patented ab
It had a conical body and cylindrical h
improvements were—first, covering the
natural with keys so as to get them near t
positions without altering the spread of the
second, an improvement on the old C and
mechanism. The systems of Pratten,
and others were intended for players who
then care to change their fingering fro
the old system of flute, but yet desired so
advantages of the Boehm system, such
holes, cylindric bore, key stopping. T
therefore, a compromise between the new
old system, and supplied an urgent deman
the transition state some years ago. I am
to a friend for the following descriptio
Carte's flutes. "After a large number of
different pattern flutes, Mr. Richard Carte
and patented one in 1851, which was awa
prize medal at the Great Exhibition of L
1851 for 'an improved Boehm flute.'
ference between this instrument and the
the right hand is that the first finger is
making F sharp (same as the old flute);
cross F natural is retained, and the long F
This latter key, however, has an advantag
is an open key instead of the old closed
closing it F sharp is changed to F natural,
on the old flute, by opening the key E was
to F. The long open F key enables a play
down the finger in advance, and save
fingering. There is also a fork F m
facilitate the passage from D to F
As to the left hand, it differs from th
in the arrangement of the thumb ke
one making B flat being lower down on
than the one for B natural, which may be
considered the more natural order. As

duplicate C hole the thumb is not taken off to make C sharp, so that from this, and also from the fact that this instrument retains the old F sharp and F natural, it has always been found easier to learn than the Boehm for those who know the old flute. As long as the thumb is kept down on the upper thumb-key all fingers off gives C sharp, but when the thumb is raised then all off gives D, and this very much facilitates many passages in which D comes in rapid alternation with other notes, and which were so difficult from their cross-fingering on the old and also Boehm fingerings. This open D necessitates the use of an extra C sharp, made by the third finger left hand to be used when going from C natural to C sharp; but, of course, this action is not more difficult than the passage from F to F sharp on the Boehm flute, being as it is exactly the same action, only done with the left hand instead of the right. The fact that the first finger right hand closes the G sharp key, worked by the fourth finger of the left hand, makes many passages very easy, and also its closing the upper thumb-key enables the player, after making B flat with the thumb on both keys, to make an accidental B natural without slipping the thumb. This and the duplicate C natural hole make the key of E as simple as that of D on the old flute.

May 24. Vulcanite.

(To be continued.)

REPLIES TO QUERIES.

⁂ In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.

[64911.]—**Electric Lighting.**—We consider that 12in. glazed earthenware pipe is sufficiently strong for the purpose, and in the case cited by us the joints were made by pouring in a "grouting" of Portland cement, having previously placed a sinnet grummet over the spigot. This should be left for a week before use, if possible.—FREDK. WALKER AND HYDE.

[64949.]—**Organ Swell.**—I am obliged to "Uranium" for his useful details on how to make a swell-box, and I am convinced that it will be much appreciated by many of our readers. I wish to thank him for his offer to send sketch, and to say that the front pipes are imitation, and I have six stops that I intend using for the swell-box (including the open diapason 8ft.); the dimensions for same are 5ft. by 4ft. 6in., by 5ft. 6in. high, over all.—MECHANIC.

[65042.]—**Cold Bluing.**—To "NUN. DOR."—The recipe, as sent, was inserted under that heading in the ENGLISH MECHANIC and elsewhere some years ago. I was under the impression that the recipe was similar, in its effect, to the celebrated (?) Italian varnish (viz., solution (?) of gum-arabic in boiling alcohol—p. 112 "Enquire Within")—hence my query.—J. W. M.

[65056.]—**Box Tunnel.**—On one morning in April and one in September the rising sun must shine through it. The setting sun never can, as the west end would dip beneath the horizon were the cutting straight (which it is not). Soon after its opening, when the owners of private carriages might ride in them on a lorry, that of a lady coming from Bath detached itself at Corsham from the tail of the train and slowly rolled back the whole dark 3,195 yards, after which she probably preferred the public carriages. Though this was always shorter than Strood canal tunnel (now turned to railway use), it was famed for some 20 years as the longest railway one. Both are now excelled by four other hill tunnels, and these by the Severn and Mersey ones, to say nothing of the Alpine.—E. L. G.

[65019.]—**Gas-Engine.**—Annexed is sketch of a governor and throttle-valve drawn to half size. I have shown it arranged to work horizontally. The spindle S and S′, Fig. 1, is carried in the head B of bracket, the form of which I leave to you to adapt to the engine; the end of spindle S projecting through the head B carries the grooved pulley P for driving the governor, the other end of spindle S′ might be carried in a small bearing. The bell-crank lever G is pivoted on an arm (shown by dotted lines) cast on the bracket, or it may be mounted on a pin screwed to any convenient part of engine. The head of the connecting-rod C has a slot and sliding pin for adjustment, shown at C′, Fig. 3. The end of the bell-crank lever G′ is either forked or single, and fits in the wide groove turned on the sleeve T which slides on the spindle, and which is drawn along the same by the expansion of the balls and arms when in action. The spiral spring and nut shown on spindle is for regulating, and to keep the sleeve down or back. The throttle-valve (Fig. 2) shown in section has the short arms A and A internally screwed for iron pipe, the gas way being drilled right through at right angles to this; the longer part is bored through and fitted with a solid plunger with a neck N turned out. When the engine is at rest, the plunger allows the full way open (as shown); but on the engine being started the action of the governor draws up the plunger, and thus cuts off the gas. The proper adjustment can be obtained by the slot, &c., in end of connecting-rod, as shown at Fig. 3. The throttle-valve must be fixed between the engine and stop-cock. The speed at which the governors require to be driven will depend on the length and consequent weight of connecting-rods, and also the strength of the spiral spring or spindle; but a simple way of ascertaining the speed would be to drive the governors off the lathe (after you get it all connected up). You could by such means ascertain the required speed. I hope I have made the above plain enough. Any further explanation I shall be pleased to give, either through our "E. M.," or through the post if required quicker; the address below will find me.—ENGINEER, St. Mary Ch., Torquay.

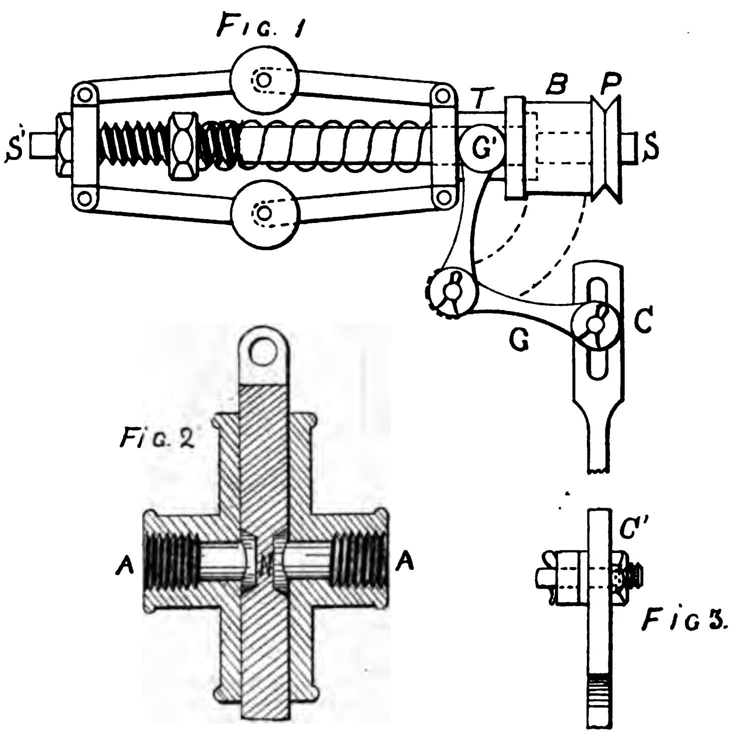


Fig. 1

Fig. 2

Fig 3.

[65072.]—**Embossing Ink.**—It is printing-ink, thinned, when necessary, with printer's varnish. If for printing only engraved lines, it is made rather fatter, and is driven into the lines of the die, the surface of which is wiped clean, and the press brought down on the paper. If the lines are to appear white on a coloured ground, the ink—rather stiff—is simply rolled over the die.—NUN. DOR.

[65081.]—**Microscopical.**—Is there any medium with a higher refractive index than Canada balsam? However, querist had better put his question before the R.M.S.—G. K.

[65087.]—**The Gramophone.**—Seeing that this instrument is practically a new and novel invention, is not this query rather amusing? Mr. Berliner is, we know, a reader and an occasional correspondent of this paper; but he is doubtless too busy to answer, and it is scarcely likely that anyone over here could do more than guess the answers which "X. Y. Z." (very much ex-wise-head) appears to require. It seems to me that the article on p. 528 last volume is clear enough for anyone to experiment; but if not, the number of the U.S. patent is given, and the specification of that can be seen at our Patent Office, as well, perhaps, as that of the British patent—assuming the Blue-books are published. I suspect Mr. "X. Y. Z." will, for the present, have to rely on his own inventive talent.—NUN. DOR.

[65095.]—**Sand-Blast.**—The method of sharpening files by means of a jet of steam blowing sand against the backs of the teeth, was illustrated and described in No. 694, p. 437, the number for July 12, 1878.—NUN. DOR.

[65098.]—**Engine and Dynamo.**—Mr. S. T. Hampton can easily calculate the power of an engine by the formula which has appeared almost weekly lately. How much power the dynamo would take depends upon the make and the manner in which it is made.—E. M. F.

[65102.]—**Noises in the Head and Ears.**—I see by the "Answers" that "Shon-y-Gof" is not yet cured of the noises in his ears. Why does he not seek the advice of "Hygienist," so kindly offered on p. 220? The very name is almost enough to cure him. "Shon-y-Gof," however, should be the best judge of whether he has been overtaxing his stomach with "right or wrong foods." By the way, what is a wrong food, and how do you know it is wrong?—T. M.

[65109.]—**Steam Launch.**—I think "Puffer" might find suitable dimensions by referring to the numerous replies about steam launches; but when his launch is fitted with its vertical boiler, I think I should prefer to be in a wager boat than in such a launch.—MORTLAKE.

[65117.]—**Draught for Boiler Furnace.**—The usually accepted difference in the density of the external air and that of the chimney is as 2 to 1; above that there is no gain in draught, but there may be great waste of fuel. The exhaustion must be more than the equivalent of half-inch water pressure; but the flue tension varies in different types of boilers, and the querist's allusion to locomotive boilers is peculiar. Does he mean when the locomotive is standing still or while running?—R. M. B.

[65125.]—**Japanning.**—If this querist will look through back numbers he will find all the information he requires. I saw recently a good japanning oven illustrated under the heading, I think, of Enamelling Cycles, and in Vol. XXXIV. p. 36, there is a capital article on japanning and japans.—SELIM.

[65127.]—**Rotary Engine.**—Should not this querist look up the indices? A rotary engine giving only a quarter horse-power would be a very small affair, and would soon wear itself to pieces. Look in indices for Parson's engines, and make a model.—NUN. DOR.

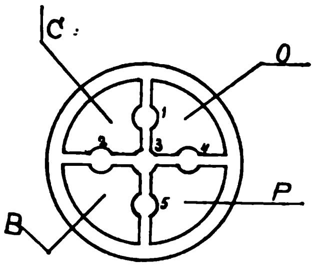
[65133.]—**Locomotive Boiler.**—This is a "model" only, and several have been described. Of necessity it must be a makeshift, and cannot be a real model if it is to work.—T. P. J.

[65136.]—**Wood-burning Furnaces in Steam Boilers.**—The furnace should have about 4·5c.ft. of space per square foot of grate when wood is to be used. Whereabouts is "Digby," that he is thinking of using wood instead of coal for generating steam?—J. K. C.

[65146.]—**Siemens Armature Winding.**—Will W. A. Walton look at his sketch of above given in "E. M.," May 18? It seems to me to be all wrong. Tested by Lenze's law you have got a short circuit, as you have connected a + and a − end to the same bars. Excuse my pointing this out to you.—ENGINEER, Govan.

[65154.]—**Beam Blowing Engine.**—Would not like to advise definitely under the circumstances, but think a thorough overhauling of the valve gear would be beneficial. The exhaust is late and the admission imperfect.—A. S., Jersey City, N.J.

[65155.]—**Electric Bells.**—I conclude you have made your switch of four triangular pieces of sheet brass, filed up so as to form five holes, and screwed to a block of wood, so insulating them one from the other. Of course, you have made your plugs to fit nicely, and bored holes in the wood block to allow the plugs to go in far enough to make good contact between each piece. Now, with one of your four wires connected to each



piece of brass, as shown in sketch—i.e., C from bell C, B from bell B, O from push O, P from push P, you can get bells to work thus:—

Both plugs out rings	A	from	P
One plug in 1, other in 2, rings	C & B	„	O
Plug in 5 rings	A & B	„	P
„ 1 „	C	„	O
„ 3 „	A B&C	„	O or P
„ 4 „	A	„	O

In fixing up your switch, be careful that screws do not cause contact with earth. If, after following above, you cannot get them to ring, add another cell to your battery.—X.

[65198.]—**Cost of Engines per Horse-Power.**—It is somewhat difficult to give the desired difference in cost, though the beam engine will, for many obvious reasons, be the more expensive. The term "modern horizontal," moreover, is not specific, covering the whole range of modern plain slide-valve engines and the various types of automatics. A 6-H.P. beam engine, by the way, for actual work seems to be a rather unusual piece of machinery at the present day.—A. S., Jersey City, N.J.

[65225.]—**Launch.**—There are, I believe, a number of patented grease extractors in the market which are claimed to effectually free the water from the surface condenser from oil and other objectionable impurities. Study of the advertising columns of trade papers will no doubt help your correspondent to get one of these if desired. Avoid the use of vegetable or animal oils.—A. S., Jersey City, N.J.

[65240.]—**Dynamical Problem.**—The weight of the monkey and of the weight on the other side being equal, I see no reason why the monkey should not reach the top—that is, the point at which the rope leaves the pulley, the weight remaining stationary. The leverages are equal.—A. S., Jersey City, N.J.

[65242.]—**Formula for Gradually Decreasing Scale.**—The series given by "Stepney" (page 287) is simply a geometrical series with a fractional ratio—namely $\frac{11}{12}$. If a = first term, the series is as follows:—

$$a, \left(\frac{11}{12}\right)a, \left(\frac{11}{12}\right)^2 a, \left(\frac{11}{12}\right)^3 a, \left(\frac{11}{12}\right)^4 a, \text{ \&c.}$$

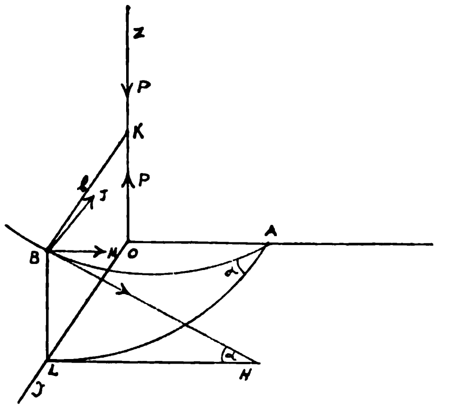
—F. S. S.

[65254.]—**Power.**—Your correspondent does not state the speed of the engine on which the result depends. Assuming the 100lb. pressure to be maintained in the cylinder throughout the stroke at a speed of 200 revolutions per minute, the engine would develop about

$$\frac{100 \times \cdot 29 \times \cdot 7854 \times 200}{33{,}000} = \cdot 138\text{H.P.}$$

—A. S., Jersey City, N.J.

[65265.]—**Springs for Safety Valves.**—Let B A represent a quarter turn of the spiral, O Z the axis or centre line; through B A draw B K, A O perpend. to O Z. Let b be radius of spiral = B K, a the angle which the spiral makes at each point with the horizontal, the axis being supposed vertical; let P be the pressure applied along the axis. All the spring below B may be considered to be acted on by the force P acting upwards, and all the spring above B by a force P acting downwards. (This is really Rankine's idea of a "stress.") Hence we know that whatever action takes place at B in one part of the spring, there is an equal and opposite action at B in the other part. Consider then the part B A as affected by the force P acting upwards. At B apply a pair of equal and opposite forces each equal to P and parallel to O Z. The one of these which acts upwards is opposed by an equal and opposite force in the part of spring beyond B. These two, therefore, constitute a "shearing stress," and tend to make the coil become shorter. In most cases, however, this effect is unimportant. The remaining one of the pair of *forces* acts downwards and, in conjunction with the *force P acting upwards along* O Z, produces a couple whose movement is P b. The "axis" of this couple is B M parallel to O H. Let B H be the tangent to the spiral at B, and let B J be drawn perpend. to B H and also perpend. to B K. Thus B J is perpend. to the plane H B K. B J is known as the "binormal." Now the plane H B K is known as the "osculating plane," and is the plane in which a small steel plate (say) would rest firmly against the spring. (If "Engineer" will try an experiment on a spring with a small flat piece of sheet iron or saw plate, he will at once understand this.)



Again, H B makes an angle a with B M and B J makes an angle $(90° - a)$ with B M. Hence, resolving the couple P b, we have—(i.) a couple P b cos. a, whose axis is along B H; (ii.) a couple P b sin. a, whose axis is along B J. The effect of (ii.) is a tendency to bend the spring at every point in the osculating plane, just in the same way that a bow is bent. This will tend to make the diameter of the spring smaller, and will affect its length slightly. Its effect is negligible compared with that of (i.). Since (ii.) depends on sin. a, when the angle of the spiral is small (ii.) will be very small. The effect of (i.) is to produce torsion everywhere along the wire. That is to say, it tends to twist the wire round itself. The wire is subject to a stress similar to that experienced by a drill while boring. Let Q be the couple required to twist one end of a unit length of wire through unit angle, the other end being fixed. For a round wire $Q = \frac{1}{2} . \pi r^4 . n$, when r = radius of wire and n its modulus of rigidity. If $d\tau$ is the rate of twist produced by the couple P b cos. a, then $\frac{d\tau}{\text{P } b \text{ cos. } a} = \frac{1}{\text{Q}}$, or $d\tau = \frac{\text{P } b \text{ cos. } a}{\text{Q}}$. Now as the "osculating plane" moves along the wire from point to point, it is gradually turned round. (Another experiment with the small plate will show this). The rate at which the osculating plane turns round the tangent line per unit length of wire is called the "tortuosity" of the spiral. This is the same as the angle through which the wire must be twisted, while a unit length of it is wound on to the cylinder on which the spiral is made. (If an experiment is tried with a piece of wire by winding it round a cylinder, this twisting will be at once seen. To get the greatest twisting the angle of the spiral should be 45°.) In any book giving the advanced parts of solid geometry, it is shown that the "tortuosity" $= \tau = \frac{\text{sin. } a \text{ cos. } a}{b}$.

$$\text{Hence } d\tau = \frac{\text{cos. } 2a}{b} d a \text{ .... } (1)$$

where $d\tau$ is the extra rate of twisting produced by a change $d a$ in the angle of the spiral. Also if Z is the whole length of the spiral, and N the number of coils, it is easily seen that $\text{Z} = 2\pi b . \text{tan. } a . \text{N}$, and

$$\therefore d z = 2\pi b \text{ N. sec.}^2 a . d a \text{ .... } (2)$$

where $d z$ is the change in the length of coil corresponding to the change $d a$ in the angle of the spiral. Putting into (2) the value of $d a$ obtained from (1), we have—

$$d z = 2\pi b \text{ N sec.}^2 a . \frac{b}{\text{cos. } 2a} d\tau.$$

But we have already found $d\tau = \frac{\text{P } b \text{ cos. } a}{\text{Q}}$

$$\therefore d z = \frac{2\pi \text{ N } b^3 \text{ cos. } a}{\text{Q cos. } 2a} . \text{P}$$

Now, for small angles cos. a = 1 nearly; and cos. $2a$ = 1 nearly; so that $\frac{\text{cos. } a}{\text{cos. } 2a} = 1$ nearly. (If $a = 10°$ $\frac{\text{cos. } a}{\text{cos. } 2a}$ would differ from 1 by about $\frac{1}{20}$). Hence, for spirals of small angle, we have—

$$d z = \frac{2\pi \text{ N } b^3 . \text{P}}{\text{Q}} = \frac{\pi \text{ N } d^3}{4\text{Q}} . \text{P}$$

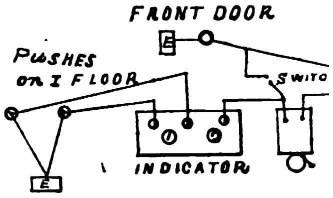
where d = mean diameter of coil, since $b = \frac{d}{2}$ when $d z$ is the change in length produced by the force P. Taking the case of
$\text{Q} = \frac{1}{2} \pi r^4 n = \frac{1}{32} \pi c^4 . n$, if c is thic

$$\therefore d z = \frac{8\text{P} . d^3 . \text{N}}{n c^4} = \frac{\text{P} . d^3}{c^4} + \text{K}, \text{ where}$$

stant depending on the steel. This ex
I fear at some length, the method
the formula. If "Engineer" will
various quantities involved are to b
i.e., whether in tons or pounds, inche
explain the method of arriving at th
—G. F. C. SEARLE, St. Peter's
bridge.

[65270.]—**Compensation Pen**
W. G." will find a full description of
lums in Grossmann's "Notiz Kalend
(1s.).—W. VAN EYS, San Remo.

[65285.]—**Electric Bells.**—Inse
shown in sketch. "On" in daytim



push rings both bells. "Off" at ni
bell only.—W. PERREN-MAYCOCK.

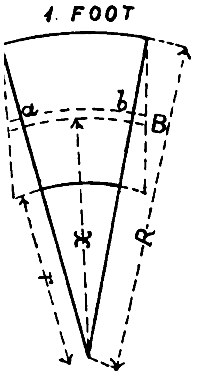
[65310.]—**Duke Violins.**—Richa
an excellent English maker. One of
instruments bore comparison with th
soon as his name was "up" every
ment was christened "Duke" to att
hence "a pedigree" is indispensabl
good price. Hart in his book says, "
fine specimen of Duke is once seen
to be forgotten. As copies of Amat
ments are scarcely surpassed—varni
material being of the best descriptio
to £10, or more. There was a son
name of less value as a maker.—J. D.

[65318.]—**Chloride of Gold.**—I
will turn to my "Lessons in Chem
Vol. XV., of the ENGLISH MECHA
he will find that Mr. Bottone kno
about the constitution of water whic
chloride of lime. Perhaps "Chemis
had occasion to dissolve the gold wh
the inside of toning bath bottles. I
since 1854 with the very solution
and have found it far superior to any
purpose, since the alkalinity due to th
the calcic carbonate, consequent upon
the atmospheric carbon dioxide on th
lime solution, renders the resulting
eminently fit for use in toning
"Chemist" ever tested a solution of
of lime for free chlorine? If he has
will he kindly try, and report the per
BOTTONE.

[65324.]—**Fans.**—I find there ar
takes in "N. A. F.'s" work which
notice, and I have made one of my own
wrong sign in the "boiling down" pr
the result is not correct. Also the
cubic foot of air is about ·08 or 1·28
chief error is in taking the air as if it
The proper way is to calculate the pre
air at the radius of gyration, and by d
pressure by the circumference in fee
radius we get the pressure per square
end of the radius of gyration; at by
pressure of fluids and gases, this same p
square foot must also be exerte on
casing of the fan; hence, instead of d
sure by 2πR, we must divide it by

This gives a much simpler formul
square foot in ounces = ·000219
per min.)². This gives a pressu
on the square foot in the particula
at the end of my reply, where the
per minute is 500, and R = 4, r =
out the problem directly by the c
will be seen much more clearly.
represents a sector of the fan, or the
two blades, the tips of which are s
1ft. apart, the two dotted circula
together are supposed to represent a
of the sector of infinitesimal width
of these strips contributes its quota
the air beyond it, and this pressure is
ferred to the outer case; but here it
that according to the laws of pre
and gases, the pressure on strip
ferred to outer case, becomes in
proportion of 1ft. to a b, so th
our calculations we must take all

long, or A B instead of *a b*. It is sort of thing as the pressure on the low cone when filled with water, me as if the cone were a cylinder ; as the cone. The weight of the



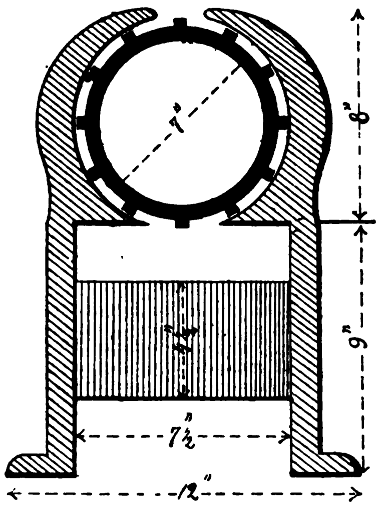
efore be (if the fan is 1ft. broad) 1ft. × dx, or simply ·08 dx. The rifugal force is $P = W\frac{v^2}{rg}$. Sup- mber of revs. in 1sec. N, then the stance x is $2\pi N x$; the pressure the strip is $P = \frac{\cdot 08\,(2\pi N x)^2}{xg}\,dx$, dx, and the integral of this between nd R will give the pressure in pounds on the outer case of the fan; it is $\frac{R^2 - r^2}{2}\Big)$, which gives 40·56lb. in ase given above. If there is a space blades and outer case, we must add e pressure accruing from the air in ch will be $\cdot 08\,h\,\frac{v^2}{Rg}$, h being dis- to case, and v = velocity at tips.—

olution and Transmutation of fusion of blood is called for when- is imminent from profuse loss of ding in labour, operations, wounds, eeth, and the bursting of varicose *ne quâ non* in this operation, the find some healthy person" who of his or her blood. The strength eing exhausted, and the circulation ealthy, vigorous blood is required so e formation of clots, bringing on ndition and death. The blood of ving the human life and vigour, is cause clot and blood-poisoning. on on this subject may be had in st. of Med.," Vol. I., or "Braidwood, Pyæmia," 1869, as also various Med. Chir. Trans. for 1852." The ystals are always prismatic, animals' rahedral and hexagonal. If "Nun. that the existence of low-type nple fact," then he need have no ying where they are to be found. ement (which he traverses) in the 384 in "Ours," and, giving proofs, tackle me then, instead of making led-for insinuation now? As for olutionist metaphysics," if "Nun. e the metaphysics involved in the ory, I cannot help it; at the same e to understand is no reason for nsult to me.—DENS.

dius of Gyration.—I have been by substituting other curves than "Glatton" in his problem, see 11th. If we take the curve ult is so curious that I should like "Elag," or "Glatton" himself to see if my result is correct. The imaginary ring at distance x x is $2\pi x\,\frac{1}{x^3}.dx$, or $\frac{2\pi}{x^2}dx$, the in- is $-\frac{2\pi}{x}$. Taking this between d R, we get the total contents $-\frac{1}{r}\Big)$ or $2\pi\frac{R-r}{Rr}$. The moment he ring is $\frac{2\pi}{x^2}.x^2.dx$ or $2\pi\,dx$, the ich between r and R is $R - r$. latter by the former, we get the f gyr. = Rr or rad. of gyr. = $\sqrt{Rr}$. hole in the centre of the wheel—that is if $r = 0$, the rad. of gyr. = 0; but if we take $R = \frac{1}{r}$ the rad. of gyr. will always be 1, whatever r may be. Now take r infinitesimally small, still the rad. will = 1. We, therefore, get the curious result that if $r = 0$ the rad. = 0, but if r is taken infinitesimal, the rad. = 1.—M.I.C.E., Bath.

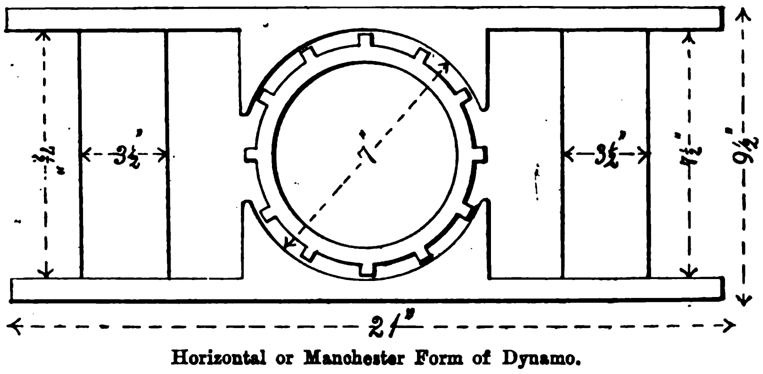
[65330.]—**Plating Dynamo.**—TO MR. BOTTONE.—I append two sketches, both of good forms of dynamo. Fig. 1 is perhaps the easier to make, and can have the field-magnet core in wrought iron, which greatly conduces to efficiency. The dimensions are marked on the sketches. The armature must be of laminated iron rings, with cogs. These rings should be built up to a depth of about 6in. The armature should then be wound with about 6lb. No. 8 d.c.c. copper wire. Each coil will therefore take about two yards of this wire, as the wire runs four yards to the pound, and there are 12 sections on the armature. Wind the field-magnet core (or cores, if Fig. 2 be chosen) with 25lb. No. 14 d.c.c. Connect up the field-magnets in shunt with the brushes. Remember that if form Fig. 2 be adopted, the F.M. wires must be connected together so as to produce consecutive poles, as in the Gramme machine. The ampèrage of a dynamo can be calculated thus:—Taking the E.M.F. as 1 volt for each yard of wire on the armature, divide the voltage by the total resistance, *id est*, that of the armature and outer circuit together. The result is the ampèrage. One-tenth must be deducted from this, as required to supply current to magnetise the field-magnets. See also my book, "Elect. Instruments" on this subject.—S. BOTTONE.

FIG. 1



Vertical Form of Dynamo.

FIG. 2



Horizontal or Manchester Form of Dynamo.

[65339.]—**Power for Small Lathe.**—Give it up. You will have to grind in as much power (and a little more) before you start, as you will use.—T. C., Bristol.

[65345.]—**Engine Query.**—This is the same as query 65144, the power at 30lb. being about 8½I.H.P., so you have all you require; but you must keep the pressure more regular.—T. C., Bristol.

[65351.]—**Greenhouse.**—There are two plans by which I have succeeded when in a similar difficulty. One is to allow the heat from the fire to rise a foot or so immediately above the fire, and descend to the flue in a gentle curve. The other is, first to allow the fire to heat the chimney well, then turn the damper so as to allow the draught to go along the flue.—WM. GRIMSHAW, Sunderland.

[65353.]—**Engine.**—This is not worth the trouble of doing, as it is of very little real use. Besides, it is not so simple as "Novice" thinks, and the use of logarithms is necessary. Again, the actual curve, owing to condensation and re-evaporation, differs from it and the hyperbolic curve.—T. C., Bristol.

[65354.]—**Steam.**—"Puzzled One" forgets that in a condensing engine the heat is abstracted by the condensing water, and in a non-condenser the steam is discharged into the air, and the heat it contains thereby lost. The quantity of heat available is represented by the difference of boiler temperature and condenser, which is a small fraction only of the total heat in the steam. A good engine will work on as low as 16lb. of steam per I.H.P., if triple expansion with high pressure.—T. C., Bristol.

[65354.]—**Steam.**—"Puzzled One" must take into consideration that even with the very best class of steam-engines only a lamentably small fraction of the potential energy in the coal is rendered available in work of the crank-shaft; whilst it is doubtless true that 0·177lb., or less than 3oz., of good coal is theoretically sufficient to represent work equal to 1H.P. for one hour, it is nevertheless a fact that a first-class single-cylinder condensing-engine using steam of, say, 105lb. absolute (90lb. above atmospheric pressure), and cutting off at ¼th of stroke, developing, say, 100H.P. effective or brake H.P., requires 26·5lb. of feed-water per brake H.P. per hour. If of greater power less, but if of less power more. A very good boiler of, say, the water-tube type might be able to evaporate at the rate of 10lb. of water to 1lb. of coal, so that the coal consumption per brake H.P. would be 26·5 ÷ 10 = 2·65lb. per hour. In this case the useful work of the coal is $\frac{2\cdot 65}{0\cdot 177} = \frac{1}{15}$th of its potential energy. In the case of compound, or of three-cylinder expansion engines, the result will be better, and very likely raised to $\frac{1}{13}$th and $\frac{1}{11}$th respectively; whereas, in high-pressure single-cylinder expansive non-condensing engines it would be only about $\frac{1}{17}$th. Thus, for a 100H.P. engine of the latter class, cutting off at ½ stroke, 30lb. of feed, for condensing-engine 26·5lb., for compound and condensing 22·5lb., and for triple-expansion condensing 19lb. of feed per brake H.P. per hour may for high class work be assumed. The indicated H.P. is of course not to be confounded with the brake H.P., and if the consumption per indicated H.P. is derived from these figures, it may be a fair average to multiply brake H.P. consumption by the factor 0·65. The proportions between the piston areas for triple expansion condensing "hammer" engines of equal stroke are now usually taken at 1, 2·86, and 6·86 for a 12-fold expansion, the steam being cut off in h.p. cylinder at from 10 to 65 per cent. of stroke. Such an engine with "rider" slides, using steam of 12 atmospheres pressure in the boiler, and working at a piston speed of 400ft. per minute, indicates a theoretic feed consumption of only 11½lb. of water per indicated H.P. per hour — or, say, 17·7lb. per brake H.P. This raises the useful effect of the coal to one-tenth of its total energy, being burnt under a boiler of an efficiency of ten tons, or, in other words, a boiler utilising 66⅔ per cent. of the total heat of the combustible. I should prefer a vertical boiler with horizontal tubes of the "Cochrane" type for the purpose named; if not for more than 50H.P., I think an evaporation of 4lb. of water per hour per square foot of heating surface might be estimated upon. Hard (anthracite) coal gives a higher result per unit of weight than bituminous coal or coke, in the proportion of 81 : 75, and 81 : 65 respectively.—MARIENBERG.

[65362.]—**Piston, &c.**—"A. D." had better invest a shilling in one of the many elementary works on the steam-engine.—T. C., Bristol.

[65367.]—**Chiretta.**—Having taken infusions of above (with good effect on a torpid liver), I soon found that it rapidly went mouldy and bred organisms—to prevent which, the infusion made with water which has been boiled and cooled to blood heat should, after standing 24 hours, be strained through a fine cloth into a clean tin or enamel saucepan, and brought up to the boil for about ten minutes; again filter through another clean cloth into a bottle well stoppered. This will keep well, and does not taste of mouldy hav like the unboiled infusion.—F. G. L.

[65373.]—**Annealing Steel Strips.**—I would advise "Stamper" to get these annealed for him by some maker of corrugated roofing, as such maker would have suitable furnace and boxes to contain the strips to be annealed. The process is simply to heat red hot and cool very slowly.—T. C., Bristol.

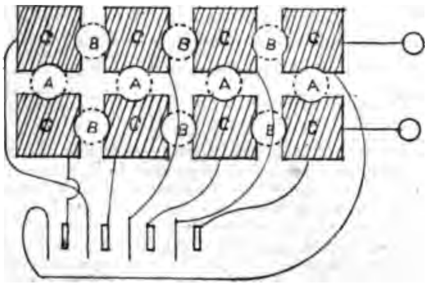
[65376.]—**Flat Filing.**—"New Reader" did not say whether the file to be used was double or single cut. If the former, the handle should be held firmly in the right-hand, with the thumb on top of handle pointing towards end of file; the fleshy part of left-hand thumb should rest on file near the end, and the two first fingers closed firmly underneath as far as the second joints, the file to be pressed on with the back stroke as with stroke from you. If a single-cut file is used, the handle should be held as above; the left-hand thumb should rest on end of file as far as first joint. All the fingers should be bowed; but only the side of forefinger should touch the file at and a little beyond the first joint—the file to be pressed on the work when making the stroke from you, and lifted just clear of the work when bringing it back. If pressed in the back-stroke, the file will not do near as much work before it gets slippery. A new file should be worked lightly, and the pressure on end of file to correspond with the pressure on the handle.—SCORRIER SAW MILLS.

[65377.]—**Gas for Blowpipe.**—To make oil-gas for blowpipe use alone would be somewhat costly even for the smallest practical working apparatus; but if combined with the general lighting of a residence or workshop, it may be done with economy, with apparatus so small as to supply from five to ten lights. Maker's name of such small oil-gas plant will be found in Sale Column. Could not "F. B." make use of wood naphtha or methylated spirits for his burner and blowpipe, which are nearly as good as gas, if not so handy? —L. A. S.

[65380.]—**Strains.**—Not more than 10cwt. if applied at centre, or one ton if equally distributed. The flitch plates should be deeper.—T. C., Bristol.

[65384.]—**Carbons, Lead Capping.**—Will Mr. Bottone please say why he advises adding antimony to the lead to "insure expansion"? I have often read it was the property lead possessed of contraction on cooling that made it so suitable for capping carbons, especially if a hole is drilled through, or a cut or two made with a file on the end of the plate or rod before pouring the lead in, the cap then hardly ever gets loose.—A. I. E. E.

[65385.]—**Switch.**—I think "Thales" will find the peg-board system better than a switch, as it gives closer contact and less resistance. To connect in series pegs in A; parallel, pegs in B; pegs slightly conical, C plates of B.—WIERD.



[65390.]—**Iridio-Platinum Gauze.**—I remember seeing a burner at a lecture of M. Fehrig, the electrician, which, if I remember right, was composed of platinum, iridium, and zircon. It was a beautiful light, but I have never seen it since, and that is over 15 years ago. There is a new self-lighting burner advertised by the same inventor, but as yet I have not seen it. "Morca," no doubt, will learn of some of "ours" where to obtain them. Look through patent specifications.—MANN.

[65391.]—**Trapezoid.**—By means of the integral calculus I have deduced this formula:—

$$\text{Contents} = \frac{h}{6}\left\{bl + am + 2\,(bm + al)\right\}$$

Where l is the length of the lower arc, *m* that of the upper arc, *a* is thickness at lower arc, *b* thickness at upper arc, *h* is distance between the two arcs. Take care to have all the dimensions of one denomination, either feet or inches; the contents of the figures given in this query will be found ·3055 cubic feet. The formula is exact for any dimensions. Example—Put $l = o$, $m = 2\,\pi\,h$, and let $a = b$; the formula will give contents $= a\,\pi\,h^2$, or a circular disc of thickness *a* and radius *h*.—M.I.C.E., Bath.

[65393.]—**Screw-Cutting.**—The lead screw has 26 threads in 6½in., and you require 20; so the ratio is $\frac{20}{26}$ or $\frac{5}{65}$. Use wheels 50 and 65 with 40 and 40, thus—$\frac{40\ \times\ 50}{40\ \times\ 65}$.—T. C., Bristol.

[65393.]—**Screw-Cutting.**—If the screw to be cut has 20 threads and 20 spaces in 6½in., and the leading screw has 26 threads and 26 spaces in the same length, then any wheels in the ratio of 20 to 26 ought to cut the thread. Take, say, a 40 and a 52, place the larger wheel on lathe spindle, and work with as large an "intermediate" wheel as you can.—TOMSON.

[65393.]—**Screw-Cutting.**—If your wheels advance by 5's only, put 130 on mandrel, and 100 on leading screw. If you have not a 130, put on any other wheel suitable, say, a 65; now you have only to find a wheel and pinion for intermediate stud, in the ratio of 65 to 130 1 : 2, and gear the 65 into the smaller wheel. The same with the 100 wheel on leading screw, if you have not got one; put on any other wheel you like, say a 75; now put wheels on intermediate stud in the ratio of 75 to 100, 3 : 4, and gear the 75 wheel on the leading screw into the smaller of the two on the intermediate stud.—TOMSON.

[65393.]—**Screw-Cutting.**—In 6½in. there is 20 threads on the screw to be cut; on the leading screw there are 26 threads in the same distance, and this is the ratio between the wheels required. As the screw to be cut is coarser than leading screw the ratio stands thus: $\frac{26}{20}$ multiply by $10 = \frac{260}{200} \div 4 = \frac{65\ \text{lathe spindle}}{50\ \text{leading screw}}$. If you want a compound train the following will do—$\frac{26}{20} = \frac{13\ \times\ 2}{4\ \times\ 5}$. Multiplying the four terms by $10 = \frac{65\ \times\ 20}{40\ \times\ 25}$; divide the 130 and 50 by $2 = \frac{65\ \times\ 20\ \text{drivers}}{40\ \times\ 25\ \text{driven}}$.—SCREW-CUTTER.

[65395.]—**Fixing Charcoal Studies.**—A simple method for the above is to float the drawing, when completed, in a solution of isinglass. Dissolve a ¼oz. in a little hot water, and fill up with a pint of cold. Should the first floating not be sufficient, repeat.—AVICULA.

[65395.]—**Fixing Charcoal Studies.**—I put four pennyworth of isinglass into a quart jug and poured boiling water upon it till the jug was nearly full. I then held each of the drawings one at a time in a slanting position face upwards, immediately over a handbasin, and gently poured the contents of the jug over them, taking care that no portion should escape the wash. Then, after leaving the drawings lying flat to dry, I found that no rubbing with the hand, or even with india-rubber, produced the slightest smudginess; and yet there was nothing of a glaze visible, nor anything to show any change whatever from the appearance of the drawings before fixing. Thenceforward I continued, with unfailing success, to fix all my charcoal drawings in that simple way.—FRANK CAWS.

[65397.]—**Wimshurst Influence Machine.**—The brushes are made of gold tinsel, and should touch the plates.—H. C. BEAUMONT.

[65397.]—**Wimshurst Influence Machine.**—The brushes are best made from the twisted metal cord known as "gold braid," or "gold cord," and used for military and other trimmings. The brushes must touch the surface of the plates.—S. BOTTONE.

[65400.]—**Engine Formula.**—Have the weight so that wheel tends to lift it, and put just sufficient weight to keep engine at desired speed. The power = weight × revolutions per minute × circumference of wheel in feet.—T. C., Bristol.

[65401.]—**Block Signalling.**—Details of block signalling would take up some space. Get Mr. Stretton's "Safe Railway Working," which gives a full description of the block system.—J. LATIMER.

[65402.]—**Electricity.**—The Glynde telpherage line. The experiments with dynamo and motors, between Vizelle and Grenoble (1883). This was on a line 14 kilomètres (say 10 miles) in length. The nearest approach to an electrician's "Molesworth's" is Hospitalier's "Electrician's Pocket-book," English translation by Gordon Wigan, published by Cassell and Co., last edition. Kapp's
"Electric Transmission of Energy," pub
Whittaker and Co., gives very full infor
to machine working by electricity.—S. Bo

[65402.]—**Electricity.**—There are se
stances of the transmission of power by
electricity to a much greater distance
miles—for instance, the Grenoble exper
Deprez. The loss in the conductors is C²
age; but as the total loss in transmission
upon the loss in conductors, dynamo, and
is impossible to give formulæ. However
take 15 per cent. as the loss in dynamo a
cent. as loss in motor, the loss in the co
being, say, 10 per cent., if power is de
generating station. If water is used,
might be increased to 30 per cent. with
age.—H. C. BEAUMONT.

[65404.]—**Starting and Stopping**
motor.—TO MR. BOTTONE.—The c
turned on or off by means of a switch.
is regulated by the amount of current t
The lever of the Reckenzaun's reverser (
a sketch appears at reply 65163, so I do no
turns on the nose of the front bearing of t
See also my reply, 65163, at p. 241, No.
BOTTONE.

[65408.]—**Developer.**—The best dev
have used is that used for the "Ilford dr
and also has the least stock solutions. N
solution: Pyrogallic acid, 1oz.; ammonium
600gr.; water, 6oz. After dissolved add
of HNO_3 (nitric acid). No. 2: Strong
3 drachms, 880; water, 1 pint (kept in a
bottle). No. 3: No. 1 stock, 1oz.; wat
For developing add equal parts No. 2 and
after developing and after fixing use the al
Here we have only one stock solution.—
Liverpool.

[65408.]—**Developer.**—The following
"Negative" wants; but it is not so goo
two others which follow. The last formu
latest and best:—(1) American standard
cyanide potass., washing soda, pure c
potass., of each 1oz (437½gr.), make up wi
to 10oz. For each ounce of developer 1dr
above, and 2gr. to 3gr. dry pyro. (2) M
phite developer: A, pyro. 1oz., metabisul
potash 1oz., bromide of potassium ¼oz.,
to 10oz. B, carbonate of potash 3oz,
soda 2oz., chloride of sodium 2oz., yellow p
of potash 1oz., water up to 10oz., 1dr.
ounce of developer. (3) hydrokinone 150
bonate of potash 450gr., sulphite of soda
water 30oz.; dissolve and filter, use suffi
cover plates, and pour back for future u
Henry Byk's hydrokinone is the best.
Plymouth.

[65408.]—**Developer.**—No. 1. Pyro. sol

Sulphite soda, pure 2
Warm distilled water 2

when cooled to 70° Fahr., add—

Strongest sulphurous acid water ... 1

then add—

Pyrogallic acid ....

No. 2. Potash Solution.—

A { Carbonate potash, pure 1
Warm water 2

B { Sulphite soda, pure 1
Warm water 2

Dissolve A and B separately; then combi
solution. For each ounce of complete dev
for a properly-exposed plate—measure 30
No. 1 (equal to 3 grains pyro.), and 10 mi
No. 2, make up to 1oz. with water. For
posure more of No. 1 is needed; but for
taneous exposures the quantity of No. 2
the 1oz. developer must not exceed 70
it will be only in rare cases that so much
solution (No. 2) is needed. For ordinar
exposures about 30 minims of No. 2 is su
if the plate is found to be under-exposed t
must be added, two or three drops at a time,
till development commences. For over-e
commence development with 5 or less mi
No. 2 (instead of 10 minims). Some dry
rich in silver, only require 20 minims of
get sufficient density, as this is regulated
quantity of pyro. used in the develope
advantages Mr. F. C. Beach, New York, c
and which are fulfilled—for the above de
are:—Red and green fog is banished—pota
tion (No. 2) does not change like liquid a
and no unhealthy fumes; acts well on ne
make of plates, especially good for instant
work—no restrainer necessary—soft, clear,
printing negatives, clear in the shadows
use of the sulphurous acid and sulphite
J. W. M.

[65409.]—**Automatic Switch.**—I can
better than recommend "Switch" to read
chapter on Switches, which he will find
David Salomans's "Management of Accumul
If he cannot refer, I will condense, and re
the matter in these pages.—S. BOTTONE.

QUERIES.

[65438.]—**Cement for Socket Pipes.**—Can any reader tell me of a cement for socket pipes which will not swell or burst the pipes in setting?—LINKUM DODDIE.

[65439.]—**Ebonizing, Renovation of.** — Will some kind friend assist me in renovating my piano case, which has several scratches and bruises upon it?—W. R. L. R. N. E.

[65440.]—**Black Beer**—Could any of your numerous correspondents say what black beer is made of?—SEHGUH.

[65441.]—**Pyroligneous Acid.**—Shall be glad to know how to make this acid from refuse wood, with full particulars of plant required, size of retort, cost, &c.—J. DEAN.

[65442.]—**Polishing Ebonite.**—Can anyone tell me what is the best way to polish ebonite? When letters, &c., are engraved on it, what is the white stuff with which they are filled up?—CONDENSER.

[65443.]—**Preserving Whites of Eggs.**—Can any reader kindly inform me in which way I can preserve the whites of eggs, beaten up, from going bad? The colour must not be changed, otherwise it will not be of any service to me.—EGGS.

[65444.]—**Governors.**—Will any of our readers be kind enough to give a description, size, and drawing of a pair of governors best suited for a small engine (horizontal), cylinder 5in. by 3in., steam ports 1¼in. by 5-16in., exhaust 1¼in. by ⅜in.?—CONSTANT READER.

[65445.]—**Bottle Battery.**—Should like to know the method of mixing the following for above battery Water, 1qt.; chromic acid, 5oz.; sulphuric acid, 3oz. The manner in which I mixed the above created a great heat and destroyed the amalgamated zinc plate.—J. AYRES.

[65446.]—**Bending Copper Tubing.**—I want a press or appliance of some kind for bending solid drawn copper tubing from 2in. to about 3½in. bore, ¼in. thick. Will any correspondent kindly give me particulars—i.e., if a press, what size of ram and what pressure will it require to bend a 3½in. pipe? Which answers the best for filling, resin or lead? Have we to plug the ends up?—COPPER PIPE.

[65447.]—**Finishing Billiard Balls.**—How are billiard balls finished and then proved correct? I am informed there is a hand tool for finishing, and polishing afterwards in lathe. Is there a book published on the subject?—N. LONG.

[65448.]—**Portable Canvas Canoe.**—I should be glad if any of your readers could give me an idea for a canvas canoe to take apart and pack up for travelling, and be compact, light, and cheap.—AQUEDUCT.

[65449.]—**Pump.**—Would any of your readers kindly give a sketch and particulars for a ⅝in. plunge force pump to fill a small boiler working at 35lb. pressure?—PUMP.

[65450.]—**Achromatic.**—Would any of our astronomical correspondents kindly give a few tests for a 3½in. achromatic? Would Webb's "Celestial Objects" be too advanced for a beginner with the above aperture, not equatorially mounted? If so, what book would be most suitable?—ACTONIAN.

[65451.]—**Flywheel.**—Does the size of flywheel matter in an engine? If you had a cylinder, how would you know what size travel of eccentric you would require? What is the travel of eccentric? How could you find the pressure of steam the boiler would stand?—A WILLING ENGINEER.

[65452.]—**Sensitive Plates.**—Will some of your readers give me any help in this matter? I wish to photo. some men in a foundry lit up by the red glow of the molten iron. How can I do it? In short, what plates or process will photo. a red or yellow light?—WEIRD.

[65453.]—**Backbone.**—I have a spine of a shark and I want to make a walking stick of it. Would any kind reader tell me how to drill a hole through it (without cutting it to pieces), so that I can put a thin iron rod in it? Also how can it be polished?—HEN WLAD FY NHADAN.

[65454.]—**Lamps.**—Can anyone tell me the cause of these making a hissing noise? It troubles me occasionally and defies detection. Best oil is always used and no water gets to it. Wick is well dried and all parts of the lamp are well cleaned. Supply of air is good. Several friends have been troubled in a like manner. Wicks are always rubbed and not cut.—WAKEFORD.

[65455.]—**Medical Coil.**—Have a medical coil with two terminals at back for battery wires; but at the front it has three terminals marked P. PS. S. (whereas I only thought there would be two). Should like to know on which two to fix handle cords and the use of the remaining one.—J. NEWMAN.

[65456.]—**Development.**—Will one or more of your able correspondents kindly give me the chemical account of the actions which take place during development of a gelatine coated negative by the application of the pyrogallic acid developer? I should also feel obliged by having a good work on photographic chemistry recommended, giving ample detail of the chemical action of the different developers at present in use for the ordinary gelatine coated plates.—AMATEUR.

[65457.]—**Ten Candle-Power Dynamo.**—I am thinking of having a 10c.p. dynamo, so would be glad if any experienced reader would give me a bit of advice. What size copper boiler should I want, and what thickness? Also what shape. I should think a piece of round copper tubing, about 6in. wide, would be best. What sort of cylinders would be best, and what bore and stroke do you think would do to drive the dynamo? Also what sort of lamp do you think would be best, and do you think one lamp would light a small shop up? Please say what pressure boiler would stand.—A. H.

[65458.]—**Astronomical.**—To "F.R.A.S."—I wish to make a telescope (refractor) of sufficient power to enable me to make good observations of the moon and planets. *It is my first* attempt, so that any information beyond the *answers to the following will greatly* help me. 1. What *effect upon the view of an object* has the increasing or diminishing of the length of focus? 2. What aperture and focus will give me the best results? 3. Having been simply confounded by the recent articles in the "E. M." upon aberration of all sorts, I should like to know the simplest and best arrangement of lenses from object-glass to eyepiece. 4. Will a finder be necessary? If so, how are the glasses arranged? 5. Which would give the best results—a refractor or reflector of equal aperture? 6. Can you recommend a modern small treatise upon telescope making? I should like the telescope to be as short as it can be without spoiling the results.—SIRIUS.

[65459.]—**Jupiter.**—Would your astronomical correspondent kindly say whether your remark, on April 27, about Jupiter being 2′ north of β^1 Scorpii at time of conjunction, also the statement in the *Nautical Almanac*, are not both incorrect, and should read exactly opposite? My attention was called to it in a curious way. Surveying the heavens in admiration, the moon being then three parts full, on the evening of the 21st (with the naked eye), I fancied I detected immediately east of Jupiter a star, or a satellite (I was not aware whether, under favourable circumstances, satellites ever were seen with the naked eye), so on my return home at night I turned to my *Nautical Almanac*, and soon found that what I had seen was β^1 Scorpii, which had been in conjunction with Jupiter on the morning of the day I noticed it. To me the star appeared a shade the lower in the heavens which corresponded with your remark and also that of the *Nautical Almanac* under the head "Phenomena"; but when I compare by the tables of declination, I find, as I imagine, that the star really was north and Jupiter south at time of conjunction, and slightly so, but in a less degree, at 12.30 p.m. when I noticed it. The explanation of the star appearing to me a shade lower whilst its position really was north of the planet being, I presume, the relative positions of the Equator and horizon; but the sudden shattering of my first fancied confirmation of their relative positions was so curious that for information I ask the above crucial question. I hardly know how to convey my meaning in fewer words.—AL FARD.

[65460.]—**Great Western Railway Brake.**—Can anyone give me a description of the working of the automatic vacuum brake used by the above company? Also, if possible, a sketch of the air pump to maintain the vacuum worked off the crosshead? I think the above-mentioned brake differs altogether from Gresham and Craven's automatic brake. Does it work with an air-tight space top and bottom of the brake cylinder, like Gresham's?—BRAKE MAN.

[65461.]—**Entozoa in Fish.**—I have noticed for some years that the intestines of fish are infested with entozoa. My attention was first drawn to the matter by my wife, who noticed something alive when dressing a pair of salmon, and on examination I found the moving creature to be a tape-worm, several feet in length, and portions of several others in the intestine. In the haddock I have found worms 2in. long, hard and white and alive. In the intestine of the mackerel I have found the long thread-worm, *Cercocephalus dispar*. The fish were in good condition, so far as could be seen. Can any reader say if this is a natural state, or why is it?—J. FURNIVALL.

[65462.]—**Cooling Shed.**—I have a shed measuring about 70ft. by 30ft. fitted on three sides with louvre boards. The floor is on a level with the surrounding ground, the height to the ceiling is 10ft., and there are two stories above. I wish to keep the lower story at a temperature not exceeding 60° Fahr. Is there any not very expensive method of doing this? Moisture in the air would not greatly matter.—FRIGUS.

[65463.]—**Potential.**—Will any reader show me the method of working the following question? Two equal soap bubbles, equally and similarly electrified, coalesce into a single larger bubble. If the potential of each bubble while at a distance from the other and from all conductors was V, what is the potential of the bubble formed by their union? Volume (v) of a sphere is proportional to cube of radius (r), or $v = \frac{4}{3}\pi r^3$.—S. R. CLAY.

[65464.]—**Locomotive Cylinders Bushed.**—We have some single-framed 18in. inside cylinder engines. When new the boilers were pressed at 130lb. per square inch. Since then the boilers have been repaired, and are now pressed at 120lb. Our road is very heavy; in some parts the gradient is 1 in 27. The consequence is the engines will not maintain themselves with steam. To remedy this one of our chiefs put a gunmetal bush in the cylinders of one of these engines, making them 17in. diam. Since done this engine has run over 30,000 miles, and has shown a saving in coal consumption of about 8lb. per mile compared with the other 18in engines. The engine also steams much better. Unfortunately there is a doubt as to the safety of bushing locomotive cylinders. The bushes are put in in two parts, from each end, one overlapping the other in the centre. The cylinders were heated, and the bushes pushed in tight. There is a flange on each outside end of the bush, which is covered and held in place by the cylinder covers. It is a splendid job. The joint in the centre is scarcely perceptible, and the cylinders are like looking-glasses. Would any of our practical readers kindly give me their opinion whether there is any danger to be apprehended from bushed locomotive cylinders?—SUBSCRIBER ABROAD.

[65465.]—**S.N. Telegraph.**—To MR. BOTTONE.—Would you please give me instructions (by sketch, if possible) for fitting up two single-needle instruments at about 10yds. distance from each other? What size Leclanché battery should I require, and would an ordinary covered wire suffice? Is it necessary to have an earth wire, and would you kindly show the number of wires required from each instrument to battery?—A LEARNER.

[65466.]—**Mahomet's Coffin.**—Having met with several who say they have seen this illusion, and who all insist that it is suspended magnetically in mid-air without any support, I shall be glad to have the mystery explained, or authoritatively contradicted.—Z.

[65467.]—**Gloomy London.**—I presume that many as well as myself have noticed that on approaching London in the morning by train how frequently gloomy it is, and on returning to the country in the afternoon are there informed that no change has taken place, but that the sun has been shining all the time. It cannot be the smoke, for even in Sheffield, which is twenty times more smoky than the Metropolis, the sun can be always seen when it shines. It is particularly noticed when approaching London from the east.—Z.

[65468.]—**Astro. Eyepieces.** — Have read somewhere that high-class astro. eyepieces will show the whole of moon's disc at once, even when the eyepiece is one of very high power, say 1,000 diams., while inferior oculars of same magnifying powers show only part of the disc. Will some one kindly say how far this is true?—ESNE CARALITA.

[65469.]—**Choice of Specula.**—Three silver-on-glass mirrors are offered to me; each is 10in. diam., but the focal lengths are 72in., 90in., and 114in. respectively. Which shall I buy, having regard to its use for general star-gazing and celestial photography, and why? What is the highest magnifying power (in diameters) the mirrors will bear?—ESNE CARALITA.

[65470.]—**Hydropathy.**—Is this practised anywhere in England in accordance with Dr. Duval's method of using a movable pipe or hose by which the water can be directed to all parts of the body, and of fixed jets, some of which are arranged to act upwards and horizontally on the lower part of the body, the patient being seated on a stool designed for the purpose?—T.

[65471.]—**Electric Tests.** — To MR. BOTTONE.—Thanks for your reply to my query, but you do not seem to understand any part of my query, so I will repeat it. On the top of detector there are three terminals. On the two outside are connected the ends of the two coils, which are fixed the same as in S.N. coils. There is also one very small coil about the diam. of a shilling. The ends of this coil are fixed—one to the middle terminal (on the terminal that the switch bar is also fixed on) and the other end of coil is fixed to one of the outside. When testing a No. 2 Leclanché cell with the switch bar free from the outside terminals the needle shows 55°; but when putting the switch bar against one of the outside terminals it will only show 15°. Will try and put the other part plainer. Is it possible to have a S.N. circuit when testing for earth perfectly clear—i.e. without showing any degrees of earth when testing for earth? I cannot get this circuit perfectly clear, even when testing it in dry weather. It will always show about 5° of earth when tested in the clearest weather. Would cracked insulators cause this leakage in dry weather? I found a lot of them cracked, but have not yet renewed them. What is the cause of them cracking? It cannot be from stone-throwing, as a stone would break a piece out, but these are simply cracked in half?—AMATEUR TESTER.

[65472.]—**Problem.**—In reply to a question of mine some little time ago, the amount of work done per minute by a 200-ton train moving at 55 miles per hour was shown to be 31,944,000ft.-lb. Would this amount of work developed instantaneously (or in a short time, such as the action of gunpowder) start an equal weight to the train at a speed of 55 miles per hour?—or, in other words, suppose two parallel, perfectly level railways, one having a gun and carriage, weighing 200, at rest, having a charge of powder sufficient to give, on firing, an energy of 31,944,000ft.-lb.; on the other line a train of equal weight. Let the train be at sufficient distance to enable it to reach the speed of 55 miles per hour by the time it reaches the position of the gun. Then, by previous arrangement, [illegible] the gun be fired and steam shut off from the engine. Will both be then going at equal speeds and run equal distances? What would be the extreme distance they could run, and have there been any experiments of this kind taken together or separately? If so, will any kind reader furnish particulars? Also what are the number of [illegible] of heat in combustion of each of the following substances: 1lb. of average gunpowder; 1lb. dynamite; 1lb. sulphur; 1lb. saltpetre; 1lb. potassium. Friction of wheels and resistance of air supposed to be equal in this question.—GRIFFITHS.

[65473.]—**Survival.**—1. What words are to be supplied after "Survival of the fittest"? The fittest for what or whom? 2. "The survival of the fittest to survive" implies "The destruction of the fittest to be destroyed." Were bisons the fittest animals to be destroyed by their brother animal man, and are rabbits in Australia the fittest to survive in spite of man's efforts to destroy them? Was that treasure house of oil, the Great Auk, the meetest for destruction, or is the black grouse [illegible] for it than its exterminator, the hooded crow? "The survival of the fittest" seems to me to mean "The survival of the biggest bullies and the most slippery [illegible]lings"—that is to say of (in many cases) the unfittest. Is this idea correct?—B.

[65474.]—**Mercury Pump.**—I wish, if possible, [illegible] make a Sprengel pump, but do not possess the necessary details. Will some friend kindly give the length of the fall tube and other parts, and also the size of glass tube, viz. inside and outside diam.? A rough sketch would be a great help. What is the best kind of glass to use for the purpose — ordinary soda glass or lead glass, and what quantity of mercury is needed to work it? I presume the construction of such a pump is fairly within the capabilities of an amateur glass blower.—B. S. T.

[65475.]—**Field Winding.**—To MR. S. BOTTONE.—When the wire for the field-magnets of small dynamos [illegible] wound upon bobbins instead of directly on to the [illegible] of the magnets, what is the best material to make the bobbins of? Is ordinary sheet-iron suitable, and [illegible] the flanges of the bobbins to be made of a non-magnetic metal?—B. S. T.

[65476.]—**Chromic Single-Fluid Cell.**—[illegible] much sulphuric is required to utilise to the full each [illegible] of Sullivan's chromic acid? Also how can I tell [illegible] the solution is exhausted? I have a 4-cell battery [illegible] would no longer light a 6v. lamp when the solution [illegible] still bright yellow, though darkened, and I cannot [illegible] it was exhausted? Would increasing the active [illegible] and zinc surface in each cell make it work itself out [illegible] completely?—URSA MINOR.

[65477.]—**Size of Condenser.**—Would Mr. [illegible] kindly tell me how many sheets of tinfoil and what [illegible] sheets I should want for a coil on which I put nearly [illegible] of s.c. No. 36, B.W.G. copper wire, and which gives, [illegible] one pint cell of bichromate of potash without a [illegible] denser, ¼in. spark? What is the greatest number [illegible] sheets I could have for it? Also would No. 22 wire [illegible] for a 10 volt incandescent lamp with 6 pint cells?—A

-Distilling Sea Water.—I have a house ı, but I am very badly provided with fresh ould any of your readers advise me how to put ng apparatus for distilling sea water, and what ıe approximate cost, excluding cost of tanks 'or sea water which I have already? I require, ;al. a day.—SUTTON.

-Effect of Descending Gradient on .—What is the formula for ascertaining the lescending gradient on the speed of a train— ·spective speeds could be attained down 1 in 75, d 1 in 200, with trains of 50, 100, 150, and 200 ıt of engine and tender excluded), drawn by ing 100lb. tractive force for every pound of ef- ssure, and driven at highest attainable velocity ther on dry rail?—R.

-Locomotive Power.—To MR. C. E. .—In calculating tractive force and work of gines of 1,472, 1,502, 1,562, and 1,657 classes, ıeter of driving wheels to be reckoned as 6ft. 9in.? Are they the same as those of 800 the wheels of 1,492-1,501 class 7ft. or 6ft. 9in.? been stated in these columns. Has No. 121 n. cylinders? Have the 19in. Midland engines ilers or the cylinders reduced, and are they now ır?—M.

-Games of Patience.—Can anyone re- good game of patience played with one pack, of scope for play, and not occupying much etting out? I know Sir Tommy, Fair Lucy, oth good, but require too much space), Puzzler, General Sedgewick, and Calcul. I have ıugh Lady Cadogan's books, but nearly all are ı two packs.—INVALID.

-Geneva Watch.—When it is wound up for about four hours and then stops, but when centre wheel it goes till fully down. I am ly at such things, but this one puzzles me. I reatly obliged to anyone who will help me to cause of ehe stoppage.—WALTER J. PARKER.

-Oiling Flute.—Will some one kindly tell oil for a concert flute? I have been using but find it clogs up the keys. Also can I pre- lish being blown off the mouthpiece by the ling on it? It is made of a dark-brown wood FELIX HOLT.

-Nitre.—Will some of your readers inform an make pure crystallised nitre or how I can common nitre? Also can I turn citrate the use of plating? If so, please let me know be done.—A CONSTANT READER.

-Electro-Motor.—To MR. S. BOTTONE.— indly tell me what power of electro-motor it o drive an ordinary sized grocer's coffee-mill? of bichromate of potash battery would work it, rice the motor ought to be?—AMBER.

-Electrical.—Would Mr. Bottone or other ent kindly give me the proportions of the r a quart bichromate battery? The carbons 1½in. The zinc plate the same size. The glass by 4in. How long ought the solution to last? be covered up? When it crystallises what ?—GENS.

-Amalgamating Zincs.—Will some one me how to amalgamate the zinc of a bi- attery? What kind of brush ought I to use?

-S.W. Engines.—Can any of your readers rm me if any of the four coupled expresses r. Gooch, 1851, still run on the above line? If ıumbers? They were known as the Hercules ıad 5ft. 6in. driving wheels.—G. L.

-Engineer's Lathe.—Would any reader mensions of an 8in. engineer's screw-cutting should prefer some one to answer who has been t of using for some length of time, a good lathe re description.—ENGINEER.

-Small Boiler.—I have a small vertical le of 22 gauge tinned charcoal iron, 21in. by of boiler is riveted up steam-tight. Dome is sweated with solder. Would any reader tell me are I could work it at safely?—T. C., Liverpool.

-Galvanised Iron Wires.—Do not these an iron core covered with a thin coating of o, would not the electricity, when they are egraph wires, tend to flow through the zinc ı the iron?—SATINE.

-Dyeing Leather.—Can any correspondent me how tan-coloured leather may be dyed buff, or coated with a paint which will not LD SUBSCRIBER.

-Medical Battery. — Will one of our correspondents kindly inform me how to re-silver plate of a medical battery?—ENGINEER.

-Depthing Tool.—Will some one kindly w to make a depth tool, such as watchmakers ull sized sketch?—F. J. B.

-Volatile Solid.—I am anxious to procure olid, if possible, without smell and harmless. one kindly help?—ARCHIBALD STRANGE.

' a mixture of platinic chloride and is evaporated to dryness in a glass dish, y transparent deposit of metallic platinum ed; the light transmitted through this is greyish-blue tint. In this respect, there- inum shows close analogy to gold, which, known, in thin leaf transmits green light.

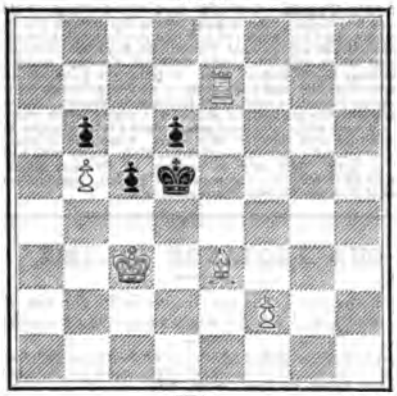
HUNDRED European singing birds are orted into Oregon by a society of German who deplore the absence of songsters in t West. Skylarks, bullfinches, nightin- ffinches, goldfinches, linnets, greenfinches, and starlings will form the cargo, and will se in the country immediately on arrival.

CHESS.

ALL communications for this department must be addressed to J. PIERCE, Langley House, Dorking.

PROBLEM MXCIX.

Black.



White. [5 + 4

White to play and mate in three moves.

SOLUTION TO 1,097.

White.	*Black.*
1. Q-K 2.	1. R moves, &c. (*a*).
2. Kt-K 3 (ch).	1. K moves.
3. Kt or P mates.	
	(*a*) 1. P takes K-Kt P (*b*).
2. Q takes Kt P, &c.	
	(*b*) 1. P-B 5 (*c*).
2. Q takes K P (ch), &c.	
	(*c*) 1. K-K 3 (*d*).
2. Q takes B P (ch), &c.	
	(*d*) 1. Kt-K 2 (*e*).
2. P takes Kt (ch) &c.	
	(*e*) 1. P K 6.
2. Q-B 3 (ch) &c.	

NOTICES TO CORRESPONDENTS.

CORRECT solutions to 1,097 by J. Palmer, J. Bryden (an elaborate problem, cleverly and carefully constructed, duals neatly avoided), J. Methuen, R. W. Barnett (good), Link (a very good problem), and W. Jay; to 1,096 by Link, J. G. Hankin, J. Bryden, and J. Palmer; to 1,092 by Myer Crown (Texas)—an excellent problem.

HENSING.—Thanks for problem.

IN the *Northern Figaro* Problem Tourney the prizes awarded by solvers are, for three-movers, A. P. Silvena, Jamaica; second prize, A. F. Mackenzie, Jamaica. Two-movers:—First prize, A. F. Mackenzie; second prize, James Rayner.

J. KEEBLE has won the first prize in the American Chancellor Tourney.

A MATCH was played on Saturday, May 12, at Paris, between the British Chess Club and the Cercle des Echecs, Paris, when the Paris Club won by 2 games to 1, and 2 draws.

THE famous Blue Hungarian Band are all ardent chess players; Herr Ignatz Samek, the second clarionet, being the strongest player. The band will shortly be at the Glasgow Exhibition, and arrangements are being made for a match between the Band and fourteen members of the Glasgow Club, to include one first-class player, the remaining boards being taken by second and third class players.

Improved Photographic Plates.—At a recent meeting of the Franklin Institute, Frederick E. Ives communicated an important discovery in isochromatic photography made by himself. After referring to the objections made to the process employing collodion emulsion and chlorophyll which is claimed to be the only one published which shows the difference between a black and a deep red without over-exposing orange and yellow, he said:—"At last I have succeeded in securing, by a surprisingly simple procedure, the full action of chlorophyll upon commercial gelatine bromide plates. The results are already superior to anything than can be obtained with cyanine. The degree of colour sensitiveness obtained appears to bear a definite relation to the general sensitiveness of the plate employed, which should, therefore, be of the most rapid kind. They are prepared by flowing with the alcoholic solution of chlorophyll, then drying rapidly, then soaking in water for at least five minutes, after which they may be used at once. With the two-year-old chlorophyll employed the absolute colour sensitiveness is fully equal to that of the best commercial 'orthochromatic' plates, and is so distributed as to be capable of giving far more accurate results; but the blue sensitiveness, which is greatly reduced by cyanide and erythrosin, is actually increased by chlorophyl, making it necessary to use an extra deep orange colour screen with these plates."

How to Learn.—A certain schoolmaster used to tell his scholars that they came there to "study how to learn," and that was all they could acquire in the way of knowledge from him. Once let a man "learn how to learn," and his education is complete. He will continue to acquire useful knowledge as long as he lives.

ANSWERS TO CORRESPONDENTS.

⁂ *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

⁂ Attention is especially drawn to Hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

BACK NUMBERS.

WE receive so many queries asking for directions how to make many instruments and appliances which have been fully described in back volumes, that we have compiled a list, which we shall insert in this column at intervals, of those most frequently sent, and as the numbers are still in stock, new subscribers should consult the list before sending their questions.

Bookbinding: No. 613.
Electric machines: Nos. 1,009, 1,025.
Electro-magnets: Nos. 772.
Lacquers: No. 866.
Pattern Making: Nos. 938, 941, 943, 945, 948, 950, 952, 954, 955, 956, 958, 959, 962, 963, 969, 974, 978, 986, 989, 993, 995, 998, 1,000, 1,001, 1,003, 1,004, 1,008, 1,009, 1,010.
Silver-plating: Nos. 1,009, 1,010.
Varnishes: Nos. 478, 619, 675, 723, 775.

The following are the initials, &c., of letters to hand up to Wednesday evening, May 30, and unacknowledged elsewhere:—

BARNETT, SON, AND FORSTER.—J. H. P.—Student.—J. M. —J. R. T.—R. J. Pippet.—John.—M.I.C.E., Bath.—Confectioner.—John Parama.—S. J. M.—Monte Christo.—Apprentice Electrician.—An Amateur.—Glatton.—Puck. —W. W. C.—Doctor Med.—T. Rigby.—Problem.—G. L. —J. Millar.—Reymond.—F. C. Allsop.—O. B. Hutchinson.—Sm.

A. F. SHAKESPEAR. (We could scarcely give a definite answer as to the infringement; but we do not believe there is a valid patent for ball bearings quâ ball bearings, though there no doubt are several for the manner of their application. We do not think those illustrated at the places mentioned are protected by patent.)—W. H. NICHOLS. (How to make a galvanometer in No. 1193. Many illustrations in back volumes.)—FOCUS. (Not absolutely necessary to use distilled water. Rain-water filtered, or water that has been boiled, will do. Several simple stills have been described in back volumes.)—W. T. GILBERT. (The query has been answered recently. There is an article describing a process of enamelling photographs on p. 597, No. 1170; another on p. 79, No. 1122, and many others in back volumes.)—G. S. W. (Any bookseller would answer such questions. Murray publishes Lyell's "Elements of Geology," price 9s., and probably the "Principles"; but we think that and the other work are out of print. If you want them, no doubt an advertisement would produce offers.)—R. (See indices for many recipes for paste. The bichromate merely helps to render the gum or glue insoluble after exposure to light.)—AN OLD SUBSCRIBER. (We do not think there is anything more to be said about cramp besides what, as an old subscriber, you must have seen. The best remedy is rubbing.)—WM. RICHARDSON. (If you will say which it is you want, we will try to help you. Plating "polished brass with mercury" is not "silver plating," and, as a matter of fact, the mercury will spoil the brass, rendering it rotten. You cannot have looked through many back numbers.)—BROKEN GLASS. (We described what you want on p. 212—only a few weeks ago!)—BATHER. (The paint is mixed with varnish. You can procure "enamel paints" nowadays from most oilmen.)—BOGLE. (Rhubarb wine is made much in the same way as other home-made wines. It is known as Bath champagne. Choose the best flavoured stalks, and allow 6lb. to the gallon of water, bruising well, and pouring the water on in a boiling condition. Strain when cool, add 4lb. of sugar, and ferment with yeast floated on a bit of toast. When fermentation has cleared the liquor, add 2 to 5 per cent. of brandy or plain spirit and bottle off.) —ISLAND. (Submit the case to Dr. Allinson in the *Weekly Times and Echo.*)—R. M. (Boot-blacking, merely, or boot polishing? See pp. 220 and 260, Replies 65151, Boot Cleaning Machine. Had you overlooked them? or do you want further information?)—J. H. RIGBEY. (We answered you on p. 291. We have other things to do than to answer questions by private letter.)—C. HYDE. (Noticed last week on p. 292. No one can answer such a question without seeing the skin.)—URSA MINOR. (It is not "necessary" to employ a patent agent in drawing out a provisional specification; but unless you have had experience, if the invention is worth a patent, you will act wisely by employing an agent.)—L. VINER. (It must be of rubber mixed with sulphur, and must then be subjected to heat and pressure. Steam heat is usually preferred, and that gives pressure at same time. See indices.)—ONE IN A FOG. (We do not recognise it, and cannot find the name "J. M. Wright" in the list of painters. Take it to a dealer in prints, as it is almost impossible to do more than guess without seeing the print.)—CONSTANT READER, Reading. (See an article on "Modern Compound Engines" in No. 1162, and the indices of back volumes. Briefly, the advantages are the use of higher-pressed steam, which is possible with the better distribution of the strains.)—H. B. (Explain what you mean by "metallic paper." If the "tablet" found in pocket-books, &c., it is simply stout paper coated with a mixture of lime, whiting, and size.)—S. J. MORTON. (Many thanks for your congratulations. It is pleasant to hear such praise from a twenty years' reader. Do you take our other paper, the *Weekly Times and Echo?* We strive to make that as interesting and useful in its capacity of a general newspaper as we do the "E. M." in its own line. Reply shall appear next week.)—G. MOLE. (If you will live by Dr. Allinson's directions in the *Weekly Times and Echo* you will speedily get rid of your dyspepsia without drugs or doctors.)—NO. SIG., Paris. (We do not think it prudent to invite information on the subject of making Bank of England note-paper.)

Every Man or Woman suffering from any form of nervous derangement, loss of power, debility, or functional disorder, should send at once for "Electropathy; or, Harness's Guide to Health" (copiously illustrated). It will cost you nothing, and if, after perusal of the astounding facts it will bring to your notice, you should be persuaded to stop physicking and try rational treatment, you will assuredly be numbered among the ever-increasing multitude who daily express their gratitude for the priceless benefits derived from mild, continuous currents of electricity generated by wearing Harness's Electropathic Belt. Don't hesitate a moment, but sit down at once, lest you forget it, and write for the treatise, which will be sent you free by post.—Address, Mr. C. B. Harness, Consulting Electrician, the Medical Battery Company, Limited, 52, Oxford-street, London, W. (corner of Rathbone-place).

A REMARKABLE diamond was exhibited at a recent meeting of the New York Academy of Sciences. It was a compound or multiple crystal, containing a large number of twinnings. It is of the class termed "extreme durate" by the French. It had been cut into the general shape of a brilliant, and its main face or table was then placed on a polishing wheel. It was kept there for 100 days, the wheel revolving at the rate of 2,800 revolutions per minute. The diamond was held upon the rotating surface at a distance of about 15in. from the centre. Based on these figures, a calculation shows that the surface passed over by the diamond amounted to 75,000 miles, or nearly three times the circumference of the earth. Yet was all futile, as the stone would not acquire a polish. The ordinary weight placed on a diamond while on the wheel is from 2¼lb. to 2½lb. This was increased by 4lb. and 8lb. without effect, and finally 40lb. was used. The wheel was badly damaged, the diamond ploughing into it and throwing scintillations in all directions. The diamond, even under these conditions, could not be given a commercial polish, and the wheel had to be replaced.

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Messrs. JAMES W. QUEEN and CO., of 924, Chestnut-street, Philadelphia, are authorised to receive subscriptions for the United States for the ENGLISH MECHANIC, at the rate of 3 dols. 25c. gold, or Thirteen Shillings per annum, post free. The copies will be forwarded direct by mail from the publishing office in London. All subscriptions will commence with the number first issued after the receipt of the subscription. If back numbers are required to complete volumes, they must be paid for at the rate of 4d. each copy, to cover extra postage.

Vols. IV., VII., XXVI., XXX., XXXII., XXXIV., XXXVI., XXXIX., XL., XLI., XLII., XLIII., XLIV., and XLV., bound in cloth, 7s. each. Post free, 7s. 9d.

All the other bound volumes are out of print. Subscribers would do well to order volumes as soon as possible after the conclusion of each half-yearly volume in February and August, as only a limited number are bound up, and these soon run out of print. Most of our back numbers can be had singly, price 2d. each, through any bookseller or newsagent, or 2½d. each, post free from the office (except index numbers, which are 3d. each, or post free, 3½d.).

Indexes for Vols. VI., VII., and IX., 2d. each. Post free 2½d. each. Indexes to Vol. XL., and to subsequent vols., 3d. each, or post free, 3½d. Cases for binding, 1s. 6d. each.

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⁂ It must be borne in mind that no Displayed advertisements can appear in the "Sixpenny Sale Column." All advertisements must be prepaid; no reduction is made on repeated insertions, and in cases where the amount sent exceeds One Shilling, the Publisher would be grateful if a P.O.O. could be sent, and not stamps. Stamps, however (preferably halfpenny stamps), may be sent where it is inconvenient to obtain P.O.O.'s.

The address is included as part of the advertisement, and charged for.

Advertisements must reach the office by 1 p.m. on Wednesday to insure insertion in the following Friday's number.

Holloway's Ointment.—Sores, wounds, ulcerations, and other diseases affecting the skin, are capable of speedy *amendment* by this cooling and healing Ointment, which has *called forth the loudest praise from persons who had suffered for years from bad legs, bad breasts, piles, abscesses, and chronic ulcers, after every hope of cure had long passed away.*

NOTICE TO SUBSCRIBERS.

Subscribers receiving their copies direct from the office are requested to observe that the last number of the term for which their subscription is paid will be forwarded to them in a PINK Wrapper, as an intimation that a fresh remittance is necessary, if it is desired to continue the Subscription.

Epps's Cocoa.—Grateful and Comforting.—"By a thorough knowledge of the natural laws which govern the operations of digestion and nutrition, and by a careful application of the fine properties of well-selected COCOA, Mr. Epps has provided our breakfast tables with a delicately flavoured beverage which may save us many heavy doctor's bills. It is by the judicious use of such articles of diet that a constitution may be gradually built up until strong enough to resist every tendency to disease. Hundreds of subtle maladies are floating around us ready to attack wherever there is a weak point. We may escape many a fatal shaft by keeping ourselves well fortified with pure blood and a properly nourished frame."—*Civil Service Gazette.* Made simply with boiling water or milk. Sold only in packets, by Grocers, labelled—"JAMES EPPS and CO., Homœopathic Chemists, London."—Also makers of Epps's Afternoon Chocolate Essence.

OUR EXCHANGE COLUMN.

The charge for Exchange Notices is 3d. for the first 24 words, and 3d. for every succeeding 8 words.

Good Value Offered (cash or instruments) for all kinds of Scientific Appliances.—CAPLATZI, Science Depot, Chenies-street, near British Museum. Estab. 1862.

Silvered Glass Specula.—A few of my choicest reserves only left. Exchange Scientific Apparatus.—WITH, Hereford.

Wanted, 2 Manual-organ **Keyboard**, double Soundboard (about 6 stoppe'), bellows, &c., thoroughly sound and cheap. Exchange Musical Instrument, Cigars.—HOLT, Ormskirk.

52in. **Bicycle**, by Coventry Machinist Company, hollow forks, all latest improvements. Exchange for Half-horse Boiler or offers.—ROBINSON, 100, Stockwell-road, Brixton.

Dynamo 60 candle-power, Siemens laminated armature, series wound, in perfect working order, equal to new. What offers?—C. A. BEAL, Westgate, Peterborough.

One horse-power vertical **Engine Castings**, with all forgings complete, pump, flywheel, bored, parts of castings planed, cost over £4. Wanted, View Lens for 10 by 8 camera, or offers.—C. A. BEAL, Westgate, Peterborough.

Gas Engine, 1-horse, vertical atmospheric, by Crossley Bros., in good working order, with water tank and pipes complete. Offers.—W. HUTCHINSON, Liversedge.

Two 5 doz. **Partition Wood Cupboards** for bottled wines, roller doors panelled. Large dining table, 13ft. by 4ft., suitable for board room.—WILKS, Burnley.

Lawn Mower, 8in. grass box, complete, cost 50s., now worth 40s. Exchange Jewellery.—Offers to W. SMITH, Bilston-road, Wolverhampton.

Safety, light Rover type, wanted. Exchange old VIOLONCELLO, recently repaired and purfled, unvarnished, splendid tone; Magnetic Battery, powerful magnet (medical); 54in. ordinary Bicycle, roller bearings, suit learner; Salvo Tricycle, wheel buckled. Exchange all or any of above to value offered, for Safety, or decent Lathe and Tools or offers.—S. HADFIELD, 2, Lime Villas, Kingston-road, New Malden.

Wanted, Kangaroo or Safety Bicycle in exchange for ½H.P. Vertical Steam ENGINE, 22in. plate Electrical Machine, and Hearder's Improved Galvanic Machine.—W. E., Inquiry Office, Shirley-street, Hove.

Marion's Academy **Phtographic Outfit**, takes 12 instantaneous photographs, 1½in. square, without changing plates, includes camera, dishes, chemicals, leather sling case, &c., packed in polished mahogany locked box, scarcely used. Exchange for Dynamo or Boiler to value £4, or offers.—J. R. ELLIS, Trinity College, Cambridge.

Grand Model Tank **Locomotive**, 37½in. long, 5½in. gauge, 1½in. bore, cylinders 2½in. stroke, six wheels, coupled, steel link reversing motion, steel connecting rods, fitted with brasses, steel riveted and stayed boiler, 5 tubes, 1¼in. diameter, copper, internal firebox made to burn coal, spring buffers and steel working springs, strong and powerful, cost £60 secondhand. Photo. sent. Part exchange. Genuine bargain.—W. DOWNING, 295, St. Philip's-road, Sheffield.

Nearly ½-Horse Horizontal **Model Engine**, good workmanship, strong and powerful, will work lathe; also iron Vertical Boiler for same, with furnace and fittings. No use for them, £8, part exchange. Genuine bargain.—W. DOWNING, 295, St. Philip's-road, Sheffield.

Lady's **Work Box**, made of olive wood, lined blue satin, very handsome, cost 25s. What offers in exchange?—GOODYEAR, 3, Victoria-street, Spalding.

Sewing Machine, hand, chainstitch, warranted in perfect working order and equal to new. Exchange anything value 12s. 6d.—GOODYEAR, 3, Victoria-street, Spalding.

Wanted, half-plate bellows Camera, in exchange for a good 6 silver-keyed concert FLUTE, slide head, and a Camera Lucida.—P. LAURANE, Chapel-lane, Malahide, County Dublin.

About 2½ Horse-power Vertical Boiler wanted, must be in good condition. Will exchange rear-steering TRICYCLE, in good condition, and cash.—THOS. WALLIS, 1, Pensons-gardens, St. Ebbe's, Oxford.

Electric Motor Armature, 5½ by 2½, weight 30lb., ammeter, wire, and six ½-gal. chromic batteries, cost £7. Lathe offers.—21, George's-terrace, Canterbury.

Nearly new **Dove Aviary** and three **Hen Doves**. What offers in exchange.—E. B., 33, Westow-street, Norwood.

Large **Shocking Coil** in exchange for Coil Winder or ½in. spark coil. What offers?—WILLIAM TAYLOR, 37, Bishop-street, Dublin.

"**English Mechanic**," for 1880 1-2, unbound, clean. Exchange for Harmonium, Violin, Model Engine, Edward Ingham's Book, or what offers?—21, Backwebster-street, Dewsbury.

28lb. of 26 gauge covered cotton **Wire**. Exchange.—C. BELL, Metallurgic, Bexley Heath.

Electro Magnets, 11. Exchange, 6in. long, ¾ thick, Horseshoe.—Above.

Fretsaw Appliance, fit Britannia Company's 3in centre lathe, nearly new, cost 30s. Exchange for 3in. centre compound Slide-rest for Britannia Company's lathe or what offers?—46, Victory-street, Sheerness.

Lineman's Detector, Quantity and Intensity, and a single-pin-fire breech-loading Gun, excellent killer. Exchange. Bicycle wanted.—H. ANDREWS, 9, Marlbro'-street, Andover.

Wanted, "Chemical Society's Journals," "Chemical News," and Book on Australia, for "Smyth's Speculum Hartwellianum," &c.—GRAY, 42, Union-street, Aberdeen.

Boiler, 25in. long, 15in. diameter, and fittings, riveted with angle iron in corners. What offers? Stamp for reply.—ALFRED SEDGLEY, Witton-lane, West Bromwich.

Horizontal Slide-valve **Engine**, complete except bed, cylinder, 3½in. bore by 7½ stroke. No rubbish. Will exchange for good 50in. Bicycle.—R. SEDDON, Parr's-lane, near Ormskirk.

Carpenter's **Tool Chest**, cost 11 guineas, warranted tools new. Particulars on application. Offers. All letters answered.—A. DENNIS, 20, High-street, Chelmsford.

Cylinder **Electric Machine**, cost £10. Offers. Particulars on application. Photo. six stamps.—A. DENNIS, 20, High-street, Chelmsford.

Boat, with two paddles, sculling oar, mast, sails, rudder, boathook, painted and varnished any colour. Offers.—A. DENNIS, 20, High-street, Chelmsford.

Electric Light Battery, six cells, cost £3; two large Bunsen's Cells, in case, cost 15s. Offers.—A. DENNIS, 20, High-street, Chelmsford.

Will exchange **Eccentric Chuck**, 6in. diameter, 96 division wheel, for 3-jaw self-centring chuck.—WALKER, 11, Victoria-street, Glossop.

Gold Watch, 6 jewels, 18ct. gold dome, breguet spring, with second hand, only used as traveller's sample, for Safety Bicycle.—PIGOTT, Holywell-row, E.C.

A good 50in. **Bicycle**, ball bearings. Exchange for good Lathe. Will make up with cash.—JAS. PALMER, Junior, Austin Villa, Chepstow-road, Newport, Mon.

A Davis Period **Washing**, **Wringing**, and MANGLING MACHINE, 20in. rollers, nearly new, cost £5 5s. Offers in exchange.—CORA, 6, Albert Villas, Clifton-road, South Norwood.

High-class rear-driving **Safety Bicycle**, known Coventry maker, plated, balls, hollow throughout, quite new, latest 1888 improvements. Exchange Bicycle or Tricycle in part payment.—CYCLIST, 2, Ansford-road, Castle Cary, Somerset.

Electro-Plating, small plant, suit amateur, consisting of baths, batteries, two gallons silver solution and pint gold, tools and chemicals complete. Exchange to £2 10s. value.—J. S. A., 10, Bath-terrace, Boro., S.E.

Circular Saw, 12in, shaft, bearings and pulleys, 28in. single lathe wheel, crank treadle, 5in. Parallel Vice, wa[illegible] screw. Exchange.—W. SMITH, Bilston-road, Wolverhampton.

6in. **Lathe**, overhead motion, first-class machine, quantity tools; Vertical Engine and Boiler, cylinder 1 by [illegible] Wanted, Air Gun.—LEA, King-street, Melksham.

Camera, ½-plate, swing and reversible back, rising and falling front, conical bellows. £2 offers. See also Sale Column.—BATES, 27, Frog Island, Leicester.

Handsome ½-horse vertical steel Field **Boiler**, 50 tubes, 250lb. pressure, all fittings complete. Offers. Bargain. The engine if desired.—HARDWICK, Siddals-road, Derby.

7½in. centre 4ft. iron bed **Lathe**, face-plate, tools, treadle, &c., complete, 3 cwt. Bargain. Offers.—166, Siddals-road, Derby.

Wanted, **Photographic, Optical, or Electrical** APPARATUS, &c., for exchange on commission. Repairs on the premises.—See below.

The cheapest house for **Scientific Goods**, &c., is the SALE and EXCHANGE DEPOT, 2, King-street West, Manchester. H. W. Harris, agent.

Steam Washer, domestic, cost £3 3s. Booth's Mitre Machine, cost 30s. Both are new. What offers in exchange?—WM. HIGSON, Levenshulme, Manchester.

150c.p. **Dynamo**, fitted except drilling holes for bearings and wire for winding, in exchange for Lathe or offers.—Se[illegible]

80c.p. **Dynamo**, finished except armature, which wants winding, for Vice or offers.—G. G., 9, Canterbury-[illegible], Ball's Pond, London, N.

Hardy British **Ferns**, 24 varieties. Exchange anything useful. See Sale Column.—JOHN BURNS, Fellside, Kendal, Westmoreland.

Gramme Dynamo, 130c.p., Pacinotti ring armature, 16 sections, adjustable brushes, quite new. Offers in Electric Goods to WHITE, 17, York-street, Nottingham.

To Electrical Engineering Students.—Valuable STANDARD WORKS on Electrical and kindred subjects. Exchange for lathe or offers.—M., 59, Church-road, Homerton, E.

Small **Medical Coil and Battery**, in mahogany case, never been used. Exchange value 15s.—C. CHANDLER, [illegible] North End-road, Fulham.

Morse **Telegraph Instrument**, by Siemens, London, fitted with delicate relay, in good working order. What offers to F., 262, Brockley-road, S.E.?

THE SIXPENNY SALE COLUMN.

Advertisements are inserted in this column at the rate of 6d. for the first 16 words, and 6d. for every succeeding 8 words.

Fretwork.—Catalogue of every requisite, with [illegible] illustrations, free for 6 stamps.—HARGER BROS., Settle, Yorks.

New Illustrated Price List of **Screws, Bolts,** and NUTS for Model Work, drawn to actual size, sent on receipt of stamp.—MORRIS COHEN, 132, Kirkgate, Leeds.

Billiards or Bagatelle, or Requisites for [illegible] Billiard Work.—HENNIG BROS., High-street, London, W.C.

Woollen Cloths for men's and boys' suits, direct from the manufacturer, thus saving intermediate profits.

Woollen Cloths.—Patterns of new season's goods, fancy coatings, trouserings, hair lines, &c., post free on application.

Woollen Cloths.—Any length at [illegible] Write for patterns to CHARLES ARROW, Woollen Manufacturer, Piece Hall, Halifax.

Carbon Plates, best quality, c[illegible] and moulded, and capped; quality cannot be surpassed.—GEO. BLACKWELL

Pebble Carbon.—Graphite for [illegible]anche cells; splendid conductor; price very low.—GEO. G. BLACKWELL

Manganese Oxide specially prepared for batteries; high strength and purity, greater action; been in use 15 years with immense sati[illegible] 28lb. packets. Prices on application.—GEO. G. [illegible] Chapel-street, Liverpool.

Mica or Talc for all purposes.—R[illegible] and CO., 8, Mincing-lane, London, E.C.

No Flat Beverages.—See **Automat**[illegible] GAS GENERATOR. Illustrations free.—HOW, [illegible] street, London.

Wheel-Cutting and Dividing [illegible] meter, in brass only.—CLEGG, Belinda-street, H[illegible]

Planing to 12in. by 8in. Boring, [illegible] cutting, Slide-rests, &c.—CLEGG, as above.

Write for **King, Mendham, an**[illegible] new ILLUSTRATED CATALOGUE, 4½d. Ack[illegible] valuable to amateurs.

70 and 71 must be adopted. This is the ordinary telephone indicator, such as is used in telephone exchanges, and consists of an electro-magnet, *e e*, firmly screwed to the frame *f*, to one end of which is pivoted the shutter *s*. Above the magnet *e e* is the armature *a*, pivoted at *g*, and fitted at one end with the catch *c*, which engages with the shutter *s*. When a current passes through the coils of the electro-magnet its armature is attracted against the pressure of the spiral spring *t*, and the catch moves upwards, releasing the shutter, which falls over outwards by reason of its being set a little out of the perpendicular, thus disclosing the number printed on the card *h*. The tension of the spiral spring *t*, can be adjusted by the milled screw *m*. Fig. 70 is a side view of the indicator, and Fig. 71 a front elevation with the shutter down. Fig. 72 shows the lift cab fitted with a bell, and a four-drop indicator of the form just described. Reply keys are also shown at the bottom of the indicator, and likewise the connections to the springs on the top of the cab.

When fitting up a lift on the first-mentioned system a stout oak block (B, Fig. 73), must be fixed both at the top and bottom of the lift shaft, and the naked copper wires, one for each floor and one for each pole of the battery, stretched from top to bottom, the ends of the wires being fixed by metal pegs, after the manner employed for piano wires. The best method of fixing the pegs and wires is by employing the lift itself. Having got the wire and pegs together, get on top of lift cab and send it up to the top of the shaft till the top block is well within reach. Mark off on the block six points, leaving 2in. between each point and 2in. between the outside points and the ends of the block. Now with a gimlet slightly smaller than the metal pegs bore a hole at each of the marks, and drive in a peg, giving each peg two or three turns so as to cause it to bite. Next insert one end of the coil of wire (No. 14 B.W.G. uninsulated) in the hole in the end of the peg, taking two or three turns round it, and then having seen that the coil is likely to run out freely, start the lift slowly downwards, paying out the wire as it descends till the bottom block is reached, when the wire must be cut off, and the remaining wires brought down in a similar manner. When all the wires have been brought down, the bottom block must be marked off, bored, and pegs driven in after the manner described for the top block, and the ends of the wires put into the holes in the ends of the pegs. The pegs must then be turned round, tightening up the wires until they begin to stretch, when they will be perfectly tight. Care must be taken that the wires are quite parallel with the traverse of the lift, or the springs will not ride easily. If the lift has been properly erected it will be sufficient to hang a weight on the bottom of the first wire after it has been fixed at the top, and a mark made where it hangs, the others being marked off from this point.

Figs. 74 and 75 will be explained in the following article, when the connections to the shaft wires from the various apparatus will be shown, for which purpose Fig. 72 will be again referred to.

F. C. A.

(*To be continued.*)

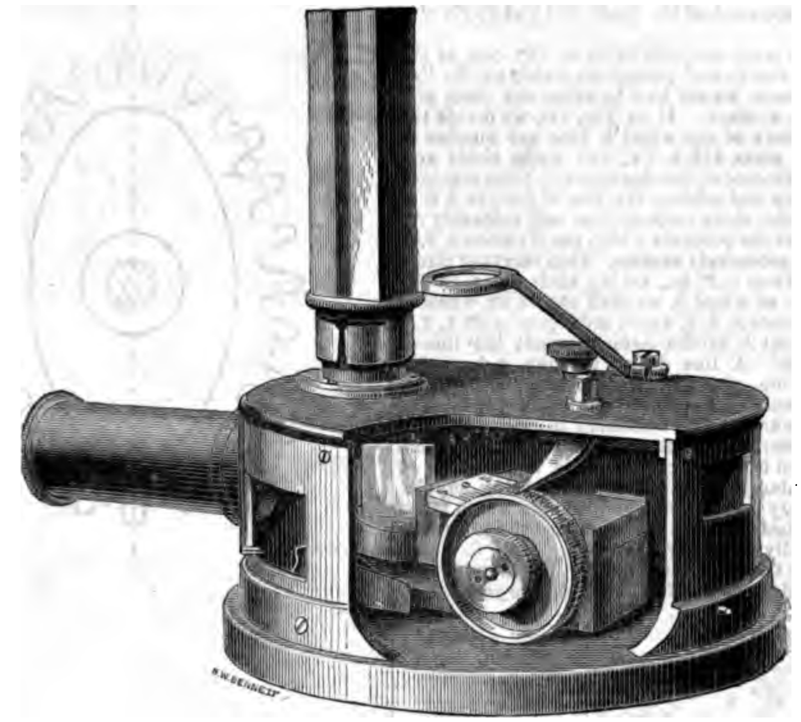
PHOTOGRAPHY IN COLOURS.

THE idea of obtaining photographs in colours—a successful process of heliochromy—is much older than many think, and, although we have had several false alarms, it is not unlikely that before long we shall hear some startling news from America in connection with the subject. At first sight it seems impossible to get the varied tints of a landscape produced direct by the sun on a sensitive plate in the camera, or, rather, to make a sensitive plate of such a character that when the sunlight has been allowed to shine on it a print can be produced by its means, which shall show the identical tints of nature; and it is certain that no one has yet succeeded in accomplishing such a feat, for the announcements of "photography in colours," which make their appearances periodically, refer only to some method of colouring the photographs. It is unlikely that the discovery will be made all at once; but it is not improbable that photographs in some colours will be produced; and, the initial difficulties overcome, there is no telling how far the patient researcher may succeed. We have from time to time published several papers by Mr. F. E. Ives, of Philadelphia, on isochromatic and orthochromatic photography, and he is well known as the inventor of the first commercially-successful method of producing what are known as process blocks—a method eclipsed apparently by the process devised by Meisenbach, of Munich, in 1882. Mr. Ives has been a patient labourer in the field of photographic invention for many years, and the first correct colour-tone photographs of objects in all colours were made by him in the laboratory of Cornell University in the summer of 1878. Those were made with collodio-bromide emulsion plates, sensitised with myrtle chlorophyl and an infusion of tea, and exposed through a light yellow medium. That is still the only process which will photograph the deep red pigments successfully, but it is troublesome to operate, and requires great delicacy. Lecturing recently before the Franklin Institute on the subject of recent advances in photography, Mr. Ives traced the history of photo-mechanical engraving, and incidentally mentioned that, in a single establishment in Philadelphia, 3,000 process plates were made during the past year, critics admitting that process plates, which cost only about one-third as much as wood engravings, are quite equal to them in quality. The important part of the lecture, however, related to photography in colours, and in that Mr. Ives said that there are two distinct methods of making colour photographs—in one, the colours are produced directly by the action of light upon a peculiar silver compound; in the other, no colours are produced, but the action of light upon colour-sensitive plates is made to regulate the distribution and combination of colours which constitute the final picture. By both methods the blues, greens, yellows, and reds of an object are represented in a general way by colours of those hues. It is not generally known that the idea of photographing in colours is older than photography itself, the first recorded observation having been made in 1810 by Dr. Seebeck, of Jena. The doctor says that when he directed the spectrum of a faultless prism on white chloride of silver spread upon paper and still wet, through an opening of about five to six lines in the shutter, and to the distance where the yellow just meets with blue, and kept it in that position from fifteen to twenty minutes, he found that the chloride had become red-brown in the violet; in the blue of the spectrum the chloride of silver became true blue; in the yellow the chloride was mostly unchanged; but in the red it had taken the red of the rose. Sir J. Herschel, in 1839, refers to this matter, or to similar experiments, and E. Becquerel, 1848, Nièpce de St. Victor, 1851, Poitevin, 1865, and St. Florent, 1873, all made advances; but the results obtained were never of any practical value, the process being so insensitive as to require hours of exposure to secure camera pictures illuminated by direct sunlight, while the colours cannot be fixed. Permanent pictures have, however, been made by the second method, which, it appears, was originally suggested by Mr. H. Collen in 1865. He was teacher of drawing to the Queen, and does not seem to have done more than formulate a theory in language not too accurate, but which was sufficiently so to explain his meaning to those familiar with the subject. Ducos du Hauron, of Paris, attempted to practise the process by employing plates sensitive to all colours, and filtering the light through suitably coloured glass. The methods of Collen and Hauron were based on Sir D. Brewster's hypothesis of the nature of light—that there are three primary colours, and that all others are combinations of those three in different proportions. That hypothesis being erroneous, for no part of the spectrum can be truly reproduced by the optical combination of other parts, it is not surprising that, neither Collen's idea nor Hauron's (for the latter worked it out) failed to lead to success, for at best it merely divided the spectrum into three parts, each represented by one negative only, and the final result was represented by a single type colour. A heliochrome made by Hauron's method would be black where it should be red, and red where it should be yellow, and although experimenters succeeded better than Hauron, reproducing many pigment colours very well, their processes have been abandoned as unreliable, and "impossible" has been written as to photography in colours. Mr. Ives, however, has persistently pursued the research, working on the view that a heliochrome process to be practicable must be capable of counterfeiting the spectrum itself, and it is such a process that he recently described for the first time before the Franklin Institute. He rejects the hypothesis of the primary colours, and does not attempt the impossible feat of actually reproducing each ray of simple colour; but he makes each select automatically and definitely, such a combination of type colours as will counterfeit it to the eye. By way of illustrating the principle of his process, Mr. Ives analysed various bright colours by means of a projection spectroscope, and found that aniline yellow, which counterfeits the yellow of the spectrum, is really a perfect mixture of all colours except blue and violet. Similarly aniline green is a mixture of green, blue, and deep red. To carry out his process the requisites are—in his own words—"(1) Transparent coloured solutions, which counterfeit three simple spectrum colours, and can be made to counterfeit all others by mixing in different proportions. I call these my 'reproduction colours.' (2) Photographic plates sufficiently sensitive to all parts of the visible spectrum. (3) Means for filtering out, in a strictly accurate manner, such coloured rays, and in such quantity or proportion as may be required. (4) A camera that will produce three negatives simultaneously of exactly the same size, and from the same (or very nearly the same) point of view. (5) Means for producing from the three negatives pictures coloured by the three solutions described above, and means for combining the three coloured pictures." The means for filtering out the coloured rays are colour-screens prepared in the manner described in No. 1,051, p. 229, and Mr. Ives's latest process consists, to describe it briefly, in making three negatives on colour-sensitive plates, which are exposed simultaneously in a triple camera, behind light-filters carefully adjusted to transmit to each plate just the kinds and quantity of light to cause the resulting negative to make a coloured picture, which, combined with two other coloured pictures produced in the same manner, will counterfeit the colours of the spectrum. Each spectrum colour that cannot be counterfeited by one reproduction colour must, of course, be repsesented by two negatives in such a manner as will secure a definite and suitable combination of two reproduction colours in the final result. For the present we need not follow Mr. Ives into such practical details as he has published, for no one knows better than he the difficulties that surround his process or any other; but may be said that, after nearly rs of research, he has got so near raphy in colours as to encourage on. The amount of labour in- the adjustment of the colour- enormous; but when once accom- is done for all time. The pictures ade in either pigmented gelatine, y lantern slides from the negatives projected by means of a triple tern and light of three colours—in method each negative is repre- the reproduction colour counter- t which has been most active in tion. The greatest difficulty is d in obtaining sets of negatives posure, development, and intensity ertain essential relation to each ut difficult as it may be to some of its details, Mr. Ives ex- elief that his process may be so that it will not only counterfeit all s of nature, but be really practical ds of those who are properly in- nd equipped. Obviously the pro- be expensive, but for certain work eat value—notably for the illustra- ctures by travellers, and Mr. Ives y expresses the opinion that the t far distant when that much will fully accomplished. It is evident least, having gone so far, is deter- render photography in colours a t success if possible before the loses.

HE OMNI-TELEMETER.

nstrument was designed by the late William Dredge to give distances by triangulation without calculation, using inside or outside angle. s have been adopted for military and surveying; but no instrument we mbraces so many alternative, and, at time, simple, methods of use as this is an advance on the "Simplex Range d Optical Square," which we de- No. 1175, p. 105 (a diagram on which s to explain the principle), and as it equire an exact right angle at one base to be laid out, it can be used ly; for by means of a compensating the opposite side of the circular box icrometer screw, coincidence can be between the direct and reflected otwithstanding they are 5° or 8° re- m 90° (the right angle): in all, a f 16° is thus obtained for choice of end of base on which to make co- with the object. Where the ground a base can be laid out is not very he outside angle of the triangle is by observing a distant natural object k—such as a tree, rock, &c.—nearly ngles to the objects to be measured. looking through the eyehole of t, or though the telescope shown ration, the compensating screw o is turned until the mark and t coincide by direct and reflected distance of 50 yards (or some of it) is then laid out in the as the mark, and at the exact spot d of the line, chain, or tape, when in t, the observer turns the micrometer il the object and mark are seen to d by reflected and direct vision. The then read off the index, and on refer- e table affixed to the instrument the l be found in a column opposite. This sent yards, mètres, &c., according to urements used on the base, and in- ges from 228 to 7,538 units. As any of 50 can be used for the base, pro- e same is also used on the range re- ollows that any distance from 30 yards visible distance can be taken, pro- e ground permits of the object being both ends of the base (constricted or as the case may be).

ined positions the inside angles are and distances obtained at sight by igning a man or picket at the end of the object (seen either by direct



vision or reflection). All that has to be done is to carefully set the instrument to its zeros, and look at the other end of base, then turn the micrometer screw until coincidence is obtained; without taking any notice of this reading, the compensating screw is now turned until pointer seen in figure is immediately over the line around micrometer head. The observer leaves a picket or man in exact position he occupied, and proceeds to the other end of base; there he looks at the object and turns the micrometer screw until he reflects the picket or man on the object. The number read off on the micrometer head will show on reference to the table fixed to base of instrument the exact range. The clever part of this arrangement is the mechanical correction or automatic addition of the two angles, so that not only can two angles, *neither* of which are right angles, be used, but only one reference to the index is necessary, and the distance of objects is obtained without calculation. One revolution of the micrometer head screw is equal to one degree (*i.e.*, by reflection two degrees), and as this is divided into 100 parts a very close reading is obtained. Mr. Coles, of the Royal Geographical Society, author of "Hints to Travellers," has thoroughly tested this instrument, and speaks in high terms of it, and the certificate from Kew Observatory, which we have also seen, vouches for the scientific accuracy. Mr. J. H. Steward, optician, 406, Strand, London, is the maker and joint patentee of the instrument. The omni-telemeter will also give vertical heights and horizontal distances by using a fixed angle, or it will take ranges without measuring the base. Now that a competition of range-finders is about to be carried out by the military authorities, as announced in the Scientific News last week, this subject has a special interest.

GEARING.—XVII.

Variable and Other Gears.

HAVING now described the usual methods of designing the correct profiles, both of pitch surfaces and of tooth curves, I purpose presently discussing the methods of formation of set gears. But before doing so, perhaps it will be desirable to give a brief summary of some of the more special applications of toothed mechanisms to the production of variable, intermittent, and reversing motions. There are some machines of a complicated and very automatic character, in which some of these gears find an appropriate place, notwithstanding that they are out of the common practice of engineering. For many classes of motion the choice can only lie between these and cam arrangements.

Bearing in mind that speed and radius are always in inverse ratio to each other, and that contact must always take place on and near the line of centres, there is no special difficulty in constructing gears of this kind in order to produce any required variations in velocity.

Should it be required to obtain an intermittent rotary motion between parallel shafts, so that a uniformly rotating shaft shall transmit motion, now faster, now slower, to its fellow, such variation to occur at regular and measured periods—the choice lies between equal star-shaped, triangular, and elliptical gears. In square and star-shaped gears there will be eight periods of maximum and minimum speed, in triangular gears there will be six, and in elliptical gears four.

The outlines of the square and star-shaped forms of gears depend on their velocity ratios. In order that they shall have continuous contact without slip, evidently the pitch surfaces must be of the same length. In square gears this can only be possible when there is a rounding off of the corners to a definite amount, the radius of curvature being equal to half the distance *b c* in Fig. 114. For if the disproportion between the distances into which the pitch point *c* divides the line of centres *a b* were greater than that shown in the figure, then the radius of curvature of the corners of the wheels would be less, producing a corresponding

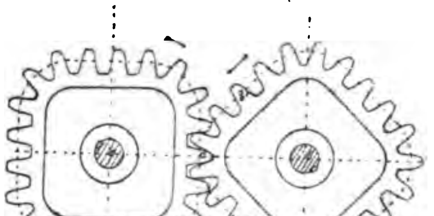
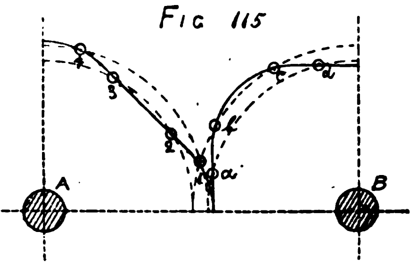


Fig 114

Fig 115



hollowing out of the flanks and yielding a *star gear.*

The pitch surfaces being in any case of the same length and contact occurring on the line of centres, we see how to adapt one pitch profile to another. If, in Fig. 115, we divide the periphery of one wheel A into any number of equal parts, 1, 2, 3, &c., and strike circle arcs from its centre, passing through these points of division and cutting the line of centres A B at 1', 2', &c., these intersections will evidently represent the positions which the divisions 1, 2, 3, will successively assume. Then carrying circle arcs from 1', 2', &c., taking their centre in the centre of wheel B, we shall obtain on wheel B the points *a*, *b*, *c*, which must gear with 1, 2, 3 on wheel A, as the latter intersect the line of centres. A line drawn through *a*, *b*, *c* will, therefore, give the profile of the pitch surface of wheel. I have not shown many points in the figure, to save confusion in lines: in practice, more intersections would be taken. This method is evidently applicable to any form of irregular gear, the one profile being supplementary to the other—a principle which must be strictly adhered to; otherwise the teeth will partially or wholly leave gear.

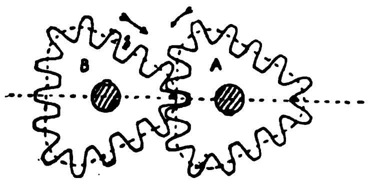


Fig 116

The triangular wheels, Fig. 116, may be considered a modification of the square gear. The outlines are those of two equilateral triangles, with corners rounded off. In the figure, if A is the driver, B is in its position of minimum speed. There are, therefore, three such speeds, and again, three others when the contrary conditions obtain, as the rounding corners of A come into contact with the flat sides of B.

Evidently in certain positions there is a tendency in such wheels to leave gear as the projecting corners begin to recede from the flat sides. In Fig. 114 this tendency would begin to operate at *c* if the wheel *b* were the driver, and also at *a* in Fig. 116 if wheel B were the driver. This can be prevented by making the teeth of sufficient length, as drawn, to fully engage with each other until the next favourable section for driving comes round, which begins at *b* and *b'* in the figures. The tooth lengths most suitable can be obtained by experiment. Properly, also, the shapes of the tooth profiles should alter with every difference in curvature of the pitch surfaces.

Fig. 117 shows elliptical gears centred midway between the foci, giving four distinct variable speeds. Here also the teeth need to be long, and the ellipses broad at the ends; otherwise pins and catches would have to be put on the faces of the wheels to prevent them from leaving gear between *a* and *b*, A being the driver.

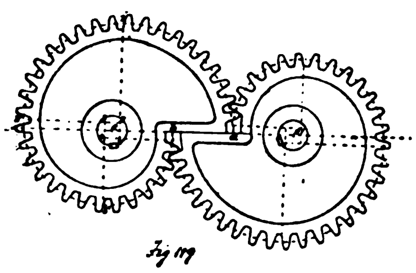


Fig 119

The ellipse supplies a means of obtaining a *quick return.* In this case the foci become the centres of motion; one being fixed, the other movable in space. The movable focus becomes the centre of radius of the connecting rod by which the quick return is imparted to the slide or table, as the case may be. Thus in Fig. 118, let A be the centre of motion of an *elliptic* wheel A' rotating with uniform velo*city in the direction of its* arrow, and let B be the centre of motion of a second equal wheel B' driven by A' In the position shown by the full lines, B' will be driven at its slowest speed, its greatest radius being on the line of centres A B. Presently A' will have come round into the new position A'', and then B'' will be moving at its maximum speed. An intermediate position is also shown, at which the minimum speed for B' is just finished, and the maximum about to commence, the centre of B', it will be noted, has moved along to *b*. Such gears should work in a horizontal plane, and means be adopted for keeping the teeth in contact, or the wheel with movable centres should be above the other.

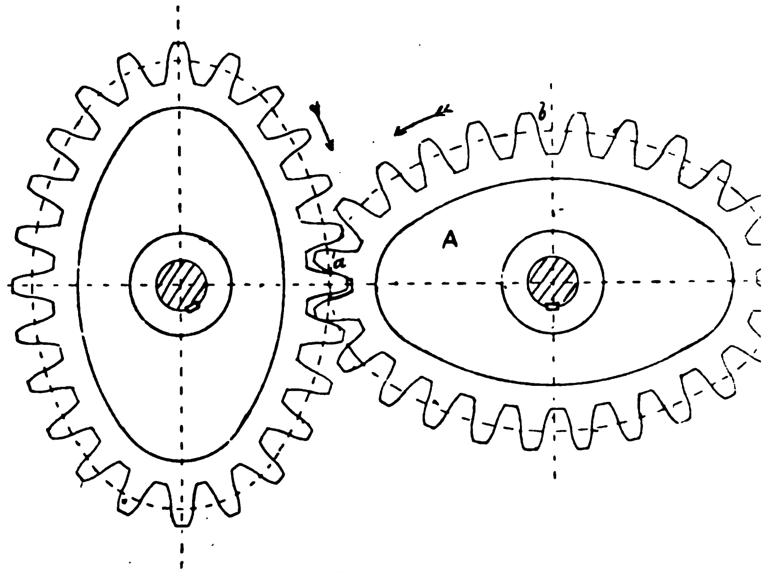


FIG. 117.

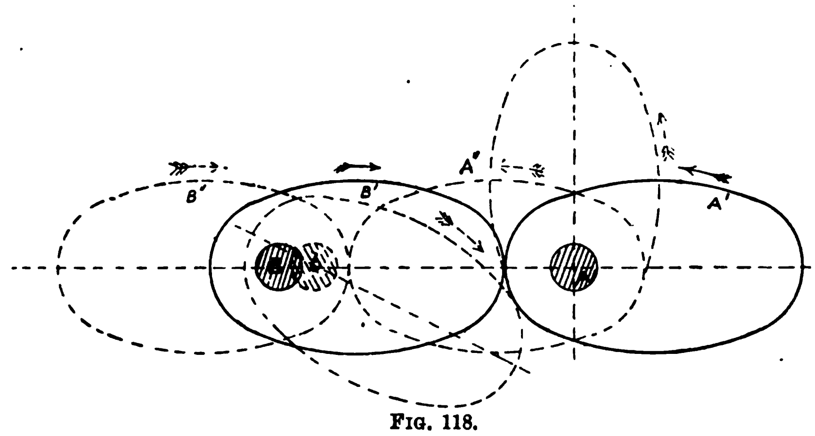


FIG. 118.

Fig. 119 shows a scroll gear in which the speed is gradually varied during one complete revolution. It is struck out as follows:—*a b* in the figure represents the amount of variation in speed between the two gears. Construct a rectangle 1, 2, 3, 4, the length of each side being equal to one-fourth of the distance *a b*. From 1 as a centre, with a radius 1*a*, strike the arc *a*, 1'; from 2, with radius 2 1', strike the arc 1' 2'; from 3, with radius 3 2', strike the arc 2' 3'; and from 4, with radius 4 3', strike the arc 3' *b*. Two such scrolls whose centres are at *c c'* will then work together with a variation in speed whose limits are fixed by the positions of *a* and *b*.

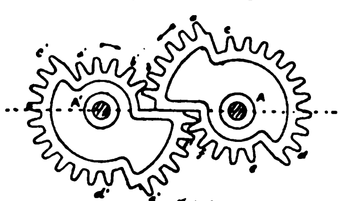


Fig 120

Fig. 120 represents the application of a method which is capable of affording a wide range of different, though uniform, speeds. It is termed a sector gear. In the figure there are three distinct velocity ratios. The arc *a b* driving the arc *a' b'*, A' has a rotation more rapid than that of A; *c d* driving
movement of the gears is equal; *e f*
e' f', the rotation of A' is slower than t

IMPROVEMENTS IN INDU COILS OR TRANSFORMER

As considerable attention is being
the construction of what are k
the electrical world as "transform
illustrate the device recently pate
Messrs. Zipernowski, Deri, and Bl
Budapest. The patentees have ta
patents for several devices of the kin
the most recently published they say t
found that to attain the best possible
with transformers with an iron core o
oval, or polygonal shape closed upon i
core, instead of being made of iron wir
preferably be made out of narrow and
iron ribbon. The iron ribbon is coi
suitable form or disc and subjected, du
ing to a considerable pull, for insur
plete filling out of the volume at
Preferably a ribbon of insulating
(paper tape or the like) of about equa
with the iron, is coiled up together
thus insulating the consecutive laye
from one another. The ends of the ir
are secured by soldering or riveting
adjacent layers. In this manner an el
ring or disc of iron ribbon is produced
able number of such discs are supe
constitute the core of the induction
ferably with an insulating sheet (pape
suitable tissue) interposed between
adjacent elements. A core built u
manner is shown in Figs. 1 and 2. T
of a sheet of iron of suitable breadt
in one piece the whole of the core,
answer the same purpose, as such a
of iron cannot be manufactured of
degree of thinness as a narrow ribbon
Foucault current in a broad strip will
much more energy than in a numbe
ones. The iron ribbon should be abo

Fig 1

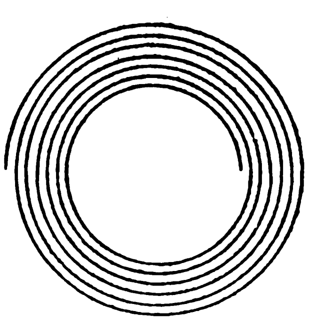


Fig. 2

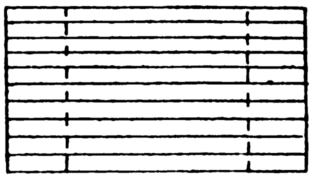


Fig. 6.

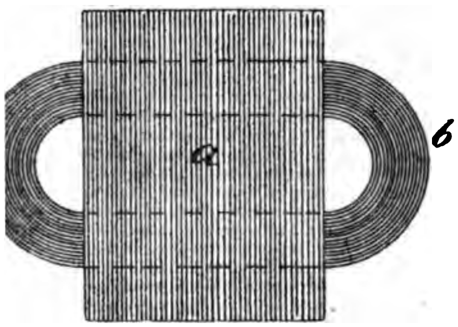


Fig. 3.

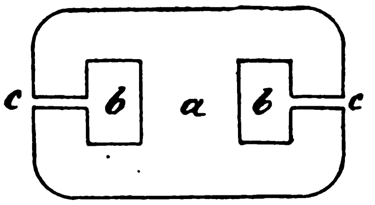


Fig. 4.

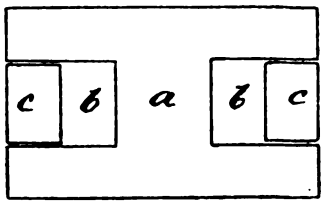
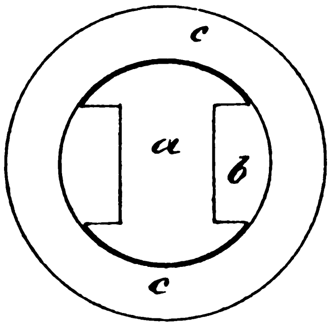
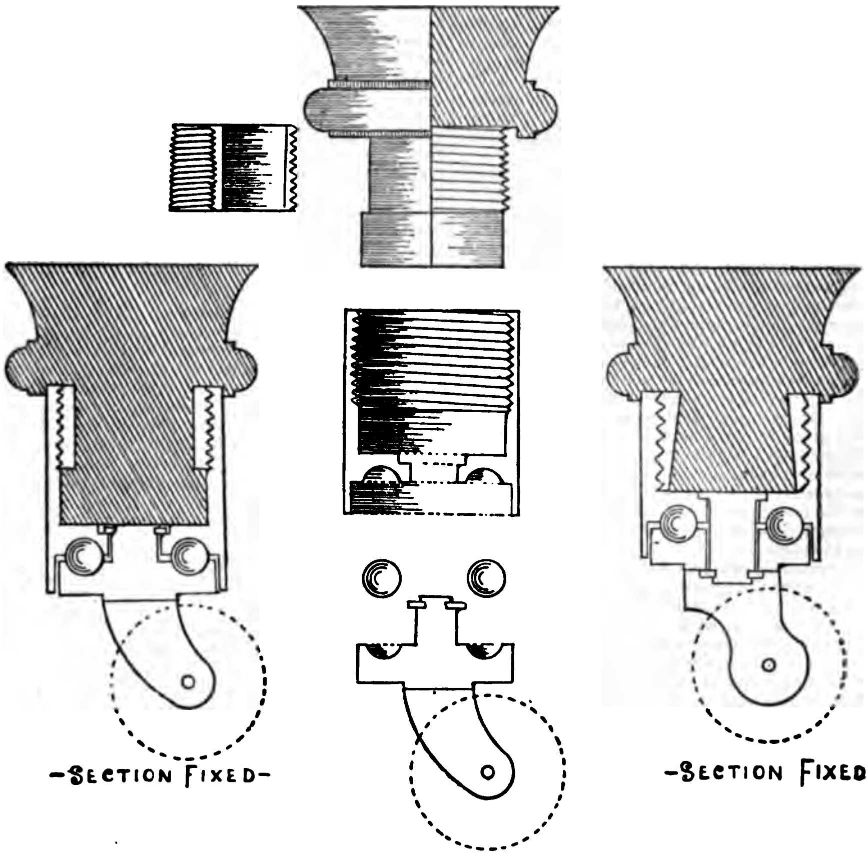


Fig. 5.



ık, and from ½ to ¾in. in breadth, but the ensions vary according to circumstances.

he second part of the invention relates to erent modes for facilitating the coiling of copper conductors in transformers consist- of a circular, oval, or polygonal coil com- d of the primary and secondary conductors, e being for the greater part inclosed by iron ıts of a suitable form. To facilitate the ding of the coil and avoiding the necessity assing the copper wires through the open- formed in the iron sheets, they provide in sheet *a*, Fig. 3, narrow slits such as *c*, ugh which the copper wires can be introd sideways into the opening *b* intended to l them. Or there may be iron sheets of the a indicated in Fig. 4, the wide openings, r winding on the coils, being filled up with able pieces *c* of sheet iron. In Fig. 5 there own yet another arrangement for accom- ing the same object. There is a core com- d of double T-shaped sheet iron pieces *a* n the middle part of which the coils are nd into the space *b*, whereupon the whole ıt into a closely fitting outer shell *c*, which so made up of superposed sheet iron rings. external form as well as the meeting sur- s of the inner core and of the shell may be ylindrical, conical, prismatical, or pyramidal e. Fig. 6 is a plan showing the exterior arance of a transformer made according to ı. 3, 4, and 5—*a* denoting sheet iron and *b* copper coil. The last-described arrange- t may also be executed in multipolar form, inner core being of a star-shape, and each e being wound with a coil of copper wires, le the external shell is made to fit closely n the several arms. In all these forms of sformers the sheets of iron may or may not nsulated from one another by a suitable in- ting material.



KINSON'S SELF-FIXING CASTORS.

N ingenious form of self-fixing castor has been devised by Mr. Henry Rickinson, of ngham, who has entered it at the Patent e. The construction will be readily understood by glancing at the annexed illustrations. The ends of the legs to which the castors are to be attached are turned wider at the lower end, or with a shoulder, and a cylindrical screw cut in halves perpendicularly is placed round the wood. The castor screws on to the cylindrical pieces, as shown, and is firmly held without pins or rivets. The leg being counter-sunk, the castor fits the leg without showing where it joins the wood. The castor itself revolves on balls running in grooves in the lower end of the socket and in the circular plate bearing the arms for the wheel. The circular plate fits into the end of the socket, which is counter-sunk to receive it, and is fixed by a rivet passing through the circular plate and the socket, and clenched by means of washers, as shown. It will be seen that by this arrangement the wheel is brought more directly under the leg, and there is consequently less strain on the arms, while the whole arrangement revolves freely in both directions. We understand that these castors can be seen at Mr. Johnson's, 13, Wellington-street, Islington.

BLEACHING IVORY, BONE, AND FEATHERS.

IVORY and bone are both strongly affected by acid, as well as by alkaline fluids, consequently for the purpose of bleaching them we must on this account use only bleach baths of a neutral reaction. Ivory requires no preparation for the bleach bath; on the other hand, bones must be freed from fat and any fleshy or other particles, whether it be by treatment with soda solution or benzine. The bleach bath is prepared from a solution of hydrogen peroxide, by the careful addition of ammonia in such a manner that when red or blue litmus paper is plunged into it the same remains unchanged, a very small acid quality being less injurious than alkali. Into this neutral bleach bath the bones or the ivory are plunged, and allowed to remain for twenty-four hours therein at a temperature of 30° to 34° C. (86°—93° Fahr.) After the same have passed through a second equal bleach bath for twelve hours, at the lower temperature of 20° C. (68° Fahr.), they must be slowly dried in the air, and when practicable in sunlight. The advantageous action of sunlight, for these substances especially, cannot be too highly recommended.

Raw ostrich feathers are not all equally suited for the process of bleaching. Of those generally met with, only one portion can be used for the production of half-white, the other portion alone for that of pure white feathers. The carefully-sorted and selected feathers must first of all have all grease and dirt removed from them. For this purpose they must be treated with soap-and-water, and afterwards with the assistance of a soft brush.

These operations must be continued until they become easily moistened with the water, when they must then be left for some time in clean water. In order to remove all fluids from the feathers they should pass through a centrifugal machine. Twenty litres of hydrogen peroxide are placed in a longish wooden tub with 450 grammes of ammonia 20° B. = 0·98° sp. gr., mixed together, and then heated by means of a closed leaden coil up to 34° (93°Fahr.) Into this fluid place 5 kilos. of the cleaned feathers, stirring the same with the hands every hour. The bleaching is completed in 24 hours. If an absolute white is desired, a second bath is then recommended, allowing the feathers to remain in the same for a shorter time. When the bleaching is completed, the feathers should be carefully removed and placed in a cold-water bath, composed of 100 grammes of sulphuric acid 66° B. to each 100 litres of water. In this bath they are allowed to remain for one and a half hours, when they must be plunged into clean, soft water, and thoroughly rinsed out. The damp feathers should then be drawn through a starch milk (not paste), somewhat tinged with aniline blue, and then finally exposed to the slow-drying process, either in the open air or in a drying-room, taking care to shake them occasionally in order to avoid any adhesion of the small fibres. After removing the starch by shaking, the feathers can then undergo the usual manipulation of curling and burning.—*Königswarter und Ebell.*

THE GREENWICH VISITATION.

THE annual visitation of the Royal Observatory at Greenwich was was made last Saturday, when the report of the Astronomer-Royal was presented. The visitors, amongst whom were Profs. Stokes, M.P., president of the Royal Society, Sir G. B. Airy, Lords Rosse and Rayleigh, Profs. Cayley and Adams, Messrs. Common and De La Rue, and Miss A. M. Clerke, inspected the new buildings, and when the report was handed round expressed much dissatisfaction that the Government is still "considering" the advisability of supplying Greenwich with a telescope for photographing stars. The extension of the computing rooms, referred to last year, has been carried out, and the whole of the staff of the astronomical department are located in two rooms, with means of ready communication between them. On the top of the extended rooms a dome 18ft. in diameter (covered with papier-mâché) has been erected, in which it is intended to mount an equatoreal and photoheliograph. This dome will be available for a photographic telescope in the event of the Government deciding that Greenwich shall take a share in the work of charting the heavens, as proposed by the Paris Conference, and for which 13 observatories have already ordered telescopes.

The subject of railways in proximity to the Observatory was once more brought into prominence by a proposal to construct a tunnel under Blackheath in connection with the Bexley-heath Railway. On five nights observations were made to test the effect of the trains on the South-Eastern line on a special class of observation (the image of the wires of the transit instrument, as seen by reflection from a trough of mercury). The result showed that tremor from trains in the tunnel between Blackheath and Charlton (about a mile distant) caused the image to disappear; and as the proposed tunnel was to pass within 570 yards of the instrument, the Government opposed the Bill, and the Blackheath route was abandoned.

The personal equation instrument was used to determine the variation of observers' personality due to change of rate and direction of motion. From a discussion of the observations, Mr. Turner (chief assistant) found that, as a rule, the variation due to rate was very small, and that due to the direction of motion agreed with the results obtained with a reversion-prism eyepiece. It is now proposed to use the instrument for testing the personality in observing the preceding and following edges of the sun and planets.

The transit-circle has been used, as in former years, for observing the sun, moon, planets, fundamental stars, and all stars in Groombridge's catalogue not observed at Greenwich since 1867. In 1887 about 1,900 stars were observed—i.e., about 760 more than the average of the preceding 17 years. The errors of the instrument having become inconveniently large, the bearings were cleaned and readjusted. The cloudy weather during the first four months of this year interfered with observing; nevertheless, 5,304 transits and 5,067 zenith distances—i.e., about 1,000 more than the average of the preceding 18 years—were observed. The current reductions and the annual computations relating to observations with this instrument are well advanced—in fact, rather more so than usual.

The computations for the ten-year catalogue of stars are in a forward state, and there seems every probability that before next visitation a considerable part of the catalogue will be in print. In the first 18 hours of right ascension there are 2,875 stars; the corresponding number in the last published catalogue was 1,656.

As a rule, the altazimuth has, during Mr. Christie's time, been used only to secure observations of the moon when its proximity to the sun rendered observations with the transit-circle impossible; but last winter, in the absence of suitable subjects for equatoreal observation, the instrument was used throughout the lunation. The moon has been observed with it on 74 nights, and the observations are completely reduced to the end of the last lunation.

The equatoreals have all been kept in good working order, and the 30ft. dome of the Lassell reflector seems to be in an excellent state, as it can be turned completely round in 30 seconds. With one or more of the equatoreals, 24 occultations of stars by the moon (double the average of the preceding 17 years), 18 phenomena of Jupiter's satellites, and three comets (on 12 nights) have been observed. In common with many directors of observatories, the Astronomer-Royal has to lament the fact that clouds almost set at naught his elaborate arrangements (with nine instruments) for securing observations of the small stars occulted during the lunar eclipse of January 28 last.

The Sheepshanks equatoreal has been devoted to experiments in stellar photography, to determine the extent of field available on curved and plane plates. The experiments show that the advantage derived from the use of curved plates is very doubtful, and that the images on plane plates are good enough as far as 2° from the centre.

With the spectroscope attached to the 12¾in. equatoreal, 333 measures have been made to determine the rate of recession or approach, in the line of sight, of 16 stars; and certain stars have been observed for Mr. Lockyer.

Photographs of the sun were obtained on 205 days of the 356 ending May 10. For the year 1887, supplementing the Greenwich series by photographs taken in India and the Mauritius, a record of the sun's surface has been secured on 361 days. The reduction of the measures of these photographs is complete, and the results ready for the Press. The diminution of current work as the *minimum* of sun-spots approaches has permitted the completion of the Greenwich results for former years by the measurement of photographs taken at Cambridge, U.S., and Ely, to be undertaken.

In the Magnetic Department the continuous registration of the changes of magnetic declination, horizontal force, and vertical force has been maintained, a duplicate set of photographs being taken since January last, so that one set may be available for persons wishing to discuss Greenwich records. Five measures of resistance of the earth-current wires gave very discordant results; in fact, these wires have not yet recovered the effects of the snowstorm of December, 1886, and it seems hopeless to attempt to express the measures of ordinates on the photographs in terms of the electrical units until the conditions of the circuits have been improved. It is thought that a slight dislocation in the trace soon after sunset and a sudden return to original position just before sunrise, which increase the difficulties above referred to, are connected with the electric lights in the vicinity of the earth plate at Angerstein's wharf. It may be remarked here that the Observatory is dependent on the courtesy of the South-Eastern Railway Company for carrying the earth wires.

The meteorological records for the year 1887 show that the mean temperature was 47·8°, or 1·5° below the average of the preceding 46 years. The highest temperature was 92·2° on July 4, and the lowest 15·5° on January 2. The number of hours of bright sunshine was 1,401, or 190 above the average of the preceding ten years. The rainfall was 19 9in., being 4·8in. below the average of the preceding 46 years.

In the year 1887 the average daily number of chronometers being regularly rated was 224, the total number of chronometers received was 717, issued 642, and the number sent for repair was 315. Since the date of the last report two competitive trials of chronometers and the annual trial of deck watches have been completed, besides a trial of ten chronometers for the Austrian Government. In the supplementary trial of chronometers, terminating in June last, the first 17 chronometers were all good and the general standard of excellence was very high, though the somewhat shorter duration of the trial prevents a strict comparison with those in the annual trials. The first chronometer in the annual trial, 1887, was very good indeed, and the next four appear to be fine chronometers. The performance of the first six was decidedly above the average of recent years, though the trial was somewhat more severe than usual as regards range of temperature, the extremes being 37° and 100° Fahrenheit. For the annual trial of deck watches, 1887, November 26, to 1888, February 11, 21 watches were entered, and of these nine were purchased for the Navy, the first three being equal in performance (on the 11 weeks' trial) to an average box chronometer.

The Greenwich time-ball was dropped regularly except on four days of very high wind; the Deal ball except on eight days, on six of which the telegraphic connections were interrupted. Automatic signals have been received to check the errors of the Westminster clock and that used to drop a time-ball at Devonport. The error of the former was less than 1sec. on 25 per cent. of the days of observation, and amounted to 4sec. on only 2 per cent.

The money for determining the difference of longitude between Greenwich and Paris having been placed on the Navy Estimates, arrangements are being made to carry out the work next autumn.

The staff consists of a chief assistant, eight assistants, 14 computers, and a clerk for office work.

The report concludes with the following remarks by Mr. Christie, which, as above stated, excited much comment among the visitors:—

"In my last report it was suggested that the instrumental equipment of the Observatory should be supplemented by a photographic refractor of 13in. aperture (equatoreally mounted) to enable Greenwich, as the National Observatory, to take its share in the scheme for forming a photographic map of the heavens, and for thus extending our knowledge of the places of the fixed stars. Consequent on the resolution of the Board of Visitors at the last visitation, I brought this question of the insufficiency of our instruments for the present wants of astronomy to the notice of the Admiralty and of the Chancellor of the Exchequer, and the matter is still under the consideration of the Government. If the Royal Observatory is to take part in this work of carrying out one of the principal objects for which the Astronomer-Royal was appointed, it appears to be essential that a decision should be arrived at without delay, in view of the circumstance that 13 observatories (including those of Melbourne and Sydney in our own colonies) have already ordered their instruments, which are to be completed by the end of the present year.

"Allusion was made in the last report to the increased demands made on the Observatory in recent years both by the scientific and the general public, and in view of the consequent development of work, it now becomes necessary to review the position of the establishment, which was constituted many years ago, when the conditions were very different. In order to understand the difficulty of the present situation, it is necessary to bear in mind the following facts:—In 1835 there were five assistants (excluding the chief assistant) having no computers to superintend, no extraneous work beyond the care of a relatively small number of chronometers for the navy, no magnetic and meteorological observations, no altazimuth observations, no spectroscopic and photographic observations. At the present time, there are eight assistants (excluding the chief assistant) having 15 computers to superintend, and of this staff two assistants are absorbed by the magnetic and meteorological branch, one by the altazimuth, and two by the spectroscopic and photographic branch, leaving only three assistants to do the astronomical work, which in 1835 required five assistants, and in addition to perform all the extraneous duties which the Astronomer Royal has felt it desirable to undertake in the public interest.

"Under these circumstances it becomes a matter for serious consideration whether, unless adequate provision be made for the primary objects of the Observatory, extraneous work, such as the supply of time-signals, may not have to be dropped. The service of hourly time-signals throws considerable work on myself and the staff of the Observatory, and, as it is purely voluntary, it appears to me that a condition of its maintenance must be that arrangements shall be made to enable the proper work of the Observatory to be carried on and suitably developed."

A HOME-MADE INCUBATOR.

UNDER this heading we illustrated, in No. 1196, p. 572, an incubator designed by Mr. P. H. Jacobs, and described by him in the *Rural New Yorker*. He has had, like ourselves, several inquiries, and makes the following reply:—So important a subject as artificial incubation cannot perhaps be made entirely plain to a novice in a few articles; but as interested parties have written for additional information, it may interest others to answer them here. Among the questions asked are, "Does the incubator dispense entirely with the use of a lamp, using at intervals a bucket of water to maintain proper temperature? I fear this will not be satisfactory unless the incubator is kept in a warm room or cellar."

All incubators must be kept in a warm location, whether operated by a lamp or otherwise. The warmer the room or cellar, the less warmth required to be supplied. Bear in mind that the incubator recommended has 4in. of sawdust surrounding it, and more sawdust would still be an advantage. The sawdust is not used to protect against the outside temperature, but to absorb and hold a large amount of heat, and that is the secret of its success. The directions given were to first fill the tank with boiling water and allow it to remain for 24 hours. In the mean time the sawdust absorbs the heat, and more boiling water is then added until the egg-drawer is about 110° or 115°. By this time there is a quantity of stored heat in the sawdust. The eggs will cool the drawer to 103°. The loss of heat (due to its being held by the sawdust) will be very slow. All that is needed then is to supply that which will be lost in 12 hours, and a bucket of boiling water should keep the heat about correct, if added twice a day; but it may require more, as some consideration must be given to fluctuations of the temperature of the atmosphere. The third week of incubation, owing to animal heat from the embryo chicks, a bucket of boiling water will sometimes hold temperature for 24 hours. No objection can be urged against attaching a lamp arrangement; but a lamp is dangerous at night, while the flame must be regulated according to temperature. The object of giving the hot-water method was to avoid lamps. We have a large number of them in use (no lamps) here, and they are equal to any others in results.

With all due respect to some inquirers, the majority of them seem afraid of the work. Now, there is some work with all incubators. What is desired is to get rid of the anxiety. I stated that a bucket of water twice a day would suffice. I trusted to the judgment of the reader somewhat. Of course, if the heat in the egg drawer is 90°, and the weather cold, it may then take a wash boiler full of water to get the temperature back to 103°; but when it is at 103° keep it there, even if it occasionally requires two buckets of boiling water. To judge of what may be required, let us suppose the operator looks at the thermometer in the morning, and it is exactly 103°. He estimates that it will lose a little by night, and draws off half a bucket of water. At night he finds it at 102°. Knowing that it is on what we term "the down grade," he applies a bucket and a half (always allowing for the night being colder than the day). As stated, the sawdust will not allow the drawer to become too cold, as it gives off heat to the drawer. And, as the sawdust absorbs, it is not easy to have the heat too high. One need not even look at the drawer until the proper times. No watching—the incubator regulates itself. If a lamp is used, too much heat may accumulate. The flame must be occasionally turned up or down, and the operator must remain at home and watch it, while during the third week he will easily cook his eggs.

The incubator can be made at home for so small a sum (about 5dol. for the tank, 1dol. for faucet, &c., with 116ft. of lumber) that it will cost but little to try it. A piece of glass can be placed in front of the egg drawer, if preferred. If the heat goes down to 90, or rises at times to 105, no harm is done. But it works well and hatches, the proof being that hundreds are in use. I did not give the plan as a theory or an experiment. They are in practical use here, and work alongside of the more expensive ones, and have been in use for four years. To use a lamp attachment, all that is necessary is to have a No. 2 burner lamp with a riveted sheet-iron chimney, the chimney fitting over the flame, like an ordinary globe, and extending the chimney (using an elbow) through the tank from the rear, ending in front. It should be soldered at the tank. The heat from the lamp will then pass through the chimney and consequently warm the surrounding water.

EARTHQUAKES, AND HOW TO MEASURE THEM.

AT the Royal Institution last Friday Prof. Ewing delivered a lecture on the above subject, in which he pointed out that seismology was a science with two sides—one geological, the other mechanical. The geologist attacked the subject by at once attempting to refer earthquakes to their source in the crumbling, tearing, or slipping of strata, in volcanic eruption, in the collapse or explosion of subterranean cavities. The mechanical student of earthquakes, on the other hand, concerned himself with the character of the motion that was experienced, and with the means by which an earthquake spread from point to point by the elastic vibration of rock and soil. His first business was to find out exactly how the ground moved during an earthquake, to determine by direct measurement the amount and direction of every successive displacement, and the velocity and rate of acceleration at every instant while the shaking went on. This was the problem of seismometry, and the lecture would deal with the solution of this problem, and with some of the results which had been obtained in the measurement of earthquakes in Japan. Earthquakes happened there with a frequency sufficient to satisfy the most exacting seismologist. It had been estimated that one or another part of the empire was shaken every day, and in Tokio, where the measurements had been made, there was an earthquake on an average about once a week. Most early attempts to reduce the observing of earthquakes to an exact science had failed, because they were based on a wrong notion of what an earthquake was. It had been imagined that an earthquake consisted of a single isolated jerk, or of a few jerks, easily distinguishable from any minor oscillations that might accompany them. The old column seismometer, for instance, attempted to measure what was called the intensity of the shock by means of a number of columns of various diameters which stood like ninepins on a level base. It was expected that the shock would overthrow the narrower columns up to a breadth which would gauge the intensity of the disturbance, and also that the line in which they fell would show the horizontal direction of transit of the earthquake wave. In fact, however, such columns fell most capriciously when they fell at all. The reason was that in an earthquake there was no single outstanding impulse, but a confused jumble of oscillations, very numerous and very irregular, which shifted their direction with such rapidity that a point on the earth's surface wriggled through a path like the form a loose coil of string might take if it were ravelled into a state of the utmost confusion. The mechanical problem in seismometry was to find a steady point, to suspend a body so that some point in it, at least, should not move while this complicated wriggling was going on; the steady point would then serve as a datum with respect to which the movement of the ground might be recorded and measured. The simple pendulum had often been suggested as a steady-point seismometer; but in the protracted series of oscillations which made up an earthquake the bob of a pendulum might, and often did, acquire so much oscillation that, far from remaining steady, it moved more than the ground itself. This was on account of its stability. To prevent the independent oscillation of the body whose inertia was to furnish a steady point, it was essential that the body should be suspended or supported astatically—in other words, so that its equilibrium would be very nearly neutral. Methods of astatic suspension for horizontal and vertical motion were described and illustrated by diagrams and models. The complete analysis of the ground's motion was effected by a seismograph, which resolved it into two horizontal and one vertical component, and recorded each of these separately, with respect to an appropriate steady point, by means of a multiplying index, on a sheet of smoked glass which was caused to revolve at a uniform rate by clockwork. The clock was started by the action of the first tremors of the earthquake on a very sensitive electric seismoscope. The record drawn on the plate gave every possible particular regarding the nature of the motion at the station where the seismograph was placed. A complete set of the apparatus, as made by the Cambridge Scientific Instrument Company, was shown in action. Prof. Ewing also described and showed his duplex pendulum seismograph, which drew upon a fixed plate of smoked glass a magnified picture of the horizontal motion during an earthquake. Apparatus was shown for testing the accuracy of the instruments by means of imitation earthquakes which shook the stand of the seismograph and drew two diagrams side by side, one the seismograph's record, and the other a true autograph of the motion of the stand. This test was applied to the instrument on the table, and the close agreement of the diagrams was shown by projecting them on the lantern screen. A number of autographic records of Japanese earthquakes we thrown on the screen, and their principal features were described. Some of these had been taken since the lecturer left Japan by Mr. Sekiya, professor of Seismology in the Imperial University, who had also constructed a model (shown by means of the lantern) to exhibit in solid form the tortuous path through which a point on the earth's surface moved during an earthquake. In general the motion began with small tremors of high frequency, which were probably transmitted by normal vibrations of the crust; these died out at an early stage in the disturbance, but usually not until transverse motions of larger amplitude and longer period had begun. The whole went on with irregular fluctuations and with a protracted and very gradual dying out of the shaking for two or three, sometimes even for ten, minutes, and comprised some hundreds of movements to and fro and round fantastic loops.

As a rule, the horizontal movement was much larger than the vertical. Each single movement usually occupied from half a second to two seconds. Earthquakes were quite perceptible in which the greatest extent of motion was no more than $\frac{1}{100}$in. In one case, on the other hand, as much as $1\frac{3}{4}$in. had been registered. Even that was in an earthquake which did little damage, and there was, therefore, reason to expect that a severely destructive shock (such as had not occurred in Tokio since the present system of seismometry was developed) would show still more motion—perhaps much more. Prof. Ewing concluded his lecture by exhibiting seismographic records he had recently taken on the new Tay Bridge to examine the shaking of the bridge during the passage of trains. The instrument had been placed on one of the great girders, where it was expected that the vibration would be a *maximum*. The records showed that the greatest horizontal motion never exceeded $\frac{1}{8}$in., even when a train was passing the seismograph—a fact which spoke well for the stiffness of the structure. Nevertheless, by watching the seismograph, one could see the index begin to oscillate whenever a train came on at the Dundee end of the bridge—a distance of one and one-third miles from where the instrument was standing. The movement began with longitudinal oscillations through something like $\frac{1}{300}$in. When the train came a good deal nearer transverse oscillations also were recorded; and the bridge did not cease to shake till the train had passed off at the other end.

DIPHTHERIA AND MOULD FUNGI.

THE belief that diphtheria is due to the implantation on the primarily infected mucous membrane of a pathogenic parasite has so much in its favour that, in spite of the want of unanimity regarding the precise form of microbe concerned, and the failure to isolate it and reproduce the disease by experiment, it is almost impossible to conceive of the affection apart from an agency of this kind. Dr. M. W. Taylor, formerly of Penrith, has long been persuaded that diphtheria owes its origin to fungoid organisms. In a paper published in the *Transactions* of the Epidemiological Society (vol. vi.) he gives a very interesting and clear account of his personal observations, and other facts bearing upon the conclusion that the cause of the disease is to be sought in the common mould fungi, which are to be found closely associated with dwellings and rooms, where he has known outbreaks of diphtheria to occur. His argument, of course, necessitates the adoption of a doctrine which has been warmly contested—viz., that harmless fungi or bacteria can take on pathogenic properties under certain conditions. That fungi, such as Oiderum aspergillus and penicillium, can grow in animal tissues has been amply shown, and there is even reason to believe in the morphological identity between these fungi and those which attack the skin and mucous membranes, exciting purely local lesions. Still, there must always remain the problem whether the truly pathogenous fungus is not pathogenic *ab initio*, although it is conceivable that outside the body it may exist in association with structurally allied but essentially distinct forms. In the words of Dr. Klein, "just as there are species of plants which act as poisons to the animal body, and other species of plants which, although belonging to the same group and family, and although very much alike to the others, have no such power and cannot acquire such a power by any means, so there are micro-organisms which are pathogenic, while others are quite harmless. The latter remain so, no matter under what conditions and for how long they grow." Dr. Taylor recognises this, but holds that there are conditions under which it is conceivable for innocent forms of mould to acquire such virulent properties, and to act as the carriers of infective material rather than as specific disease germs. His view is one which is, therefore, applicable to all zymotic disease, and if substantiated would require a recasting of our notions respecting the specificity of pathogenic microbes and the theory of ptomaines.—*Lancet.*

EXPERIMENTS IN STATIC ELECTRICITY WITH THE INCANDESCENT LAMP.[*]

THE incandescent lamp is generally classed among the applications of dynamic electricity, and, practically speaking, it properly belongs there; but many who are interested in science may be interested to know that the incandescent lamp may also be classed with the apparatus for studying the phenomena connected with static electricity. With an Edison lamp, two or three suspended pith balls, some fragments of light material, and a silk handkerchief, the two fundamental laws of static electricity may be demonstrated. The lamp should be held by the small end, and the glass bulb rubbed with the handkerchief and then presented to the substance experimented upon. The bulb should be heated slightly to dry it. Now, if a lath is balanced on a point on the bottom of a round-bottomed bottle, it can be made to revolve by holding the rubbed bulb near one end. (Fig. 1).

In fact, any experiment that can be made with a glass rod or stick of sealing-wax can be made with the lamp. If, in the dark, the lamp is held by one hand and the bulb rubbed with a piece of cloth,

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[*] By ELMER E. B. EMMONS, in the *Scientific American.*

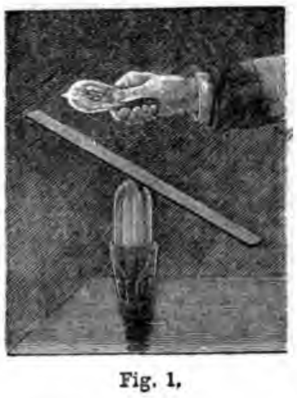

Fig. 1.

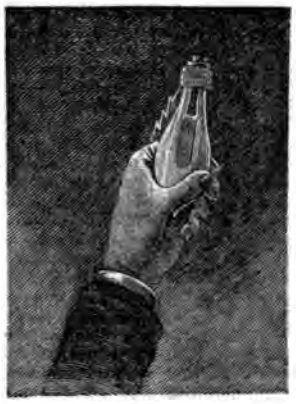

Fig. 3.

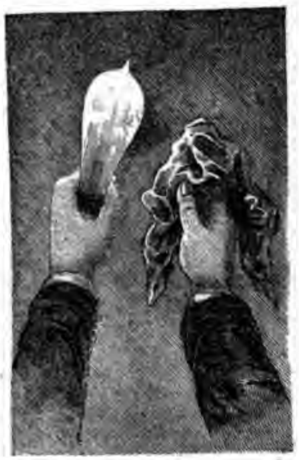

Fig. 2.

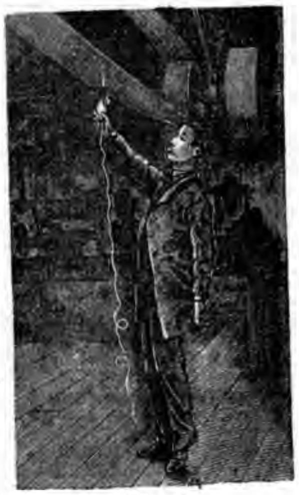

Fig. 4.

the interior becomes filled with a bluish white light. (Fig. 2).

I find that the hand is as good as anything for the above experiment, for if the hand be moved rapidly up and down, striking the bulb a glancing blow as it passes, the glow may be made to fill the entire globe, and, after stopping, if the hand is placed against the glass, the interior will be immediately lighted up, and it may be repeated several times without more rubbbing.

When a barrel of lamps is opened and the lamps gently stirred, the same glow spreads through the whole mass of lamps disturbed. In the above experiments the carbon filament may be entirely destroyed, and for the experiments in attraction and repulsion the lamp would be somewhat improved thereby. It is, however, as a condenser that the lamp excels. If the lamp is held by the bulb, and the metal piece connecting with the carbon presented to the prime conductor of an electrical machine, it will become charged, that is, if the person holding it is standing so as to be "grounded." The lamp can also be charged by an electrophorus, or from a running belt if the latter is charged.

If, when the lamp is charged, the holder touches the metal with his free hand, he will receive a smart shock. If another person touches the metal on the lamp, they both will receive a shock, the circuit being completed through the ground. If the lamp is held long enough, the time depending on the quantity of electricity to be derived from the charging device, the lamp will finally discharge itself, the spark jumping from the metallic portion of the lamp to the hand of the holder, and the holder is made aware of the fact by the loud snapping sound and a pretty heavy shock (Fig. 3). By watching, the spark may be seen as it jumps the interval. By taking hold of the lamp well down towards the end of the bulb, the spark can be made to jump the whole distance between the ferrule and the hand, a distance of 3in. or more. It is really astonishing what a heavy shock one can get from a 16-candle lamp; and if the original inventors of the Leyden jar had been holding a healthy incandescent lamp in their hands instead of the historic phial of water at the time they received their first shock, it is probable that they would never have ventured near enough to have taken another, judging from the fright the phial caused. To make a first-rate Leyden jar the lamp should have tinfoil pasted over it to within $1\frac{1}{2}$in. or $1\frac{3}{4}$in. of the ferrule. It may then be held in any convenient way suitable for experiment. With a lamp so arranged, all the experiments usually made with *Leyden jars can be* performed. The foil is, of course, to be connected with the earth. Running a wire to the floor is usually sufficient.

I have taken one with the foil on it, suspended it near a running belt, connected the foil to "ground" by running a wire from it to the floor, and then run a wire from the metal connection to within a few inches of the belt. So arranged, the lamp will become charged very rapidly and discharge, the spark leaping through the air between the ferrule and tinfoil and close to the glass (Fig. 4). During the time of charging, the space inclosed by the carbon filament is filled with a pale blue light, and at discharge the whole globe is illuminated, the light being due to discharge in a vacuum, and not to the carbon being heated. If the carbon is broken in two, it works just as well, so that burned-out lamps may be obtained and used. Anyone who has ever tried to make a Leyden jar knows the difficulty in getting good glass; but the lamp is perfect in that respect.

DETAILS OF BLACKSMITHING.*

In working sheet steel into irregular shapes by processes which draw up the material in a manner somewhat resembling that employed in drawing up cartridge cases from discs of copper, or in the stamping of tin ware, it is necessary that the stock used should be fairly tough. The property of ductility which is requisite to the success of wire-drawing operations—that quality which permits stretching or extension by pulling—is perhaps the peculiar property which should be possessed by the material intended for these purposes; and yet the material which could be wire-drawn cannot always be case-drawn, as iron which is easily split may be wire-drawn, because the tendency of the operation of pulling it through a hole is to keep it together and make it closer, while the tendency of the operation of pushing a plate of metal into a hole, with a mandrel or "former," is to open the grain around the end of the "former." It must, therefore, be homogeneous, and hence capable of yielding equally to strains in all directions without tearing apart. It is a gratification to be able to remark that there is very little trouble in this respect, even with the cheap grades of American steel. Out of some two hundred thousand of the shovel-backs, shown in Fig. 1, which have been brought under my observation, I cannot remember of seeing more than a dozen that had failed on account of seams. This is a better record than was made by some less than 5,000 pieces of $1\frac{1}{2}$in. × $\frac{1}{4}$in., which had a simple bending operation performed upon them. They were bent on a line with their length, the angle being 120°, and the inside corner a circle of $\frac{1}{8}$in. The outside corner in these showed openings in 10 per cent. The stock for the shovel-backs was $2\frac{1}{2}$in. × $\frac{3}{16}$in. cut-off $6\frac{1}{2}$in. long, round on both ends, with a horse-shoe die, used in the punch press.

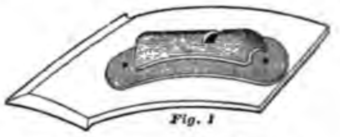

Fig. 1

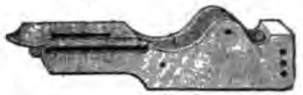

Fig. 2

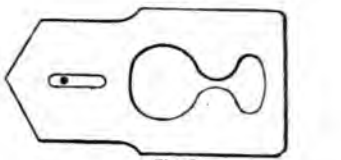

Fig. 3

In one lot of three thousand, which was made on trial, to determine what steel would be best for the purpose, the temper was so high, and the stock so brittle, that about 15 per cent. were lost at the start by nicking and breaking in the operation of cutting off. They acted about as thin stove plate would under like circumstances. From the punch press they were taken to the drop, and went through the operation of striking up without loss. The next thing to do to them was to punch the square-cornered hole $\frac{7}{8}$in. × $\frac{1}{2}$in., and the attempt to do this was very unsuccessful, for every one broke that was tried. A scheme was then attempted to be worked on them by first punching a $\frac{1}{2}$in. round hole, as a starter, but an immediate loss of 75 per cent. and a prospective loss of the balance, in enlarging the hole to the full size, led to the abandonment of the project until the pieces were annealed. They were heated in a reverberatory furnace, and put into ashes Saturday forenoon, and were barely comfortable to handle the next Monday morning, which should have given good softening results. They were then punched with a $\frac{7}{16}$in. punch and $\frac{1}{2}$in. die. The annealing had been so far beneficial that there was only a loss of about 25 per cent., and the enlarging and squaring of the big hole and punching the two small holes in the ends took off about 25 per cent. of the remainder, making the total loss about one-half of the stock. That experience decided once and for all that steel of that quality, of so high temper, could not be profitably worked for that purpose; and the steel afterwards ordered and received never gave any trouble, the loss in punching not exceeding $\frac{1}{10}$ of 1 per cent., although the square hole was punched at the first intention, without making a starting hole to relieve the strain. A pair of cast-iron dies with but little dressing would last to do about 10,000. If they were run too long, the ends of the inside die would become rounded, and the pieces would get hump-backed. This was to be avoided because it gave the shovel so much leverage on the bolts, which fastened it to the sleeves, Fig. 2, as to pull off the heads. It is evident that increasing the distance from the bolt-head to the point where the back rests on the sleeve increases the short arm, and decreases the long arm of the leverage on the bolt. For this reason some backs were made as shown in Fig. 1, the cup-shaped depression at A being drawn down by one blow at a first operation, and this serving as a guide to strike up, and finish shaping the pieces on another die. This operation was harder on the stock than drawing the first mould of a cartridge case, for the metal around the outside, beyond the depression, made a resistance which the case does not have to draw against. This resistance proved too great for the tenacity of the material, and the plan was abandoned.

This plan is adopted, however, I understand, in making the eyes, or handle sockets, for some kinds of hoes. In this the conditions are more favourable to success, in that the cup is considerably larger in proportion to its depth, and there is greater diffusion of the strain. The value of the product also allows the cupping to be done under the trip-hammer, a little at each blow, instead of all being done at one blow, thus giving the advantage of time to the yielding of the material, which is helpful, on the theory that its strength will hold out longer, to move with short steps, than with long jumps. In making the hoes, after the cup has been drawn, the bottom is punched out of it, a mandrel thrust through, and thus a nice socket is formed, which is of one piece with the hoe.

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* By B. F. Spalding, in *American Machinist.*

appears probable that the alcohol 'originates in the soil, from the fermentation of the organic matters in it, and is thence diffused as vapour in the atmosphere.' Another side issue of our Temperance discussion is the so-called Bible wine theory, which maintains that the wine used in Palestine in the time of Christ was not alcoholic. I have been unable to find evidence that the composition of the juice of the grape, the laws of fermentation, or the practice in the making and using of wine were different in that country at that time from those in other countries, or in that country at other times; and we believe it safe to say that the theory that Bible wine was different from other wine, that it had not the alcohol which other wines contain, is without any basis to support it, in the opinion of the student of science."

Referring to a paragraph which appeared in "Scientific News," p. 30, this volume, Mr. Jas. Bradshaw, a chief engineer, writing from Milwaukee, U.S.A., calls our attention to the fact that the Edison incandescent lamp there credited with a life of 5,292 hours, is not to be compared with some others. It appears that Messrs. Leonard and Izard, general agents of the Edison Company of Chicago, have in their office four Edison lamps sent to them from Animosa State Penitentiary, Iowa, which have each a life of over 9,000 hours, the two longest-lived having records of 9,966 hours and 10,023 hours respectively. Ensign Gilbert Wilkes, U.S.A., also states that when the *Trenton* (an American man-of-war) returned from China in September, 1886, one of the Edison lamps, of which a careful record was kept, had burned for 9,700 hours, and was still in good condition.

The Liverpool Marine Biology Committee, in their recent cruise in the steamship *Hyæna*, used the electric light in deep and surface netting with the tow-line after dark, and obtained seme important results. It is not unlikely that electric lights will form part of the impedimenta of the fishing fleets of the future.

Prof. Silvanus Thompson, at a recent meeting of the Society of Telegraph Engineers, lectured on the subject of influence machines—his lecture and that delivered by Mr. Wimshurst at the Royal Institution on April 27 being probably the first lectures given at which it was not necessary to warm or dry either instruments or atmosphere before experimenting with the apparatus; but the only instruments excited were those of the Wimshurst type. In view of the recent discussion on the influence machine we shall probably reproduce Mr. Wimshurst's "discourse" next week.

The example set by the Great Northern Railway Company in trying the electric light in a few of their trains is, we believe, to be followed by the Midland. Some of the Brighton line trains have been so illuminated for a good many months; but while it has been applied by the G.N. and Brighton to trains which are rarely broken up, we believe the Midland will endeavour to make each coach carry its own lighting power.

Since the commencement of this month the express leaving Euston for Glasgow and Edinburgh at 10 a.m. has been accelerated, and is now timed to travel at an average of 44·6 miles per hour, stoppages included, doing the whole journey in nine hours. The Great Northern will consequently do the journey in 8½ hours, and the fastest run in the world—viz., that from Grantham to King's Cross, will shortly be done quicker than ever, perhaps at 60 miles an hour.

Steam navigation is keeping pace with railroad travelling—at least, we learn from a telegram that the Cunard liner *Etruria* has averaged 19·54 knots from Roches Point to Sandy Hook, and has made a "best on record" by doing the outward trip in 6 days 1 hour 47 minutes (corrected time), although for part of the time half-speed was the order. She accomplished the finest run ever achieved on Friday, June 1st—viz., 503 knots, which is equivalent to 24 miles an hour, practically in mid-Atlantic. That is, we believe, the best performance ever accomplished.

The Alpine "Edelweiss" is growing very satisfactorily in the Botanical Gardens, Regent's Park, and is just now in flower, together with other mountain plants, like the "quamash," or edible bulb of the Canadian Islands, and the *Linnæa borealis*, the little creeping shrub, with its pink bells, which the Swedish naturalist called after himself.

M. Chevreul, the famous chemist, is, it appears, not the only centenarian in Paris. He has 19 rivals, who, according to all accounts, are just as hale and hearty as he is himself. They comprise four bachelors, one Benedict, and six widowers; while the lady centenarians are made up of one unmarried, one married, and seven widows. These are official statistics, compiled for the Prefecture of the Seine.

The following curious paragraph is "going the rounds," and it would be interesting to trace it to its origin:—"The finest grades of razors are so delicate that even the famous Damascus blades cannot equal them in texture. It is not generally known that the grain of a Swedish razor is so sensitive that its general direction is changed after a short service. When you buy a fine razor the grain runs from the upper end of the outer point in a diagonal direction toward the handle. Constant stropping will twist the steel until the grain appears to set straight up and down. Subsequent use will drag the grain outward from the edge, so that after steady use for several months the fibre of the steel occupies a position exactly the reverse of that which appeared on the day of purchase. The process also affects the temper of the blade, and when the grain sets from the lower outer end toward the back you have a tool which cannot be kept in condition by the most conscientious barber. But here's another freak of nature. Leave the razor alone for a month, and when you take it up you will find the grain has resumed its first position. This operation can be repeated until the steel is worn through to the back." As Mr. Crummles used to say, "Who is it sends such paragraphs to the papers?"

Further presentations of trout fry have been made this year by the council of the National Fish Culture Association to the rivers Lea and Colne, and also to the public waters of Maidstone, Canterbury, Portsmouth, Nottingham, Stamford, and Northampton. The hatching season of this year has been attended with most satisfactory results. The ova laid down were taken by Mr. W. Oldham Chambers, the secretary, from stock-fish in the ponds of the association at Delaford Park, and these were supplemented by consignments of valuable ova forwarded by the United States Fish Commissioners, being those of the rainbow trout, lake trout, and brook char indigenous to Transatlantic waters. These were incubated with a very low mortality, and the result is a plentiful yield of fry which, owing to the prevailing lowness of the temperature during the winter, are strong and healthy examples of trout. There is a large quantity of yearling and three-year-old rainbow trout in the ponds, the latter being spawned this year for the first time.

At Ostend it is intended to establish a marine zoological station similar to that at Naples, and four of the Belgian Universities have supported the proposal.

The Danish Government has set apart a sum of £500 for the services of an expert to examine the oyster beds on the coast of Denmark. The object is to ascertain whether the "preservation" has been successful, and whether the gathering of the oysters may be safely resumed.

The Meiggs Elevated Railroad.—The street railroad committee of the Massachusetts State Legislature have reported in favour of extending the Meiggs charter for two years and of striking out the requirement that one mile of road must be built and operated in Cambridge before the company can apply for a location in Boston. The committee inspected the track and equipment of the experimental line at Cambridge. Capt. Meiggs has encountered steady and violent opposition ever since he applied for a charter; but he stuck to his scheme, and has held his own so far, although he has not been able to build the line he desires. It is hoped now that the Legislature will act on the recommendation of its committee, and that the line will be built.

THE Governor of New York has signed the Bill abolishing hanging and substituting electricity for executions.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, *332, Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

⁂ *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

IN SEARCH OF A GOVERNMENT GRANT.

[28811.]—YOUR readers will probably be amused at the result of an application made by me to the Royal Society a few weeks ago for a share in the Government grant.

There is still a debt of some £60 upon the 17¼in. equatoreal, and considering the work which has been done with it, and which your valued correspondent, "F.R.A.S.," has so kindly noticed more than once, it seemed quite right to apply for help under the embarrassment of a debt which, in various ways, is a hindrance to the work. For the amusement of one or two friends, rather than from any expectation of assistance, I applied, and this morning have received a reply, addressed to me as *Esq.*, and with *no date filled in*, that the Committee of the R. S. cannot recommend the case.

T. E. Espin.

Wolsingham, Darlington, May 30.

JUPITER—THE COMET.

[28812.]—ON the night of May 31 clouds obscured the planet at 23m. after the time assigned for the Transit Ingress of No. III. The satellite was visible during the whole of that time.

The picture of Jupiter and Satellites in company with β Scorpii on the night of May 20, mentioned by Mr. Nash (letter 28786), was certainly a pretty and an interesting sight.

There has been little difficulty in picking up the comet (Sawerthal), and when found it could, on Thursday and Saturday nights, be seen in the finder.

Last night at 11h. 30m. the comet and the Great Nebula in Andromeda were almost included in the field of the telescope with power 55 on Dollond's 3¾in. aperture, and both were included in the field of the finder. The motion is carrying it over the nebula (or below it as it would be seen in telescope, inverted) and the R.A. was somewhat less than that of the nebula. The head showed a bright aggregation of light. The tail, ill-defined, could be prolonged by slightly-averted vision over a third of the field. As it was travelling amid bright telescopic stars it was easy to determine the motion. On Thursday night the tail appeared differently, rapidly widening from the head, to a wide base, in fan shape.

Hendon, June 4. **P. F. Duke.**

TABLES FOR CONVERSION OF SUN'S LONGITUDE INTO RIGHT ASCENSION.

[28813.]—WITH reference to statements in letters 28740 and 28784 by "F.R.A.S." about tables for conversion of sun's longitude into right ascension and declination, I may say that such tables *do exist*, and are to be found in Pearson's "Practical Astronomy," Vol. I. (1824). They give the R.A. and D. for every 10 minutes of arc of the sun's longitude, with differences and variation in 100″ change of obliquity.

Darlington, June 4. **A. C. Dixon.**

A REJECTED PROCESS.

[28814.]—I HOPE you will allow me, an old contributor, some little space to call attention to a few important facts in reference to the so-called "Walter" sewage process, and its strange reception by the Metropolitan Board of Works. I will state bare facts, and ask my fellow-readers what is the meaning of those facts, and whereto they point? In 1884 a gentleman named Woolheim proposed to the Board (then, as now, at their wits' end in dealing with the London sewage) a plan for treatment by lime and herring brine. It appears (and I shall be glad to give details for an experiment, if any readers care to try it) that a powerful disinfectant is evolved by the action of milk of lime on herring brine. As this substance, so evolved, will kill all micro-organisms, and as micro-organisms e sole cause of putrescence, the process at ittains an object that elaborate chemical s often fail in. Now all this was proved to ard in a succession of experiments. Some e experiments were on a large scale, and all ıccessful. Dr. Bell, the analyst at Somerset , acted as an impartial judge of the results, s report, which I have actually seen, states ne sewage after treatment was practically ess and free from putrefaction, and would o. Dr. Bell also said that a further trial, ng discharge into the Thames ought to be and facts were adduced to show that the the whole process would be moderate. *But ırd refuse to sanction any further trial.* The tes of the scheme have been worn and l almost to death by a combat against sm. They have proved all the points that ıve had a chance of proving. I should like -and I am not in the least afraid that a just can be given—why the Board refuse to go ? A few days ago the scheme was dis- from consideration by three votes. But is ot something in it?

Edward Willmore, F.C.S.

.lbert-road, Walthamstow.

bably the advocates of the scheme had not l "influence" in the right quarter, or the of Works is growing honest in view of the ions now being made respecting its past —Ed.]

COLONY AND EMIGRATION.

5.]—"Eos" (65419) speaks rather disgly of Cape Colony; but still I fancy that not been there. I have been there, and ıdvise everybody to avoid the colony unless e unable to get anywhere else. As that pertains to America means go-ahead, so that pertains to anything Dutch means stick in d. Cape Town is in the same state of ement or progress as it might have been 150 go; ten years since there was not even a ous pavement at the sides of the streets. untry as a rule is a sort of barren wilderou may go for 800 miles and not see a tree of the name. There are some pines just Table Mountain which the Dutch planted rs ago, more or less. Certainly, English uld readily find service; the native servants that I hesitate to describe their quality. lony like Australia any skilled workman h his money: there things go-ahead. The objection to these Colonies is the expense ng there. A merchant in Cape Town told t but for the gold digging and diamond urning up, they would all have been bankg ago. These remarks do not apply to the ast and Natal.

Amateur.

IE ORGAN OF THE FUTURE."

6.]—The specification of the organ in the resbyterian Church, Baltimore, erected by Roosevelt, of New York, as given in your of the 25th of May, is an interesting one ating from a firm which in important points advance of any in the Old World; but it is specimen for searching criticism. Here is Roosevelt's latest specification, the organ course of construction for the Calvary New York City:—

Ianuals, Compass CC to a³, 58 Notes; and 'edals, Compass CCC to F, 30 Notes.

GREAT ORGAN.

Chancel—Cantoris Side.
(3¾in. pressure.)

Stop	Feet	Pipes
ble Open Diapason	16ft.	58 Pipes.
)pen Diapason	8	58
Open Diapason	8	58
a di Gamba	8	58
pel Flöte	8	58
ve	4	58
e Harmonique	4	58
ve Quint	2⅔	58
r Octave	2	58
ure	4 ranks	232
npet	8	58

4 to 11 are included in the Choir swell-box.)

West End.

Stop	Feet	Pipes
le Open Diapason	16ft.	58 Pipes.
pen Diapason	8	58
)pen Diapason	8	58
ı di Gamba	8	58
iana	8	58
cipal Flöte	8	58
ve	4	58
Harmonique	4	58
e Quint	2⅔	58
r Octave	2	58
ure	*8 ranks.*	174
ı	*8 ranks.*	174
pet	8	58

to 24 are included in West End Solo-box.)

SWELL ORGAN.

Chancel—Decani Side.
(3½in. pressure.)

No.	Stop	Feet	Pipes
25.	Bourdon (Treble and bass, split knob)	16ft.	58 Pipes.
26.	Open Diapason	8	58
27.	Violin Diapason	8	58
28.	Spitz Flöte	8	58
29.	Œoline	8	58
30.	Stopped Diapason	8	58
31.	Octave	4	58
32.	Hohl Flöte	4	58
33.	Flageolet	2	58
34.	Cornet	3, 4, and 5 ranks.	230
35.	Contra Fagotto	16	58
36.	Cornopean	8	58
37.	Oboe	8	58
38.	Clarion	4	58

West End.

No.	Stop	Feet	Pipes
39.	*Bourdon (treble and bass, split knob)*	16ft.	58 Pipes.
40.	*Open Diapason*	8	58
41.	*Salicional*	8	58
42.	*Vox Celestis*	8	46
43.	*Flauto Traverso*	8	58
44.	*Stopped Diapason*	8	58
45.	*Octave*	4	58
46.	*Wald Flöte*	4	58
47.	*Flautina*	2	58
48.	*Cornet*	3, 4, and 5 ranks	230
49.	*Cornopean*	8	58
50.	*Oboe*	8	58
51.	*Vox Humana*	8	58

CHOIR ORGAN.

Chancel—Cantoris Side.
(3½in. pressure. Inclosed in a separate swell-box.)

No.	Stop	Feet	Pipes
52.	Contra Gamba	16ft.	58 Pipes.
53.	Open Diapason	8	58
54.	Salicional	8	58
55.	Concert Flute	8	58
56.	Quintadena	8	58
57.	Fugara	4	58
58.	Flute d'Amour	4	58
59.	Piccolo Harmonique	2	58
60.	Dolce Cornet	5 ranks	290
61.	Orchestral Oboe	8	58
62.	Clarinet	8	58

West End (*Solo Organ*).
(*6in. pressure. Inclosed in a separate Swell-box.*)

No.	Stop	Feet	Pipes
63.	*Stentorphone*	8ft.	58 Pipes.
64.	*Violoncello*	8	58
65.	*Philomela*	8	58
66.	*Hohl Pfeife*	4	58
67.	*Piccolo Harmonique*	2	58
68.	*Tuba Major*	16	58
69.	*Tuba Mirabilis*	8	58
70.	*Cor Anglais*	8	58
71.	*Tuba Clarion*	4	58

PEDAL ORGAN.

Chancel—Decani Side.
(3¾in. pressure.)

No.	Stop	Feet	Pipes
72.	Contra Bass (resultant)	32ft.	12 Pipes.
73.	Open Diapason	16	30
74.	Dulciana	16	30
75.	Bourdon	16	30
76.	Violoncello	8	30
77.	Trombone	16	30

West End.

No.	Stop	Feet	Pipes
78.	*Double Open Diapason*	32ft.	30 Pipes.
79.	*Open Diapason*	16	30
80.	*Violone*	16	30
81.	*Bourdon*	16	30
82.	*Violoncello*	8	30
83.	*Contra Bombard*	32	30
84.	*Trombone*	16	30

Couplers.

85. Swell to Great.
86. Choir to Great.
87. Swell to Choir.
88. Swell Octaves on itself.
89. Choir Octaves on itself.
90. Swell to Pedal
91. Great to Pedal
92. Choir to Pedal

Mechanical Accessories.

93. Chancel Swell Tremulant.
94. Chancel Choir Tremulant.
95. *West End Swell Tremulant.*
96. *West End Solo Tremulant.*
97. Wind Indicator for Chancel.
98. *Wind Indicator for West End.*
99. Belt Shifter for Chancel.
100. *Belt Shifter for West End.*
101. Engineer's Signal.

Automatic Adjustable Combination Pistons.

102—105. Four over Great Keys. Affecting Chancel Great and Pedal Stops and Nos. 85, 86, 90, 91, and 92.
106—109. *Four Over Great Keys.* Affecting West End Great and Pedal Stops and Nos. 85, 86, 90, 91, and 92.
110—113. Four Over Swell Keys. Affecting Chancel Swell and Pedal Stops and Nos. 88, 90, 91, 92, and 93.
114—117. *Four over Swell Keys.* Affecting West End Swell and Pedal Stops and Nos. 88, 90, 91, 92, and 95.
118—120. Three over Choir Keys. Affecting Chancel Choir and Pedal Stops and Nos. 87, 89, 90, 91, 92, and 94.
121—123. *Three over Choir Keys.* Affecting West End Solo and Pedal Stops and Nos. 87, 89, 91, 92, and 96.

Ventil Stops.

124. *West End Swell Ventil*
125. *West End Great Ventil.*
126. *West End Solo Ventil.*
127. *West End Pedal Ventil.*

Ventil Pedals.

128. Connecting Cantoris Organ and Chancel Pedal.
129. Connecting Decani Organ and Chancel Pedal.
130. *Connecting West End Organ.*
131. Connecting Cantoris and Decani Organs and Chancel Pedal.
132. *Connecting Decani and West End Organs and Chancel Pedal.*
133. *Connecting Cantoris and West End Organs and Chancel Pedal.*
134. *Connecting all Organs.*

Pedal Movements.

135—136. Two Roosevelt Adjustable Combination Pedals. Affecting Chancel Pedal Stops and Pedal Couplers.
137—138. *Two Roosevelt Adjustable Combination Pedals.* Affecting West End Pedal Stops and Pedal Couplers.
139. Chancel Full Organ. All Chancel Speaking Stops and Couplers.
140. *West End Full Organ.* All West End Speak- Stops and Couplers.
141. Chancel Pedal Ventil. To silence any selection of Chancel Pedal Stops *without* throwing in in the knobs.
142. Great to Pedal Reversible Coupler.
143. Balanced Chancel Swell Pedal.
144. *Balanced West End Swell Pedal.*
145. Balanced Chancel Great and Choir Pedal.
146. *Balanced West End Great and Solo Pedal.*
147. To Close all Boxes.
148. To Open all Boxes.

Summary.

	Stops.	Stops.	Pipes.	Pipes.
Great Organ—Chancel,	11		812	
West End		13		986
Swell Organ—Chancel,	14		984	
West End		13		914
Choir Organ—Chancel	11		870	
West End (Solo)		9		522
Pedal Organ—Chancel,	6		162	
West End		7		210
Total Chancel Speaking Stops	42	—		
Total West End Speaking Stops		42		
Total Speaking Stops	84			
Couplers	8			
Mechanical Accessories	9			
Adjustable Combination Pistons	22			
Ventil Stops	4			
Ventil Pedals	7			
Pedal Movements	14			
Total	148			
Total Chancel Pipes			2,828	
Total West End Pipes				2,632
Total Pipes				5,460

As this organ is probably unique in the history of organ building, its specification and a few descriptive remarks will undoubtedly prove of interest to organ enthusiasts.

The present instrument comprises only so much of the specification as is printed in Roman type—viz., a divided Chancel Organ arranged to produce the most complete and useful antiphonal effects. The *italics* represent a complete West End Organ which, though not yet contracted for, will be used in conjunction with the Chancel Organ and played from the same "console," the latter being prepared and fully fitted for its attachment.

The unique features are the method of dividing the instrument and the location of its various parts in the church, with a view to antiphonal effects and the extensive use of electric action.

Speaking as though the West End section were already built with the Chancel Department, for the sake of ease of description, the disposition of the component parts is as follows:—In the gallery over the vestibule are placed Great, Swell, Solo, and Pedal Organs. The remainder of the instrument, comprising a complete Chancel Organ, occupies the extreme Eastern bays of the two aisles, being elevated upon floors above the pews, so that no floor space or seating capacity is lost. Here Great and Choir Organs are located on the Cantoris side, and Swell and Pedal Organs on the Decani side.

the specifications being somewhat unusual for the sake of adaptation to antiphonal uses.

The console or key box for the entire instrument is located among the stalls of the Cantoris choir, entirely detached from every part of the instrument proper. With the exception of the pneumatic tubes, by means of which the various sets of swell shutters are operated from the console, there are absolutely no connections between the latter and the different sections of the organ other than electric wires, bunched into several cables.

Beneath the choir is the bellows room, which contains two large and one small bellows, with hinged feeders and rotary actions, and a 4H.P. Baldwin gas-engine which drives them. From these bellows the wind is conducted to the different departments of the instrument, each of which is supplied with an auxiliary reservoir or "Regulator," to insure absolute steadiness under all conditions. The console extends through the choir floor to the bellows room floor, and it is in this room that access is had to its labyrinth of combination and electric mechanism.

From the above it will be seen that, considered as a whole, there is a three manual organ, containing eighty-four speaking stops, which is divided into three parts, located in widely separated positions, but all controlled by one complete console in the choir, by means of which, being fully supplied with combination action and ventils (in reality electric contacts), the whole is placed under the ready and easy control of one performer.

The entire organ is supplied with Roosevelt patent windchests, which are tubular-pneumatic in principle and action, affording a separate pallet for every pipe, a light and sensitive touch, and a marvellous rapidity of repetition.

To the above windchests is due largely the unparalleled success of the Roosevelt patent electric action, by means of which the entire organ is played. This action is reliable, positive, and quick in operation, obviates all of the annoyances consequent upon extended and complicated direct mechanism, and is applied with equal facility to both drawstop action and key action. The electric current is derived from a dynamo generator of special construction, which is driven by the gas-engine that also drives the bellows. The entire plant demands less care, and is less liable to accident or derangement than would be the case in so large an organ of ordinary construction, whereas it surmounts obstacles imposed by the conditions of site, that could not be overcome in any other way.

The Roosevelt patent automatic adjustable combination action is a recently-invented device, simple and durable in construction, whereby the organist may change the effect of each piston or Pedal at any moment, by drawing the desired selection of stops and then "setting" or "locking" the same by a single touch, to such piston or pedal as he may desire, after which the latter, on being pressed, will instantly cause the knobs to revert to the positions occupied when "set." As this mechanism moves the knobs themselves and releases itself at the close of action, the knobs can be operated by hand in conjunction with the combination action, which is not the case with that form which fails to move the knobs.

Crescendos and diminuendos, of startling intensity and of peculiar and novel effect, are rendered possible by the extensive recourse had to the use of swell-boxes, of which there are four, together inclosing every stop in the instrument except the Pedal Organs and the diapasons of both divisions of the Great Organ. Besides the sudden transitions from one part of the instrument to the other by means of the ventils, the most charming *gradual* changes in the origin of tone from one part of the building to another are rendered possible by these swell-boxes, since by playing upon two departments, either with or without contrasted quality of tone, the gradual reversal, from opposed positions, of the two swell pedals involved, causes a correspondingly gradual cessation of volume of tone from one quarter and increase from another, without any discernible break or point of transition, which has aptly been likened for the ear to "dissolving views" for the eye.

Of course the electric action dispenses with the necessity of introducing pneumatic action, as there is only needed sufficient resistance in the touch to return the keys to their position after being depressed, the electric contact calling for practically no exertion in itself; and the departmental ventils, in conjunction with the combination action, enable three manuals to accomplish more, and with greater ease to the performer than would otherwise be possible with any number of claviers.

One can hardly study such a scheme as this without admitting that a degree of perfection must have been obtained in mechanical arrangement far in advance of anything yet attempted in this country.

We are marvellously slow as a nation to grasp any new idea. We suffer every people under the sun first to point out the way, and when we accept it it is generally long after a better way has been adopted elsewhere. We dearly love the old and beaten path, so sweetly safe and sure, and we are thoroughly content with it in all directions. It is therefore consistent with precedent to learn, on no less authority than the late Hildebrand Roosevelt himself, that in our latest application of electricity to the organ as a motor (now two years old) we commenced upon lines discarded by him twelve years ago!

Now here is an immense instrument presenting many novelties besides that of mere mechanism; but, after recovering from the effects of a first examination, the question of *Cui bono* has to be considered, and it may be doubted whether the ends gained fully justify the means.

Certainly, the conception is a grand one; but, first, is the effect of this instrument enhanced by the duplication of stops shown? Secondly, is the general treatment the best which could be devised to secure the end in view? To the first query I reply, *I think not*.

Suppose we take, for example, a series of paintings hung in different positions in a large building: we should hardly think of placing in such positions merely duplications of one picture, be that one ever so fine. Yet that is precisely the proposition for the Calvary Church. On this question of the value of duplication in organ stops there is much to be said. First, is it ever *necessary?* Take the stock form of the English church organ: the Great Organ will contain double diapason, two open diapasons, the second being usually about three pipes smaller than the first, claribel or hohlflöte, with possibly a stopped diapason, &c. In the swell we find ditto, the second diapason being probably what is called a salicional; in the Choir again ditto. Here we have in the Great Organ, say, a rich back ground of tonal colouring; in the Swell, the same colouring of a lighter shade; in the Choir again, the same colour lighter still! This is the sort of thing to be found everywhere! To return to my simile of the painting—What would be thought of the artist who thus restricted his colouring?

The larger the instrument the greater the duplication, that is the rule: and the inconvenience of this system lies in the fact that it is increasing the difficulties not merely of construction, but what is of much more importance, the management of the instrument, without in any adequate degree adding to its capacity for effect.

This subject of tonal colouring is an interesting and highly important one; but it will not be within the limit of one article to deal with it except thus in a general way; but I propose, if opportunity is afforded me, to take it up in a future number.

This point "capacity for effect," brings me to my second query—the general treatment of this organ. Here we note a great advance upon our English system. I do not, of course, allude to the divided organ—that is a luxury not to be expected in England, except in rare instances, but to the general treatment of a single instrument.

By our method a large portion of the organ becomes an extravagant outlay, when it is considered how comparatively seldom it is used. I refer to the super or chorus stops of the Great Organ. By Roosevelt, this portion of the instrument is made to serve a double purpose. Upon this point there are, I think, weighty questions involved. I am entirely at one with Messrs. Roosevelt in their aim; but I am not prepared entirely to endorse the means employed.

First, I regard as essential to the true character of a Great Organ chorus that (as I shall term it) its *attack* be decisive and marked. Every expert knows the effect of the unison stops of a Great Organ coupled to a large swell. This is essentially not the effect to be satisfied with *for all purposes*, and I confess that I see no other effect possible in the organ before me.

Secondly, I regard it as an error of judgment to inclose the first harmonic of the diapasons—the "octave," commonly called "principal"—because its service is absolutely distinct from all the remaining superwork.

Lastly, there are certain stops which lose their character entirely by being inclosed. This is true of some of the delicate stops, such, for example, as the lieblich gedact and some others, which I can more fitly describe when I deal with the subject of tone colouring, as I hope to do. It is very specially true of the "tuba." By all means, if funds will admit, have a tuba under control of a swell; but it should not be to the sacrifice of the true tuba effect with its grand attack, the climax of a general piling up of the chorus.

Of the "capacity for effect" of the individual stops of the Roosevelt organ I am not qualified to give a reliable opinion, because I have not seen any of their later work. What I know is of the Walcker type—essentially German. I can therefore only deal with the instrument in general design, and from this point of view it must unquestionably rank before any instrument we can show here. We miss in this specification 8ft. stops on the pedal organ, and the type of reed so associated with the name of Henry Willis, and, from my own point of view, this is an element which I should be unwilling to dispense wi
its absence need not detract from the meri
design as a work of art.

Under the heading of "Tone Colouring"
if possible, in a following number to d
this interesting subject in detail, and I pr
give a sketch or two showing how the ol
I have here raised may be overcome.

Carlton C. M

20, Torrington-square, London, June 4.

WATER WHEELS AND TURB

[28817.]—I WAS very pleased to see t
tical and interesting letter of "V. I. A.
must disagree with him on one or two p
being hardly fair to the ordinary wheel.
says, "Millwright" must include in price
the cost of gearing to give 629 revolution
he allows nothing *against* the turbine
speaking generally, I should say that mill
rarely runs at much more than 200 or 25
tions at the fastest, so to be fair we must
include the price of gear to bring up spee
200 revolutions. Now the circumference
wheel = 314·6ft., and at 5ft. per secon
speed we have $5 \times 60 \div 314 = 0{\cdot}955$ r
minute; so speed must be multiplied al
times—expensive enough in all conscien
out going as far as "V. I. A."—and this
the outside limit; and then there is the co
large wheel, which would be a job to erect.
case of the turbine, to make a fair compar
must include gearing to *reduce* speed to
3·14 times, and in addition the cost of iron
piping and laying must be added.

If we allow 5ft. per second as velocity
in turbine pipe area = 1·2sq.ft., which i
about 16in. diam., and the weight of pipe
without being exact is, say, 5 tons, allo
100ft. of pipe. If, however, we are allowe
earthenware pipes for about 30ft. or so,
take about four tons, as required, and act
without laying, as, say, £20, against turb
addition to this, we have the cost of tw
valves—one at top to shut off water o
occasions, and one at bottom for ordina
pages. Of course, a dam is necessary in b
in most situations, so it cancels out. Th
of pipe above given is about the lowest al
A larger pipe would be desirable. On t
hand, against all these extra costs for the
we have, in the case of the vertical wheel,
of the sluice and head race. If we use a
cating water-engine the cost is even more
the wheel, since we can then do with lit
gearing, as we can reduce revolutions to a
or 80. If we use water from a distance th
tage to the wheel is greater, since the c
open puddled channel is less than pipes.
"V. I. A." observes, "high falls with sma
tities of water can be economically m
Take the case of the wheel at the F
Quarry, which I mentioned in a previo
The diameter is about 30ft.; the head, fro
to top of wheel, is about 120ft. (very r
The wheel makes 6½ revs. per min. = 10
sec. bucket velocity. "Millwright" say
4ft. is about the thing (I write from memory
correct, if wrong), or about 2½ times
limit. Taking one-third the theoretical
as channel is very stony and in bad condi
have 44ft. per sec. as velocity of delivery.
falling on the wheel with the energy du
velocity, the wheel acts as an impulse w
velocity of the delivery is giving a pressur
buckets. If they were straight vanes, the
be a pressure on them, but at the same tim
splashing—all this splashing is, of course
wasted.

By Smeaton's rule we should run the
24ft. per sec. = say 15 revolutions; but,
should lose water by centrifugal force, an
by air resistance; on the other hand, by t
speed we should have, in many cases, l
work and, therefore, less friction. Of cou
is not so in this instance, as the wheel is
slow-running machinery (stone crusher).
reduce the splashing, due to radial va
curving them on the same system as
Poucelet wheel; but then we appro
turbine's curves. Would it not be better
turbine in this instance right away? It w
impossible to use a larger wheel, for lack
In the second place, by using a "vortex"
an additional 30ft. of fall below the wheel
utilised, and allowing 65 per cent. as mod
wheel and 75 for turbine, and allowing 4H.
H.P. of wheel, we could probably get, say,
from turbine. I think we should all be
hear further from Mr. "Millwright"
"V. I. A." on this subject.

Engineer, C

P.S.—The automatic governing action
vortex wheel is due to the increased cent.
water in buckets opposing entrance of wa
guides, which partly obviates the diffic
lower efficiency at under load by runni
half-empty guides and buckets.

OPULSION OF STEAMSHIPS.

8.]—I HAVE to thank you for allowing my letter of Dec. 4, 1887, and regret that, uch a very long way off, I should appear, long interval, as if stirring up matters ave gone to rest, or may have been well-'gotten. But the subject is a good one, and ay be many who would like to hear more t—not that I would desire to push forward ously. And besides, the remarks made y letter by some of your correspondents to call for a few words of explanation or on.

ring to "Dens'" letter (28321), I may that I did not go into the cause of Ruth-ilure, and it would take up too much space upon it at present. With all deference to ' however, I may assure him that the cause re was really not as he states it to have His idea is that the "columns" of water had not rigidity enough "when striking er on either side of the vessel." Now, the act is that Ruthven did not take the water into consideration at all. Water was from the nozzles *above* the water-line, with tance whatever from the water outside. Mr. n himself told me that he would have pre- to have the "nozzles" submerged; but on trial he found he lost speed at once, and e he adopted the plan of ejection above ith no resistance but from the atmosphere. his propelling principle was exactly that ker's Mill," or the recoil of a gun. With-g into detail, I may indicate three points among others, help to explain the failure: he departure from the original model, in odel the water was taken in at the bow, so greater the speed, the greater the supply; the steamer the water entered by a per-plate under the pump, in which case, as the ended to increase, the water supply fell Second, the centrifugal pump was not c enough; too indirect, slow, and even only ve, instead of being direct, instant, and ory, as it should have been. Third, the were not taken off at tangents to the water-wer being thereby seriously lost.

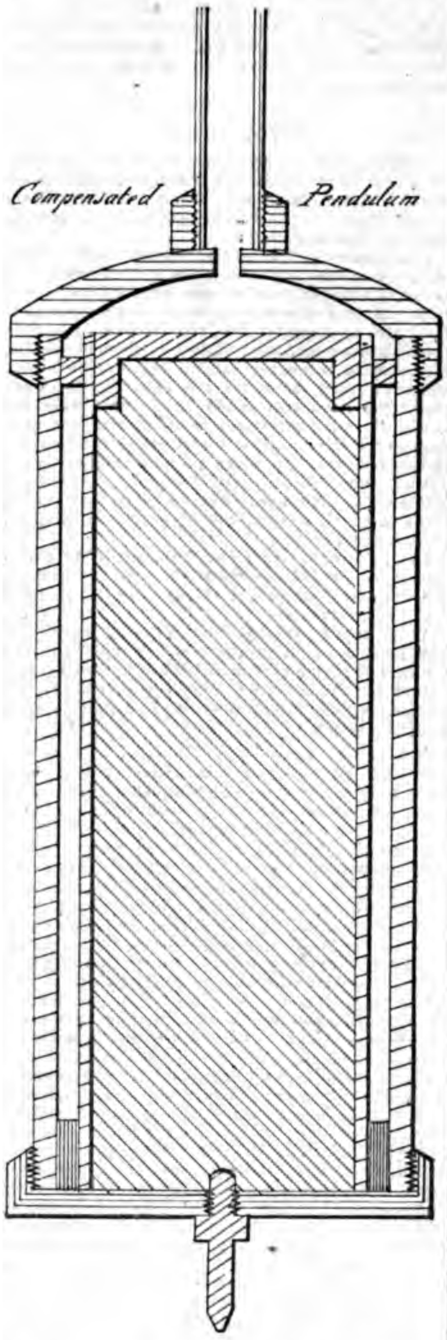
er Hydraulique" (28322) was "amused" tter. This "hydraulic ram" seems inclined with ferocity upon very small provocation. end of his first paragraph he might well en us Artemus Ward's confidentially ex-y parenthesis "(N.B.—This is wrote sar- I am sorry, however, if I gave offence— no intention of doing so, he may rest Upon looking at his letter (27578) again, , after all, but adhere to what I said—that ere surface immersion his piston did won- well. In his letter criticising mine (letter, on) he says my experiment seems to have otal failure. Not so; the model ran the the bath in good style, as I said, notwith- the short supply of steam. He also asks, results were so promising, why were they proceeded with?" How does he know that g wasn't proceeded with? "Belier," again, recent letter (28353), says that "Dens" has d his ("Belier's") argument better than have done himself. So far as the "argu-pplies to Ruthven's boat—which it does ntirely—the fact I have mentioned above h for it; otherwise I do not agree with the ion that hydraulic propulsion is a vain any means.

not exactly understand Mr. Hillier's r" piston (letter 28323), or where the ffect of it would be shown. He says s and screws occupy space outside the lines ull—why should the frames or guides be able?" But the paddles and screws being the lines is exactly what *is* objectionable, nt of liability to damage.

e of the Auckland newspapers there a paragraph to the effect that the Liver-*rnal of Commerce* states that one of the rtling and important inventions of the day ard to the propelling of steam-vessels is nder consideration"—"revolutionise the eamer service"—"£100,000 offered for the &c. Can any of your correspondents verpool," perhaps) tell us something about What if it be some hydraulic plan at last! and, N.Z., April 21. **J. M.**

MPENSATED PENDULUM.

.]—I HAVE for some time thought that it easy to compensate a pendulum (as sug- Mr. Latimer Clark, 28256, page 417, VI.) by having a reservoir of mercury side the bob, and the lower half of the lar in connection with it, so that on an of temperature a small weight of mer-ld be added about half-way between the suspension and oscillation, where the ould have the maximum effect, according Grimthorpe (page 49 of his book), Mr. Clark (28256) says "by carrying the reservoir up to the point of suspension its effect might be still futher enhanced." This small quantity of mercury would have an action precisely similar to those small regulating weights described at page 49, "Clocks, Watches, and Bells." In the accompanying sectional sketch the innermost shaded portion represents lead. It is contained in a piece of iron tube 2¾in. internal diameter, and turned down to 3in. external. In the top a cap is fitted mercury-tight; all the unshaded portion around this represents mercury. This mercury is contained in a piece of 3½in. iron tube turned true outside (and in if desired). Between the two tubes at the bottom is an iron ring, which must be connected mercury-tight with both tubes.



At the top is a ring (having portions of its circumference cut away, so that the mercury can circulate) merely to keep the inner portion steady. Screwed on to the top of the outer tube is a cast-iron cap, and into this the tubular rod is screwed. It would be, say, 17in. long, for a 1sec. pendulum, with a bob the size I have drawn. On the top of this small tube would be screwed a cap, also tapped to take a $\frac{5}{16}$in. steel rod, which would form the upper portion of the pendulum-rod, and be connected with the spring in a suitable manner. I would divide the top of the cap into 60 parts, and have an index fitted to the rod adapted to the divisions, so that one division would mean altering the rate 1 sec. per day. At the bottom of the bob is also a cap having a central hole, through which the lead is intended to be poured, and a screw afterwards inserted as shown, and which would serve as an index to the degree plate. This pendulum would weigh about 40lb., and I calculated roughly that it would take about 9½lb. of mercury to compensate it—that is, if the mercury at a mean temperature reached to the centre of the pendulum's length, and neglecting the expansion of the containing vessel. I, therefore, propose to allow 12lb., and if found over-compensated, by lowering the mercury in the tubular rod so that it will act at a less effective place, this can be remedied.

The action of this compensation would be very quick, as the mercury would mostly be about ¼in. thick.

I should like some of your contributors to say how they think this would answer, as, if likely to be successful, I intend to use it for a four-legged gravity escapement sidereal clock which I have started making. Can anyone say how would be the best way to make the joints mercury-tight, so as to keep the mercury from the lead? I think it would be possible to weld two of them, and the other two might be screwed up tight and a rust-joint formed, or some kind of cement put in, unless, indeed, it would suffice to turn up the parts in contact and screw them tight. Perhaps someone can suggest a good way? I should be very glad, too, if anyone can show that it will not require so much mercury. I thought before I began to calculate that about 1lb. would be enough. The cost of this pendulum (except the mercury, and not counting one's own labour), would be small, and besides being much cheaper than a *solid* mercurial bob of the same weight would, I think, be more sensitive.

O. B. Hutchinson.

Hindmarsh Valley, South Australia, April 17.

IMPOSSIBILITY OF MANKIND BEING DERIVED FROM ONE COMMON ANCESTOR.

[28820.]—"SATINE" (28799) sets up a theory and then demolishes it, with exceptions. Would not "Satine" be wiser to take the revelation given in the first chapters of the Book of Genesis? Man and pigeons are not quite ruled by the same laws, for man was "made in the image of God," and so has not "withered up." If "Satine" would read and think, he would see why that most noble animal called "man" is obliged to eat his bread by the sweat of his brow, and why also women are prone to such trouble in childbearing, neither of which occurs with animal creation in their wild state. These facts, which are so evident to all, surely prove the truth of the revelation given in Genesis; and if this be undoubtedly true, why not that which pertains to our one common ancestor?

June 1. **Amateur.**

IMPOSSIBILITY OF BIBLE-READERS SUPPOSING US DERIVED FROM ONE COMMON ANCESTOR.

[28821.]—WHETHER there are people lazy or thoughtless enough to fancy (or, as they might say, "believe") that the Bible implied us all to be "derived from one common ancestor" is not a question I deem worth discussing; nor yet whether that phrase, however defined—and it needs far more definition than people like "Satine," p. 305, seem to dream of—involves possibility or not. "Satine" seems to think there is a distinction between what he calls "fast-breeders" and "slow-breeding man" so radical that the same is impossible to the latter, but possible to "rats and guinea-pigs," even as Darwin thought documents proved all the Porto Santo rabbits descended from one doe that a ship placed on that island with her litter four centuries ago. Without touching his position, however, I have to note for any races to *have had*, at a particular date, a common ancestor is one thing, while to be "*derived from* one common ancestor" is quite another. For instance, Genesis doubtless implies Noah to have had, and his nine named fathers each to have had, the first of those as an ancestor, and thus a father of all of us. How many human contemporaries the said "Haadam" of Eden had, nowhere appears. Before he is mentioned, we find in Chapter I. there were "Adam" (no name of an individual, but of a race) created, male and female, and numbering for aught that we read ten million. This one "Hadam" placed in the garden to keep it, is evidently the same that Berosus called "Alorus," who said that "God had appointed him shepherd of the people." He was a prophet, a king, and perhaps first institutor of marriage, or at least of that marriage law (now utterly inverted), that a man should "leave his father and mother and cleave to his wife," instead of, as now, every wife leaving her father and mother to cleave to her husband. Well, among his contemporaries (one of whom, Hanahash, seduced him, through his wife, to sin), ten or a thousand, for all that appears, may each, equally as himself, have been a father of Noah and all of us; and of contemporary females, ten or a thousand may each, equally with Eve, have been a common mother of us all. But so loose is "Satine's" wording or fancy, that he does not see his phrase "derived from one common ancestor," goes outside of known nature, and that outside of the known, "impossible" or "supernatural" are terms meaningless. If, however, he says that by "one ancestor," he means one pair, has any text implied or driven readers to imagine us all derived from one pair? The nearest approach thereto I can find, is Paul's statement to the Athenians (Acts xvii. 26), that God "hath made of one blood all nations of men." (The R.V. omits "blood.") Doubtless Genesis affirms there was a date, that of the Flood, when all of us had but eight, or even but six, ancestors. It is commonly so read as to imply only six; but the statement, that of Shem, Ham, and Japhet "was the whole earth overspread," does not necessitate fewer than eight, when we observe that the rule of the narrator is to name only males. If Noah had, after the Flood, one or more daughters, they would marry one or more of the sixteen sons of Shem, Ham, and Japhet, and would very well explain a singular Hindoo legend that makes the founder of the present human race have no son, but three daughters, whose husbands were three quasi-divine persons. If this were so, the smallest number of contemporary ancestors the Bible implies us to have ever had, would, instead of six, be the whole eight in the Ark.

And these eight, observe, in all probability comprised individuals as different as any now living, say Huxley and King Jaja. The great difference of age between Noah and Shem points decidedly to their being not father and son, but more likely great grandfather and son. Their inequality (alike in all copies) is greater than our, or the modern Jewish, copy (which, however, is corrupted) makes between Adam and his youngest named son's grandson's grandson, Jared. This at any rate shows that, while there was but one word for *son* or *descendant*, the phrase that "Noah begat Shem, Ham, and Japhet," by no means implies these were children of his own, especially when we find from x. 21, that Shem and Japhet were nearer of kin than either of them to Ham, perhaps first cousins, and he only a second one. The root of the fable that Saturn devoured all his children—namely, that the head of our race, before wars began, had survived all children of his own, was very probably true. Before the birth of any in the Ark, but Noah himself, he had probably two generations of offspring, all of whom, like the rest of the world, believed him mad. Three from among his youngest great grandchildren alone could believe him.

Now not only the wives of these three, but their mothers, and even their three fathers' mothers, were probably of races as distinct as Europeans, Chinese, and negroes are to-day. Each of the three had Noah for one common ancestor, but each of them had, contemporary with Noah, eight great-grandparents, of whom Noah was only one. Again, each of their children, the first births after the Flood, was probably descended from sixteen of Noah's generation, of whom Noah was but one. Each also had, in the tenth generation above themselves, any number of ancestors between four and 1,024, which is equally true of any of us to-day. All that the Bible implies, therefore, of the man of Eden, is that he was a common father of us all. A thousand or two of his contemporaries may each equally have been so, and a thousand or two of Eve's contemporaries have been, each equally with her, a "mother of all living" since Noah.

The way the longevity of the long-lived race is represented sinking to the present, or rather to the Mosaic, standard, not gradually, but by such halvings at first as appear in Gen. xi., just accords with the results of intermarriage at certain steps with the shorter lived. Noah being called, besides "a just man," one "perfect in his generations" probably means he was of pure Edenite pedigree, and the last who ever was so. In like manner, Heber's longevity may imply he was the last pure Shemite. All nations remembered the gods, and after them the demigods; and though all the gods were immortal, all were sons, brothers, cousins, &c., to one another, exactly like men. Everywhere the reigning Jove had somehow superseded his old father, and everywhere he had two brothers that, as Neptune and Pluto, divided with him the empire of all things. Three cities that claimed to be each the oldest of its continent kept special record of the Ark, two of them, the African and European Thebes, being called by its name, and the Asiatic Apamea having ark and dove for its coinage badge. At the great Nilotic city, an actual gilded ship, as long as Genesis makes Noah's, had from immemorial time been worshipped; and there, too, was celebrated on the 17th day of the "second month" of autumn, the treachery of Typhon (whose name means "storm" or "flood") inveigling Osiris, the last of the gods, and saviour and representative of all mankind, into a wooden coffin, closing it hermetically (the exact day of the year that Genesis says of Noah, "the Lord shut him in"), and launching this to be swept all down the Nile, out to sea, and to ground on the north of Syria, where the corpse would be found, and divided into pieces that somehow became all *nations!*

Yet the Egyptian priests, between the time of Herodotus and Manetho so muddled their chronology that from the latter, or rather the discordant notes of those who last saw his lost books, Egyptologists can now make any number of centuries between 24 and 50, provided we admit that all the monuments belong to some three or four of those at wide intervals, the intermediate dumb millennia having left nothing. Persian and Hindoo astronomers kept the record of the Deluge date exactly alike, and doubtless truly, though only as a matter of science, not history. No nation but China seems to have aught that can be called chronological history going back into Genesis times, and this agrees therewith as well as conceivable. It knows of the seven years' famine, exactly in Joseph's time; it mounts no higher than Peleg's generation when "the earth was divided"; and the reigns, at first of just such average length as the Genesis patriarchs might have had, are shortened to a modern average exactly as and when the Bible implies such shortening. **E. L. G.**

EVOLUTION.

[28822.]—In the letter by "Eos" (28800, p. 306), he makes mention of the "Bushman in all his primitive repulsiveness." Might I call the attention of "Eos" to the following as having a bearing upon the subject?

Dr. Bateman, of Norwich, having read a paper at the Victoria Institute upon "Darwinism and Language," a discussion was raised outside the Institute, and the case of the Bushman was referred to, as being a race who had no language more than a click. Dr. Bateman applied to Dr. Moffat as to his experience among the Bushmen, and got a reply, of which the following is an extract: "I have had much intercourse with the Bushmen in the interior of South Africa, and they may be set down as the lowest grade of humanity in that country. In some respects their language has a resemblance to the clicking language of the Hottentots. When taken into service, they readily learn to speak fluently the languages of English, Dutch, and Techuana."

Now, I would ask "Eos," or any other correspondent, how long would it take for the highest ape to learn even a little English, &c., let alone to speak them fluently?

What, in the name of common sense, I would ask, has the analogy in physical structure got to do in the face of such a radical difference in the Ego and nature of the essence? The common skate fish has the periodic function—is it to be considered as a blood relation? **Dens.**

[28823.]—I don't think "Dens" (letter 28801, page 305) is right in assuming that the fact of there being no evidence to show that mankind have differed from what they now are, applies with equal force to all living nature. But, unless we have a complete series of animals, differing by very slight variations, we cannot say that any one animal in the middle of the series is a link between the two ones at the end. The modifications to which all animals are subject seem to be governed by no law; they turn up in the most unexpected way, such as a peach-tree suddenly bearing nectarines, or a white baby from entirely black parents. So that the one in the middle of the series may be structurally as different from the two end ones as the latter are from themselves. Thus we may have existing to-day parents and their modified offspring, together with links between them, as entirely separate species. Thus a lion may be a link between a mouse and a newt, but we have not got the complete series of gradations between a mouse and a lion, or a lion and a newt, therefore we have no right to say that the lion is descended from mice, or newts from lions. Yet they may be thus descended: we have no proof that they are not; but we have, on the other hand, no proof that they are thus sprung, so we continue to call mice, lions, and newts distinct species. Neither is there any possibility that a series of such fine gradations should ever be found. For, consider what a tiny fraction of the earth's former inhabitants are represented in our museums; think what millions of cattle are yearly killed, and, does anyone imagine that one of them will survive in a fossilised state until the year A.D. 8000? It is probable that only a very few indeed would become thus preserved, and those few probably unconnected by links—thus, a buffalo and a Brittany cow. Living nature is now changing slowly and, to us, imperceptibly. We have no exact description of animals and plants of a thousand years ago to compare with those of now. Even within this century the Dinornis elephantopus, or "the elephant-footed Moa," and the Rhytina gigas, or sea-cow, have become extinct, and other animals have taken their place. So nature must be changing, though so slowly that in a few generations no difference can be observed. The only way to prove that there is a difference is to institute a museum in which a stuffed animal and its skeleton is placed, say, every five years. Will "Dens" please explain to my dull mind how men
are enabled to carry on their business a
with confidence, because animals and pla
alter in the space of fifty years.

If "Dens" does not know where I got
about the hairy fœtus, it implies that h
read the "Descent of Man," in which t
mentioned on the twenty-fifth page. If
case, no wonder that he does not believe
tion, when he only reads books against
and leaves the greatest works for him in
"Dens" says this story has been refuted
over again (yet he does not know whe
from); but I mentioned it, not only on t
rity of Darwin, but also on that of Henri
M.D., Professor of Diseases of Wome
Gynæcology in the Michigan College of M
a man who has devoted his whole life to
of hairs. The fact that men who are h
are edentulous and otherwise imperfect,
this statement. For these hairy men ar
their lanugo states before their full time
tion is up—therefore, they are very apt
perfect.

The hairs of man and animals differ i
bowls of which the whole hair is mad
more or less serrations, or that there
bowls to the inch, or that the bowls are
by longer or shorter stems. But in
species this arrangement differs exc
thus, in the sheep, Leister wool has 1,
to the inch, while in fine Saxon there ar
as 2,720. The same with human hair;
the head, the finest hair is $\frac{1}{1500}$in., and th
$\frac{1}{210}$in., in diameter.

Evolution *is* the old doctrine of chanc
and placed on a firm basis, so that we ca
there is sense in it. It is very true tha
nothing new in the world. The undisco
in virtue of which animals are subject
tion, is very mysterious, and may puzzle
for centuries to come. But the savage
thinks it a most mysterious thing that
hears his own words repeated by some
means; but we laugh at his ignorance,
him that it is due to the rocks reverbe
words; and, in like manner, people of
may laugh at our ignorance of the va
species.

I have to thank "Dens" for suggest
two books, and Wm. John Grey and "
siding with me.

PRICE'S UNIVERSAL LAT

[28824.]—I fail to see how Mr. F. Car
at the conclusion that the bed will s
untrue if applied to screw-cutting, as w
ing large diameters the front face of
takes the thrust, and the saddle being 8
long, I reckon it will last as long as ordi
lathe; but without canting heads wear is
take place, as the top V would have to
thrust. I am thinking of disposing of
and having an F. C. lathe, as it costs no
an ordinary slide-rest lathe, and has the
of milling and boring, as well as turning.
London, E.C.

[28825.]—Through the kindness of a
was favoured with a sight of one of the
useful lathes, of which, to say the least,
in the right direction, when it is wished
adays," to multiply variety of work wi
tools as possible.

I have no interest in the front-slide la
ever, and but for noticing a remark in th
Mr. F. Carre (28807) in this week's iss
"E.M." I may never have thought of
our esteemed friend the Editor of this p
any remarks of my own concerning it;
practical mechanic of some 30 years' e
and a lover of fair-play, I cannot agree
with "F. C.'s" opinion when he says
purchaser of such a lathe will be grievou
pointed. As to the rapidity with which
front slide will wear untrue, I would as
if a front V-slide so easily wears out,
that practical engineers, "and they ar
have found no objection to the front slid
in some large shaping and milling
and other tools, made and sold by we
makers of the same, and which work
cisely the same principle as Price's lathe
many instances, with even a less prop
wearing surface than Mr. Price uses. Th
question is a light one, being of 3½in. cen
and the work done in it, and consequ
wear and tear, will be in proportion to
weight of such a tool. A short while ba
some work done upon one of the front-sli
that has been in constant work for over ei
the compound sliding saddle of which h
a V-slide, and weighs over five hundr
The work it turns out is excellent, yet th
surface of the V-slide is only 3in. by 24
is a far less proportionate surface tha
Price's lathe; but, apart from this argum
is no question but that the front vertical

hifting slide-rest to such a lathe supplies a lt want both to amateurs and mechanics, as uch a tool milling, wheel-cutting, fluting, n be executed with ease after a little prac-

Comparison.

LATHE MATTERS.

'26.]—I AM glad to see that the subject of is again coming to the fore. Price's uni- front-slide lathe, as described this week, s to be a very efficient tool; but, to my the bed appears rather light for the work it to do.

e time ago there was a great cry out to do with back gear, and substitute bands with and divers pulleys. I designed a 6in. self- lathe at the time; but find now that the e of gear is the greatest drawback. A friend e tells me that he saw a lathe many years which the gear was all contained inside the —a sort of sun-and-planet motion, in fact.

, as my pulley is 10in. in diameter, I think I able to fit such a gear if any fellow-reader help me out with details. My friend forgets y how it was managed.

'feil's catalogue I see the following sentence: n ingenious arrangement (patented), any r of threads, from 3½ to 60, can be cut, only 9 instead of 22 gears. By simply a pinion, the operator can obtain the orth's or millimeter pitch, and the change rdinary feed to screw-cutting is effected by tion of a lever."

not wish to infringe the patent; but if we is arrangement to our lathes, the back gear the pulley, front slide, milling, &c., our would be very much more handy and less than at present.

d any fellow-reader describe Pfeil's arrange-

J. L. D.

THE PYRAMID ANGLES.

27.]—AS "M.I.C.E." quotes one of these), which I had not given quite correctly, it as well to do so. His Euclidean slope is er the two higher ones, being 51° 49′ 38·6″. rcle-squaring one is, to the nearest tenth of (as Prof. Smyth gives it), 51° 51′ 14·3″. The o one" of the passage slopes is misprinted instead of 34′. Kephren planned his base han exactly twice that of Mykerinus (which cubits), namely 420, but his cubit rule was short. The largest Pyramid at Dashoor is the second of all in base area, being 420 full but the height 200, against Kephren's 270. e only one with a commensurable slope.

E. L. G.

LITTLE-KNOWN PLANTS OF THE FLORA MEDICA.

8.]—ORDER: Loranthaceæ. This is a amily of "parasites," our British mistletoe representative.

36 a young military officer on duty at Cut- Lower Bengal, observed that the natives l the *Nux vomica* trees, so abundant there, lected the leaves of their natural parasite, they were a "great medicine," describing s a powerful narcotic, and poisonous in small hough useful in the treatment of agues and tism. Dr. Wallich, the great Indian botanist, ing specimens of the leaves, without flowers , supposed this parasitic plant to be *Viscum m.*

riments were made in the large English ls on dogs and kids. Three-grain doses pro- tetanic spasms, recurring from five minutes rter of an hour, and proving fatal by fixing phragm and causing asphyxia. The con- movements were precisely the same as used by strychnine, brucine, &c.

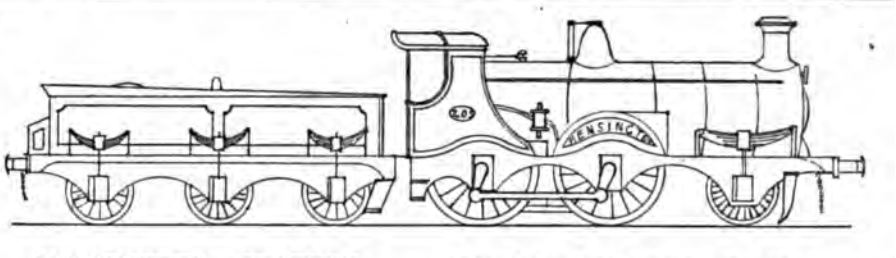
powder of the dried leaves was used with te success by Dr. Duncan Stewart and other ioners. Dose, 1 to 3 grains thrice daily, dis- ing its administration when tingling or dic contractions were observed. This dis- attracted some attention at the time, being iderable interest in botanical physiology.

Eos.

DYNAMO BRUSHES.

9.]—IN reply to "Engineer, Govan" (letter I have tried all angles for brushes, and find en they butt, or press end on, they are most o spark. They then cannot follow the rities of the commutator, and every spark matters worse by still further lowering the lowest surface of the commutator. My wear to an angle of about 30° to 35°, and I hey are about correct, if the worn part is the breadth of one bar or segment of the tator. My brushes are $\frac{1}{16}$ thick, and platted ike basket work, so that they may be stiff tic. They are easily clipped by tinsmith's

Vulcanite.



LOCOMOTIVES — CRAVEN'S "IMPROVED."

[28830.]—SOME time ago a correspondent asked for a sketch of above, and as none has appeared, I venture to send an outline drawing of No. 265, "Kensington," a four-coupled engine. The drivers are 6ft. diameter, and cylinders 17in. by 24in. I do not know any other dimensions.

Reymond.

"F.R.A.S." AND THE SCRIPTURES.

[28831.]—IF "F.R.A.S." reads the Scriptures as carelessly as he does the "E.M.," I do not wonder that he finds fault with my *first* reference to Scripture ever made in the "E.M."

I am neither ignorant of science nor of the Scriptures. I know what I can say on one side, and I know what "F.R.A.S." can say in reply, and I disagree with his views of Scripture as much as I disagree with the pancake earth theory.

Thomas Moy.

8, Quality-court, Chancery-lane, London, W.C.

A VERY OLD FORCE IN THE GUISE OF A NEW MOTOR.

[28832.]—I SINCERELY trust W. H. Evans, of Durban, Port Natal, will give us early and minute particulars of his new discovery. I for one (and I do not think I am singular) have always believed in the control of the human mind (or perhaps I had better say the human organisation, as comprehending mind and body) over matter, which he says he has demonstrated, and I look upon it as the explanation of table-turning, spirit-rapping, the curious vagaries of Planchette, and nine-tenths of our stories of ghosts and apparitions. But I have never been able to prove it, though I too, like Mr. Evans, have experimented in this direction. I therefore look forward eagerly to an opportunity of testing his discovery, and experimenting with it.

But as one who in his time has made many discoveries which have turned out, on farther examination, to be not new, I hope Mr. Evans will pardon me for hoping that he has not hit on a variant of Crookes's radiometer. **P. P.**

"THE ENTELECHIASCOPE."

[28833.]—WHILE entirely agreeing with Mr. W. H. Evans (letter 28792) as to the existence of a vital force hitherto ungauged, I doubt greatly that he has succeeded in making an instrument to show its action.

From the diagram on page 304, and the vague description annexed, I am inclined to think that he has invented either a sensitive heat measure, or an equally sensitive galvanometer—perhaps both, in the form of a thermopile. If a description be given it will be easy to see which.

T. Preston Battersby, Capt. R.A., F.R.A.S.

TURRET CLOCKS.

[28834.]—RE the correspondence in your paper on turret clocks, I have by me an old print (published in the *Illustrated London News* 30 years ago) of the "Great Clock at Westminster," which I should be pleased to send to Mr. Fred. Carre, if he cares to have it. It gives, besides a picture of the works, an account of the sizes of the various wheels, number of teeth of same, weight of pendulum, bells, &c., &c. If Mr. Carre will advertise his address in the usual column, I will send it to him with pleasure. **Star.**

STEAM BOILERS.

[28835.]—A CONSIDERABLE improvement has been made in steam generators by Mr. Thomas Lishman, of Newcastle, who has contrived to put into ordinary Cornish or Lancashire boilers an apparatus by which smoke is entirely done away with, fuel economised, and feed water heated to as nearly as possible the same temperature as that in the boiler. He also does away with the old form of fire-bars, thus saving a great deal of expense. The apparatus consists of a long U-shaped tube inserted under the furnace tube, through which the feed water circulates, the space between the two branches being an air passage through which a blast is driven, worked by a small separate engine and fan. This is covered with sheet iron perforated to admit the air to the fuel, which lies on top of this and the U tube; thus a large amount of air is obtained for the combustion of the fuel, and thus admits of a perfect generation of gases, which are then conveyed to a combustion tube which passes through the boiler above the furnace tube, where the whole is converted into carbon dioxide. The great advantages which are obtained are as follows:—(1) Thorough combustion and consumption of coal, (2) perfect generation of gases, (3) increased generation of steam, (4) water supply heated to highest possible temperature, (5) no chimney required, (6) 50 per cent. more economical than ordinary boilers. **Broke Foulston.**

[We described this invention on p. 251 of the last vol., and at pp. 278-9, two letters will be found claiming a similar invention. At that time some experiments had been made at the Elswick Works; but perhaps our correspondent can give more particulars of the results actually obtained in regular work.—ED.]

PURE MATHEMATICS.

[28836.]—I AM glad to see that my suggestions on this subject have produced some interesting letters, especially that of "E. L. G." on "Cheops and his Pyramid," which to me is very interesting. Now, I should like to see if "J. R. C.," or any other correspondent can solve the problem already given (to find half angle at apex of isosceles triangle of given length of sloping sides, when the radius of inscribed circle is a maximum), but without the aid of the diff. calculus or the method of limits. I have done it, and if there are no correct replies within a fortnight or so, I will send my solution; all that is required is a slight knowledge of the theory of equations and co-ordinate geometry; and it is very short.

Calling the sloping side unity, we start with the equation, rad. of inscribed circle = tan. θ (1 − sin. θ), θ being half-angle at apex. This gives the radius for any value of θ. Find value of θ where rad. is a maximum. My object in finding whether the problem could be so solved was to show that, although the diff. calculus was not invented at the time that the Pyramids were built, yet there are other means whereby the problem could be solved, and that therefore possibly the builders having solved it may have used this angle for their slope on account of this (as well as other) peculiarities. "E. L. G.," however, says that there was not geometry enough in those days so long before Euclid for such problems. After all, what do we know of those old times? There must have been mathematicians before Euclid. It seems as impossible that one man could have discovered all his theorems, as that Newton alone could have discovered all the theorems of the calculus; besides, mathematics may have flourished in the Pyramid times, and afterwards may have become a lost art, until revived again about the time of Euclid.

Bath. **M.I.C.E.**

MATHEMATICAL PARADOXES—LOGIC AND MATHEMATICS—MR. DYER'S DIAGRAM OF THE EARTH—"E.L.G.'s" DELUGE.

[28837.]—MR. GREY, F.C.S. (28798, p. 305) defends what he calls the "advanced school in mathematics" by a method apparently most humble and modest. Newton compared himself to a child gathering pebbles on the shore of a boundless ocean. All such expressions of humility in front of an infinity of unknown, and possibly unknowable, truths, are dignified and rational. But that is no reason why we should accept as true statements that are self-contradictory, and, therefore, pure nonsense. The tenets of Prof. Clifford, alluded to by "Wolfenbüttel" (p. 284), are such, as I will show presently. The number of persons who believe in space of four dimensions, in the boundaries to infinitude, and so on, will always be extremely small, like the numbers of those who understand and say they believe in Hegel's metaphysics. Such speculations are not mathematics. They are metaphysics supposed (erroneously) to be deducible from mathematics. It is, therefore, quite incorrect to call them "advanced mathematics." They are no more mathematics than Mr. Hampden's ideas about astronomy are "advanced astronomy." Mr. Grey, I think, falls into two errors. He defends the belief in a space of four dimensions by the argument that "it is tolerably certain that creatures living in space of two dimensions would be utterly incapable of grasping the conditions of existence in our own ordinary space." This is indeed a *petitio principii*. It is assuming the existence of a space of two dimensions—one of the very things in dispute. Then he defines a point as a "trace" of a line, a line as a "trace" of a plane, and a plane as a "trace" of a solid!—most unmathematical and ungeometrical definitions, which are enough to make Euclid turn in his grave. The analytical chemist cannot introduce his material ideas into the purely abstract definitions of geometry without creating woful confusion.

Mathematics is nothing if not strictly logical. If we find a statement, professing to be mathematical, that is self-contradictory or that contradicts first principles, it must be rejected. True mathematics will not suffer by any such elimination. The *raison d'être* of mathematics is to perform calculations. No one will say that the speculations, properly condemned by "Wolfenbüttel" (and also by "F.R.A.S," p. 302), could in any way be useful even if they were true. I said they were self-contradictory or contradicted first principles. Let us examine one of two of the examples given by "Wolfenbüttel." Clifford said that if he left his front door and travelled off into space in a straight line, he would arrive at the same spot again, coming back in the opposite direction! Is not that full of self-contradictions? I can imagine how easily Euclid would have refuted that by a *reductio ad absurdum*. Then the assertion that parallel lines meet. Is not this, too, a self-contradiction? What is the definition of parallel lines? "Parallel straight lines are such as are in the same plane, and which being produced *ever so far both ways do not meet*." (Eucl. def. xxxv.)

"Wolfenbüttel's" allusion to a hollow sphere that "can be turned inside out by simple flexure, though it be without crack or opening in its surface," leads one to the thought how useful such remarkable properties would be to the makers of maps and charts. The earth's surface could then, no doubt, be depicted on a plane without distortion—a thing which we all know cannot be done.

By the bye, that reminds me that Mr. Dyer (28795, p. 305), although he points out the utter inconsistency of "Parallax's" map of the earth with facts, somewhat weakens the remainder of the argument by incorrect figures. The world, he says, is illuminated "4,000 miles all round from the point where the sun is vertical." Should he not have said 6,000 miles, which is about a quarter of the earth's circumference? Again, why does he say that on the "Zetetic" theory, the sun would illuminate only 2,000 miles round? Taking his own diagram, the distance between *b* (the position of sun at the Equator), and the North Pole would be 6,000 miles, and the diameter of the whole "circular plane" would be four times that, or equal to the spherical circumference of the earth. Of course, this criticism of mine only holds good if the plane-earthists make *their* diameter equal to *our* circumference.

Would "E. L. G." (who apparently devotes himself to the laudable, but, I fear, difficult task of reconciling the old Hebrew books with modern science), very kindly tell me whether he considers the universal deluge of rain from the clouds, which he seems to believe really happened, to have been a miracle? and if not, how he can explain so tremendous an event in accordance with the laws of meteorology?

F. S. S.

ALTERNATE SUBMERGENCES OF NORTH AND SOUTH—THE SOLAR-SYSTEM MOLECULE.

[28838.]—I do not know where "E. L. G." (28802, p. 306), can point out any suggestion by me of "submergences sudden enough not only to drown animals, but extirpate whole species." That such submergences may have occurred, and that often in the world's history, I do not doubt; but I believe them to have been partial, or local, due to such volcanic disturbances as that which changed the form of the Straits of Sunda some five years ago, or to the uprising of mountain chains. The submergences to which I have referred would have been very gradual, taking many ages, possibly thousands of years in completion, and enduring through thousands of years. That such conditions have occurred geology proves, and my suggestion was that they may probably be explained on astronomical grounds, together with the production of successive Glacial epochs occurring alternately in the northern and southern hemispheres, together with an alternate preponderance of water, and submergence and exposure of dry land.

Sir R. Ball, the Astronomer Royal for Ireland, has given several lectures on this subject, showing that slow changes in the eccentricity of the earth's orbit would account for the known facts of the Glacial epochs, and with the accompanying alternate presentation of the poles at perihelion would also explain the other well-known fact of the prevalence of moderately high temperatures in the Arctic Circle. In fact, the two would be concurrent—glacialism in one hemisphere, warmth in the other. Now, it seems pretty clear that at the cold pole water would be fixed as ice, and therefore drawn away from the other hemisphere, exposing more land. That is the present condition of things on this earth, though only to a moderate degree, because through our epoch the eccentricity of the earth's orbit has been very small.

Mr. Schwarz (28803, p. 306) no doubt has originated the idea worked out in his letter; but it was long ago published in these pages and in both editions of my "Electricity: its Theory, Sources, and Applications." I should be sorry to claim the actual origin of it for myself even, knowing how ideas float about and are picked up in suitable brains.

Sigma.

USEFUL AND SCIENTIFIC NOTES.

The Sightseer's Headache.—Of the lighter penalties which pleasure entails, none probably is more widely known and felt or more persistently endured than the sightseer's headache. It is nature's tax levied on the comfort of that great body of busy idlers to which we all at some time or other belong. It is endemic among the frequenters of museums, picture galleries, and exhibitions, varying somewhat perhaps in different cases in its precise causation, but associated always in a manner significant of its origin with the habits of the observant loiterer. The circumstances in which it arises afford the most reliable clue to its true character. Among these, temperature, atmosphere, and strain, both of body and mind, though commonly combined, play their several parts in varying degrees of activity. The influence of a warm and close atmosphere as a cause of headache is too well known to require more than a passing notice. The torpid congestion of tissue which it tends to induce, and from which the brain is not exempted, is familiar to most of us as a morbid process too often illustrated in our painful experience. It contributes its proportion, doubtless, towards that total of malaise which affects the visitor to a crowded picture-gallery or assembly-room, and culminates in the localised ache which renders the slightest mental effort a weariness. The very general prevalence of this variety of headache, however, and its independence in many instances of any vitiation of atmosphere, teach us to look for its explanation in other causes. The effort of mind implied in long-continued observation, even though this does not involve the strain of study, has probably an appreciable, though a secondary, influence. Fatigue certainly has an important share in its production; but it is with most persons rather fatigue of muscle than of brain. The maintenance of the upright posture during several hours of languid locomotion, the varied and frequent movements of the head commonly in an upward direction, and the similar and equal restlessness of eyes whose focus of vision shifts at every turn as a new object presents itself, form a combined series of forces more powerful in this respect than the sunlight and frequent changes of mental interest and attention by which they are accompanied. The muscular strain implied in these movements is necessarily very considerable. It affects more or less every member of the body, but the distant localisation of the resulting ache has probably much to do with the unusual activity of the cervical extensor and rotator muscles and of the muscles which move the eyeball. Whatever the minor influences at work, therefore, there can be little doubt that mere fatigue is primarily accountable for this most general form of headache, and that rest and nourishment are most reliable antidotes. The utility of stimulants for this purpose is necessarily temporary and deceptive. One improvement on existing arrangements ought to be of real assistance to the suffering sightseer if more generally introduced by responsible authorities. The comparative scarcity of seats in many places of amusement has often been noticed. It would be much to the public advantage if this want were supplied. For the attendants at exhibition stalls a chair for occasional use is an absolute necessity.—*Lancet.*

THE action of sea-water on cast iron is commented upon by C. N. Draper, in a recent number of the *Chemical News.* A specimen of cast iron, weighing 557·31 grammes, and measuring 85mm. by 52mm. by 20mm., was broken from a rail which had been exposed to the alternate action of sea-water and the atmosphere for about 50 years. The lateral surfaces were slightly coated with oxide, and the upper surface consisted, to a depth of 7mm., of a brownish-grey, graphitoidal substance, amounting to 67·59 grammes, and containing 23·6 per cent. of carbon along with much unoxidised iron, presumably existing as FeC_3. The graphitoidal substance was easily removed from the specimen with a knife, leaving a clean, bright, metallic surface exposed. This operation was accompanied by a distinct rise in temperature.

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[64990.]—**Cycle Spokes.**—You had better let the job be. You can try as I have seen done, by making a clamp, and recess it to size. The reason why you could not get spokes to suit, is, doubtless, because the spoke is drawn from wire the size of butt-end, and it is not likely manufacturers will care to make work for which there is no call, and which you may guess would be difficult.—A. M. M. A.

[65042.]—**Cold Bluing.**—I don't remember the recipe for cold bluing referred to by "J. W. M.," though it is not unlikely that some one copied it out and sent it to the "E. M."; but he surely does not mean to say that "Enquire Within" gives a celebrated Italian varnish as a solution of gum-arabic in alcohol! Recipes of that sort are got up, I know, as deliberate hoaxes; but it is too bad to find them repeated in works which are supposed to be edited.—NUN. DOR.

[65056.]—**Box Tunnel.**—To "J. M."—As you request me to give more particulars as to this query, I write to say I was told of the phenomenon by a local gentleman whom I met last summer in Bath. I gathered that the fact of the sun shining occasionally through the tunnel was one that was well known in the neighbourhood; but having some doubts as to the possibility of it, I placed the query in the MECHANIC. I cannot add more.—E. MASHITER.

[65098.]—**Engine and Dynamo.**—To "E.M.F."—Thanks for noticing my query. Engine is not fixed yet; hence my query whether or not it would do its work. With regard to the formulas in "E.M." for finding H.P., none of them actually agree with one another. In the calculation below, I have reckoned the pressure of steam at 50lb., as that would probably be the average pressure, and have reckoned for a cut-off at half-stroke, and 200 revolutions per minute, as the engine would make that, or perhaps more, on account of the stroke being so short.

Area of piston. Pressure. Cut-off. Speed of piston in feet.

$$\frac{12\cdot5664 \times 50 \times \cdot5 \times 141\cdot66}{33\cdot000} = \text{H.P.}$$

$$= 1\cdot3486032\text{H.P.}$$

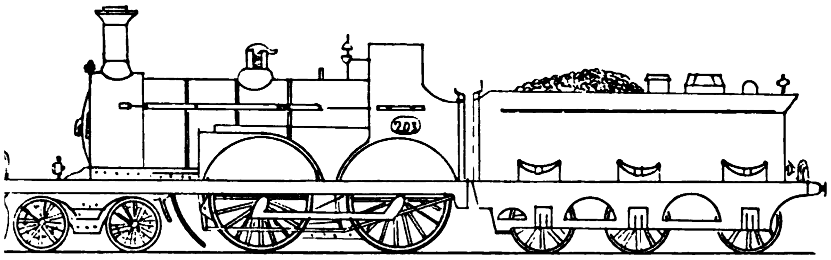
Would that be actual H.P.? Dynamo is of soft cast iron, with nearly 6lb. of 16 on armature fields, holding about 24lb. No. 20 armature cog punchings.—S. T. HAMPTON.

[65109.]—**Steam Launch.**—I should be glad to hear "Mortlake's" reason for saying that a launch of the size mentioned in my query would be unsafe if fitted with a vertical boiler, as most of the small launches I have seen have been so fitted. I should also be obliged to him if he would mention some back numbers of the "E. M." which contain information on this subject.—PUFFER.

[65162.]—**Noise in a Tunnel.**—Having been through this tunnel several times lately in Midland locals and Midland mains, as well as in Chatham and Dover trains, I noticed that the noise referred to by "A Passenger" seemed to be more intense in the case of the main-line trains. What is the exact cause is rather a puzzle to one who has not had an opportunity of examining the road-bed; but it is noteworthy that, entering the tunnel from the Finchley-road end, some distance is traversed before the noise is heard. There are, I believe, two shafts in this tunnel. Is it possible that they act as great speaking pipes, for the noise is like woo—woo—woo?—NUN. DOR.

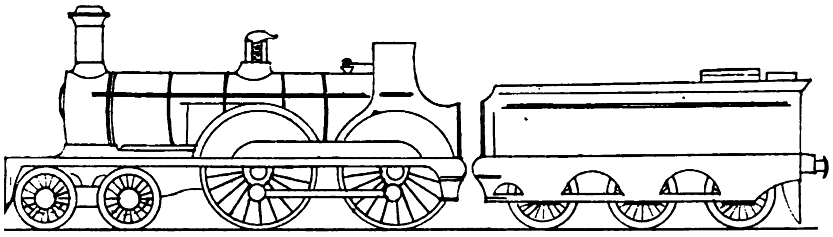
[65165.]—**Violin Repolishing.**—This question has been repeatedly answered. Stain in any way you please (with dragon's blood in spirit, for instance), and use French polish for the varnish. Or do what I should do: look through the "Sale Column" advertisements, and purchase some of the varnish there offered. I saw some specimens at the Inventions, and it struck me as being a very good varnish indeed.—N. U.

[65172.]—**Ritchie's Revolving Magnet.**—Is it not self-induction that influences the size of wire on this motor, and others of the same style—viz., with a rapid make and break? When fine wire is used, and consequently a high E.M.F. on making connection, a counter E.M.F. is induced in the wire, but in the opposite direction to that of the battery current, and thus preventing the iron from magnetising quickly. On breaking connection there is a similar effect, only this time the counter E.M.F. or extra current, as it is often called, is in the same direction as the previous battery current, thus preventing rapid demagnetisation; with thick wire, this effect is not so noticeable, and in that lies the advantage. Many shocking-coils work on this principle, the self-induction current being of an extremely high E.M.F., and alternating.—APPRENTICE ELECTRICIAN.



9.]—**S.E.R. Engines (U.Q.)**—I inclose h of one of the engines asked for. It is . It has 6ft. driving-wheels, I think; the of cylinder I don't know.—G. L.

9.]—**S.E.R. 7ft. Bogie (U.Q.)**—I beg to sketch of S.E.R. 7ft. bogie, 202 class. Chief ions: driving-wheels, 7ft.; bogie-wheels, .; tender-wheels, 4ft. Wheel-base: bogie, .; trailing bogie-wheel to driving, 7ft. 4½in.; to trailing, 8ft. 6in.; tender centres, 6ft. 10ft. 4in. long, 4ft. 4in. diameter; firebox . long; cylinders 19in. by 26in. Heating : firebox, 103·5sq.ft.; tubes, 917sq.ft.; total q.ft. Tender carries 2,630 gallons of water. t (full): engine, 41tons 10cwt.; tender, 10cwt. No dome; Ramsbottom's safety- Painted black, with narrow red lines.— OND.



74.]—**Gas-Lighters.**—Either a spark or an escent wire can be used; but those most in are the portable patterns in which the spark uced by means of a little influence machine, tes of which are revolved by a press button handle or reservoir, illustrated in No. 1,033. ability is not required, any battery will do as there are enough cells, and arrangements adopted for turning the platinum spiral out way when the gas is alight. The querist look up the indices of back volumes.—J. K.

88.]—**Non-sensitive Ink.** — Have you rinter's ink? That ought to stand heat.—).

90.]—**Model Screw Steamer.**—You want electro-motor and a propeller attached to aft—that is all. Battery, of course, would eded. See the model electric launch in 7, p. 113, and look through the indices.—

91.]—**Air-Pump.**—Oil-silk is best material ves, I believe.—S. P.

65.]—**Springs for Safety Valves.**—If ant to know what weight or lead a spring of dimensions will carry, you will have to use rmula, $\frac{S^4 . C . c^1}{d^3 . N}$.

here S = thickness of steel in $\frac{1}{16}$in.
C = constant
c^1 = compression in inches
d = mean diameter coil
N = number of coils.

sing a spring 1in. mean diam., ⅛in. diam. number of coils 40, and compression 4in.

$$\frac{2^4 \times 22{\cdot}8 \times 4}{1^3 \times 40} = \frac{16 \times 22{\cdot}8 \times 4}{1 \times 40} = 36{\cdot}48\text{lb.}$$

$$\text{mpression} = \frac{W d^3}{S^4 C} = \frac{36{\cdot}48\text{lb.} \times 1}{16 \times 22{\cdot}8} \times 40 = 4\text{in.}$$

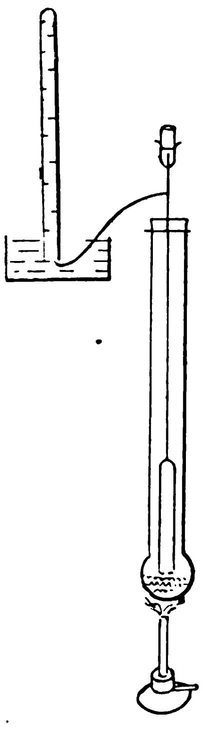
W. C.

72.]—**Soldering Fluid.**—I have prepared ed with satisfactory results a flux for sol- brass, copper, and tin-plate, as under:— actic acid, 1oz. glycerine, 8oz. water. The is inodorous and non-corrosive, and was ed and patented by Mr. C. N. Waile, of on, Mass., U.S.A. Should like Mr. Bot- opinion of it.—W. NORTON, New South- N.

84.]—**Carbons, Lead Capping.**—Ha, ha! eautiful English language. If "A. I. E. E." flect, he will see that in some circumstances nsion" and "contraction" have in effect the neaning. Antimony added to lead causes the alloy to expand at the moment of cooling, and it consequently fills up any line in the mould, hence its use for casting type; but lead also contracts; when it forms a cap on a carbon, say, as it cools, and consequently it holds on tight.—LEXICON.

[65357.]—**Cycle Making.**—(1) Make a die of steel about 1in. square, with shoulders to rest on vice. Make long enough to drill several holes to sizes required. Recess holes about ¼in. deep and ⅜in. diameter, then countersink spoke hole for head, harden, and make set punch for ⅜in. recess, with flat or round end, as desired. (2) If you have any rollers, you might roll the rims into shape, otherwise you might force them near true; then, with a cross-peaned hammer or vice, remove any short bends. (3) A spare link or two, with screws to match; or, if Morgan's chain, have the links made for joining chain. Some provide themselves with a piece of stout copper wire. (4) I think you cannot do better than the following, the only way I have seen wheels tested. Take a single spoke, and fit up with fastenings; test with breaking strain compared with ordinary spoke; make up a wheel, support rim on something to keep hub off ground, and apply pressure to hub; also drop wheel on to ground from a height, say, of several feet. Compare these tests with same on an ordinary wheel.—A. M. M. A.

[65298.]—**Science Exam.**—If you are "well acquainted" with Victor Meyer's method, I cannot understand the reason of your query. I send the sketch of the apparatus.—SM.



[65361.]—**Compensation Curb.** — "Gwent" will find some information about the "Compensation Curb" on page 78 of Britten's "Watch and Clockmakers' Handboook," 6th edition, 1886, a valuable book for either amateur or practical man to possess, with the great advantage of having been brought up to date. I am afraid, however, that the watchmaker "Gwent" mentions has not consumed the midnight oil over its pages. The compensation curb is believed to have been invented by John Harrison— B. 1693, D. 1776— but some writers give the credit to Ferdinand Berthoud (see Reid's work), and it has, as Britten points out, often been modified and reinvented since. "Gwent's" watch probably dates from about the end of the last century, or the beginning of this (more especially if it has the parachute end stone, which often accompanied the compensation curb in good Geneva watches of that period, although not connected with the action of the curb). Harrison applied the compensation curb to his timekeepers, called, in the actual meaning of the word, "chronometers," but which have vertical escapements and compensation curbs. A chrenometer has now come to mean only those timekeepers, for either nautical, astronomical, or pocket use, which have the detached escapement founded upon one invented by Pierre Le Roy somewhere about 1765, and finally evolved by Arnold and Earnshaw into its present form, which is not materially different from what Earnshaw left it, and the compensation balance also perfected by Arnold and Earnshaw, and in the case of the ordinary comp. balance, little altered since the latter's days. The curb was, of course, anterior to the comp. balance, and wrong in principle, as the balance spring once right should theoretically be severely let alone, which the curb by no means does. Roughly speaking, the balance compensates by giving the spring more or less work to do, according as the balance increases or decreases in diameter through the same causes which impart to the spring gain or loss of elasticity—viz., rise or fall of temperature, whereas the curb practically alters the acting portion of the spring itself by closing or opening the curb pins with each change of temperature, thus directly interfering with the spring, and being, therefore, bad in principle. I should say a compensation balance could not be put to the watch in question; but this will depend upon the nature of the escapement and other considerations, and can only be decided after inspection by a really competent, practical man. It might possibly be converted into a lever, and have a comp. balance applied; but this would be a very expensive operation. If "Gwent" is curious about curbs and compensation generally, and desires more information, he will find the subject treated in Beckett's "Clocks, Watches, and Bells"; Nelthropp's "Treatise on Watchwork, Past and Present" (the latter's information about "Curbs," however, is somewhat shaky); Reid's "Watch and Clockmaking," where a chapter is devoted to the subject, with special reference to "Curbs"; Moinet's "Nouveau Traité d'Horlogerie," Vol. II.; a drawing of the comp. curb given; Berthoud's works (the most voluminous writer on horology, see "Essai sur l'Horlogerie," "Traité des Horloges Marines," "Histoire de la Mesure du Temps," &c.), in which all horological matters known in his time (1745—1807) are dealt with; Jurgenson's "Principes de la Mesure du Temps," and Saunier's "Horlogerie Moderne"; but I do not think he need go further than Reid, or (as easier of access) Britten.—STUDENT.

[65393.]—**Screw-Cutting.**—If you had spent a little time working out a simple sum in arithmetic, instead of trying to cut the screw with different wheels, you would have saved a lot of time and trouble. To cut twenty threads in 6½in., with leading screw 4 per inch, you want wheels in the ratio of $\frac{26}{20}$. If your wheels rise by fives, multiply each number by 5 = $\frac{130}{100}$; reduce to $\frac{65}{50}$ $\frac{\text{mandrel}}{\text{screw}}$. If compound train, the following, amongst many other trains, will do it:—

Drivers.	Driven.
20	40
65	25
30	75
65	20
40	80
65	25

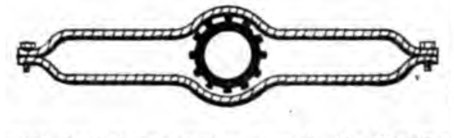
—W. W. C.

[65395.]—**Fixing Charcoal Studies.**—Pin the finished drawing face downwards on a frame, and brush over the back with a weak solution of gum-lac in spirits of wine. The solution should be quite fluid, and about the colour of pale sherry. —R. A.

[65395.]—**Fixing Charcoal Studies.**—The best fixative for crayon or charcoal studies is a weak shellac varnish (say a teaspoonful of shellac to a half-pint of methylated spirits of wine), blown lightly over the drawing through one of those spray siphons sold with perfumes. Another way is to float the studies, face downwards, on milk-and-water.—E. J. PIPPET.

[65395.]—**Fixing Charcoal Studies.**—In the favourite mode of charcoal drawing amongst the French, known as Fusain, the drawing is fixed by taking the drawing in the left hand, holding it before him at 9in. or 10in. distance, and at a slight slope, and then induing it by means of a spray diffuser with a fluid to be bought at Lechertier Barbe, artist's colourmen, Regent-quarant, W.; but I make it myself by simply putting a drachm of mastic spirit varnish into 2oz. of spirits of wine and shaking it up. Any glass spray diffuser will do. Those who do not mind 5s. can get one at the above address of special make.—X. X.

[65396.]—**Electro-Motor.**—TO MR. BOTTONE.—I make, and find excellent in practice, motors from castings of the shape figured. These are

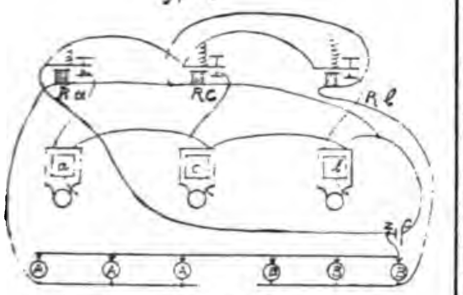


precisely of the dimensions given by Mr. Hopkins in the ENG. MECH. for April 6th, 1888. The best sizes for the wires, and the nearest to the A.W.G., are No. 18 and 20 B.W.G.—S. BOTTONE.

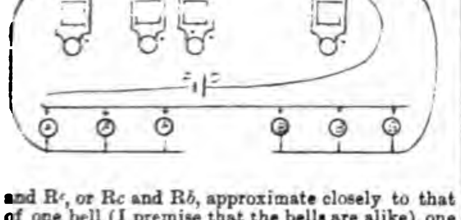
[65401.]—**Block Signalling.**—I would strongly advise "U. O. G. T." to get Mr. Stretton's "Safe Railway Working," which will give him all the information he desires. The number of rings varies on different lines. I will give the Great Northern code bell signals:—To call attention, 1 beat; train on line, 2 beats; be ready for goods, &c., 3; be ready for passenger train, 4; be ready for express goods, 5; obstructive danger signal, 6; stop and examine train, 7; signal given in error (cancel signal last sent), 8; train passed without tail lamp, 9; the other signals, (up to 18 beats) refer to trains breaking loose, testing, and time signals, &c. Dial signals:—Signal correctly repeated, 1 beat of needle to right; ditto, incorrectly, 1 beat to left; passenger train on line, 2 to left; express goods, 3 to left; light engine, 4 to left; through mineral or ballast, 5 to left; slow goods, 6 to left; stop and caution, 7 to left; train out of section, 2 to right; line clear, needle pegged to line clear (to right). When the needle is vertical the line must be considered blocked.—REYMOND.

[65407.]—**Electric Bells.**—The connections for fixing the bells as desired are somewhat complicated; but the only satisfactory way they can be made is as shown in the accompanying diagram, No. 1. R^a, R^c, and R^b are relays completing the bell circuits marked *a*, *c*, and *b* respectively. R^a is in connection with pushes A A A, and R^b in connection with pushes B B B; R^c is in connection with both sets of pushes. 3^c represents the battery. If the resistance of either two relays, R*a* and R^c, or R*c* and R*b*, approximate closely to that of one bell (I premise that the bells are alike), one battery need only be used for both relay and bell circuits. The diagram will be found fully descriptive. Where lines cross and not a dot at the juncture, it is intended to represent that the wires *are not attached*, but where there is a dot at the *juncture the wires are attached.* Why does not "J. W." use two bells at C; then the connections are less complicated, and this arrangement would work equally well? I give below a diagram showing how to fix with two bells at C. One bell would only ring at C whenever A or B called attention.—S. J. M., Boston.

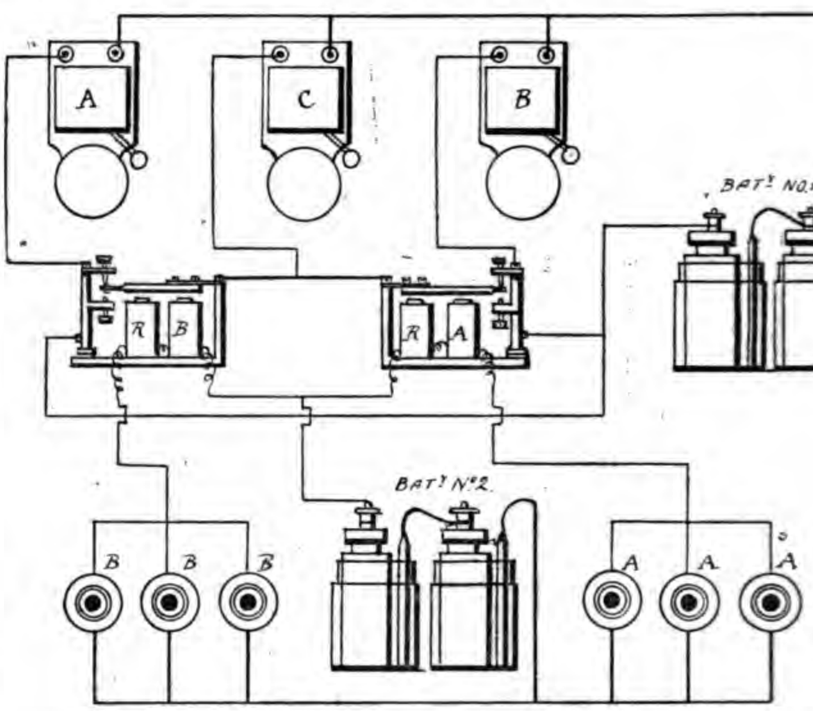
Nº 1



Nº 2



[65407.]—**Electric Bells.**—The accompanying sketch will show how you can work your bells, using two batteries and two relays. Pushes A A A ring bells A and C by means of the relay R A, while pushes B B B ring bells B and C by means of the relay R B. The relay is shown in detail in Fig. 25, page 473 of last volume. When the pushes B B B are pressed, a current flows from battery No. 2 through the coils of relay B B, which thus attracts its armature, throwing the current from battery No. 1 on to bells B and C. The same action takes place when the pushes A A A are pressed only with relay R A and bells A and C. See my reply to 65155, page 240, which was to a similar query, only the relays here take the place of the double-action pushes.—F. C. ALLSOP, Brighton.



[65413.] — **Waterproofing Cardboard.** — If you will crush 2oz. of white shellac and place it in a bottle with 6oz. of methylated spirits, shake up occasionally, and, when dissolved, allow to settle; pour off the clear liquid, and apply with camel's-hair brush; three coats should be sufficient.—THOS. RIGBY.

[65438.]—**Cement for Socket Pipes.**—I have made thousands of socket-pipe joints with red lead and painted yarn, which have stood the test of a lifetime. I have never known one to break or leak.—E. T.

[65438.]—**Cement for Socket Pipes.**—Portland cement, mixed with water to the consistency of mortar, makes good joints for either iron pipes or pot pipes. "Linkum Doddie" must remember, before he makes a joint, to thrust a stick, with a lump of rag large enough to fill the pipe on it, beyond the joint to be made, and to withdraw the stick and rag attached before the cement has set, and thus sweep out any superfluous cement that has reached the interior of the pipe. I knew once of over two miles of piping being ruined for want of this precaution.—D. H.

[65442.]—**Polishing Ebonite.** — Polish with fine brickdust and water, finish with rottenstone and water; use a high speed and light pressure.—H. C. BEAUMONT.

[65444.]—**Governors.**—If you look in the "E.M." for April 13 last, you will find details of a governor of a suitable size for your engine.—W. W. C.

[65445.]—**Bottle Battery.**—Add the sulphuric acid slowly to the chromic-acid solution, and allow to cool before immersing the zinc. Surely, J. Ayres has not allowed the zinc to be immersed while mixing.—H. C. BEAUMONT.

[65445.] — **Bottle Battery.** — Dissolve the chromic acid in the water, and then add the sulphuric acid with constant stirring. When the mixture is cool, it is ready for use. The zincs must be thoroughly amalgamated, or else they will be dissolved rather faster than is pleasant.—PRINCIPIA.

[65445.] — **Bottle Battery.** — Dissolve the chromic acid in the water and then add the sulphuric acid. Of course, in mixing the acid with the water heat is generated, which is probably the trouble you have. The best way is to let the solution cool before using; and even then the battery, when in action, generates heat. As to the destruction of the zinc plates, you cannot run a cell without it, as your current depends upon the said destruction.—S. D. SAUNDERS.

[65445.]—**Bottle Battery, Exciting Fluid for.**—The best proportions are:—Chromic acid, 6oz., by weight; water, 1qt., by measure; sulphuric acid, 6oz., by measure. Dissolve the chromic acid in the water, stirring with a glass rod, in a glazed stoneware vessel. Add the sulphuric acid in a fine stream, with constant stirring. The mixture gets very hot, owing to the condensation which takes place during the combination of the sulphuric acid with the water. When quite cold, it may be poured into the bottle of the battery. Of course this acid attacks the zinc plate, and finally consumes it. Were it not for this action on the zinc plate, no electricity would be set up. See also my book, "Elect. Inst. for Amateurs," in the section devoted to batteries.—S. BOTTONE.

[65447.] — **Finishing Billiard Balls.**—I wonder whether "N. Long" has looked on page 1[illegible] of this volume? There is no book published on the subject.—J. P.

[65448.]—**Portable Canvas Canoe.**—Will not a Berthon boat do? Illustrated in back volumes.—J. T.

[65449.]—**Pump.**—What does "Pump" want a "sketch and particulars" for? If he cannot draw the thing himself he certainly is not competent to make it. There is a diagram on page 94, No. 1,174, and others in back volumes.—S. M. P.

[65450.]—**Achromatic.** — "Actonian" should get Proctor's "Half-Hours with the Telescope," or Noble's "Hours with a Three-Inch Telescope," and then pass to Webb, whose charming book seems in no danger of being outrivalled.—ARTHUR MEE.

[65450.]—**Achromatic.**—As tests for "Actonian's" 3½in. achromatic I may suggest β Orionis, (Rigel), α Lyræ (Vega), α Tauri (Aldebaran), ε Hydræ, the fifth star in the trapezium of Orion and ι Ursæ Majoris (the last is perhaps too severe). Such tests as these, however, are too much dependent on circumstances to be altogether reliable, and if "Actonian" wishes to give his instrument an impartial trial, he will do well to subject it to an examination for possible defects under these heads, viz.:—1. Chromatic aberration, or false colouring of the object. 2. Spherical aberration, resulting in indistinctness of the image. 3. Centring of the lenses, a defect which gives spurious curvature of the object. If when the telescope is directed to the Moon, Venus, or Jupiter, the object is seen surrounded with a violet fringe of light, then the instrument is free from faults under the first head. If, on the contrary, a red or yellow border appears, the object-glass is respectively under or over-corrected for chromatic aberration. To determine whether the telescope is defective in spherical aberration, direct it to a bright star; upon displacing the focus half a turn either way the star will be found to enlarge into a sensible, luminous disc. The outline of this disc should be perfectly regular, of an equable brightness throughout, and the image on one side of the focus should be no better or worse defined than on the other. Any departure from these conditions shows that the object-glass is not a good one, but still not necessarily useless. For the third test, the telescope should be directed to a bright star as before, accurately focussed, and if the stellar image is perfectly round, with no divergent rays, and the little rings of light surrounding it are perfectly circular and concentric with one another, the lenses are perfectly centred. Care should be taken in all these cases to employ several eyepieces, as defects in the magnifiers are often attributed to the object-glass. Webb's "Celestial Objects" is not too advanced for a beginner; the following books may also be serviceable to "Actonian": Westwood Oliver's "Astronomy for Amateurs," Proctor's "Half-hours with the Telescope," and Noble's "Hours with a 3in. Telescope."—AJAX OILEUS.

[65451.]—**Flywheel.**—Make the diameter of flywheel equal 3½ to 4 times the length of stroke of engine if it is for a model. The throw of eccentric (not travel) equals half the travel of valve—i.e., the centre of eccentric to centre of crank-shaft equals half the distance that the valve travels when working direct. The travel will be twice the amount of port opening plus the lap, if any, and size of steam port will depend on the area of cylinder. It is usually about $\frac{1}{15}$th the area of cylinder. The safe pressure of steam will depend on what material the boiler is made of, thickness of plates, diameter of boiler, and the workmanship.—W. W. C.

[65451.]—**Flywheel.**—Yes; you should have it about three or four times the stroke. With this you may take for the weight 100lb. per indicated H.P. The travel of the slide-valve depends on the size of steam-ports, which are about one-twentieth of the area of the cylinder, the length being about three-quarters the diameter of the cylinder. The travel of the eccentric is the amount by which the eccentric is out of truth with the shaft. The best way, if your boiler is small, is to test with cold water force-pump and divide by two-thirds, which then gives the working pressure. The pressure a boiler will stand depends on its shape and good workmanship, besides thickness of plate and soundness of material. Knowing these exactly, the bursting pressure can be found, and by dividing this by 6 you would have an idea of what it ought to bear.—C. ANDREW, Leamington.

[65452.]—**Sensitive Plates.**—I should think Edward's "Isochromatic" plates would do; they are sensitive to yellow light.—AN OLD LEYSIAN.

[65452.]—**Sensitive Plates.**—I think I may safely say that, with our present appliances, you could not get a satisfactory picture with the ruddy glow only from the molten iron. But, on the other hand, nothing would be easier than to get a picture of the scene by the aid of a "flash light," consisting of pyroxyline and magnesium powder in conjunction with the ordinary gelatino-bromide process. The "flash light" would, in this case, prove a positive advantage, as it would give the high lights and deep shadows, which are so characteristic of the weird scene. Full descriptions of the mode of preparing these "flash lights" have appeared in the *Photographic News* for the last five or six weeks.—S. BOTTONE.

[65454.]—**Lamps.**—Having noticed the same thing happen, I put it down to a series of slight explosions of oil vapour between the wick and the burner, and is probably due to a small space between the two. I have found that cutting the wick stops it; formerly, the wick was always rubbed. I only cut the wicks about once a week, at the end of which the wick is very much charred and requires cutting again.—PRINCIPIA.

[65455.]—**Medical Coil.**—From the description you give, the coil has two powers. Fix handles on P. and P.S. for mild currents, and on P.S. and S. for stronger (this takes in remaining terminal).—H. J. J.

[65455.]—**Medical Coil.**—Your coil is probably one that gives two different currents. If the handles are connected to P. and P.S. you will get the primary current, but if to P.S. and S. you will get the secondary current. The general way is to have four terminals, two P.'s and two S.'s; but in this case one of the primary wires and one of the secondary are finished off at one terminal, which amounts to the same thing, and saves having four terminals.—S. D. SAUNDERS.

[65455.]—**Medical Coil.**—The handle cords are to be fixed to the terminals S. and P.S.; this is to get the secondary shock, which can be regulated. To get the primary shock you must have a second regulator, and attach the handles to P. and P.S. Beware of putting the handles on P. and P.S. without a regulator, or you may get rather more shock than you want. The primary coil goes to P. and P.S., and the secondary to S. and P.S.—PRINCIPIA.

[65456.]—**Development of Negatives by Pyrogallol.**—The action of the light is to dissociate the silver from the haloid radicals, to which it is united—viz., iodine and bromine. Under the twofold influence of the developer, which is greedy of oxygen, and of the halogens of the dissociated silver salt, which are greedy of hydrogen, a portion of the water of which the developer is made up splits up, yielding its oxygen to the pyrogallol (or other reducing agent), and its hydrogen to the halogen (bromine, iodine, chlorine, &c.), which thereby become converted into the corresponding haloid acids. The silver is thus set free, and forms the image. The following equation gives a general idea of the reaction—

$$H_2O + \bar{P} + AgI + AgBr = \bar{P}O + HI + HBr + 2Ag.$$

$\bar{P}$ here stands for pyrogallol, or any other reducer. As to photographic literature, I do not think you can do better than read Capt. Abney's works, and the last edition of Hardwich's, "Photographic Chemistry."—S. BOTTONE.

[65457.]—**Ten-Candle Dynamo.**—If you buy a new small dynamo with laminated armature you could work it off an engine 1½in. bore and 3in. stroke, with a horizontal copper boiler 9in. in diameter and 2ft. 6in. long, 3-16in. plate; if well made, would stand 20lb. working pressure. Run engine 200 revs. per minute. Do not mess with copper pipe; have it riveted thoroughly. Mind you have a good feed-pump. A 10-candle would light shop 10ft. by 12ft., if it is not lofty. I would have two lamps and a larger plant, or you might not be able to tell a base coin on your counter.—C. ANDREW, Leamington.

[65461.]—**Entozoa in Fish.**—Most of the finny tribes, both of salt water and fresh, are very subject to internal parasites. The *Intellectual Observer* some years ago gave much information on this subject. The coloured plates, I believe, were from Spencer Cobbold's fine work on "Helminthology." The ova or immature forms of "helminths" are swallowed by quadrupeds, birds, and fishes, which then become "hosts" or supporters of parasitic life; the intruders, subsisting on their friends' gastric fluids, attain maturity, their reproduction going on by ova discharged in the fæces, and being again multiplied by introduction to water, green foliage, or garbage, to be swallowed again and again by all living creatures. In the intermediate stage of growth called *Cysticercus*, very common in the mouse, the house-cat becomes the "host," and is a future sufferer from the jointed tapeworm known as *Tenia mediocanellata*. Raspail, the French doctor, traced this disease among children to their pet cats. Two or three years ago two large pike captured at the mouth of the Elbe were so largely infested by *Trichina spiralis* (probably acquired by diseased offal thrown into the river), that the experts pronounced they contained enough germs to kill a whole town! Still, there are many harmless white worms—notably in the gills of the spent salmon before returning to the sea. Much depends on the class of parasites, but boiling or frying will kill all of them. Spencer Cobbold very long ago predicted that the insanitary practice of making our town sewers tributaries to our main rivers would end in the multiplication of parasitic diseases; moreover, he specially warned the nation against liquid sewage systems on grass lands and green herbage, all animals grazing thereon being certain to contract entozoic disorders. I read of a case a few months ago ending in the painful death of a young lady on a visit to some large town, gathering impure watercress loaded with deadly ova. Steeping any raw substances in strong salt and water is, I consider, the best precaution we possess. "Hydatids" can be propagated in the human system by dirty vegetables, as lettuce, celery, cress, &c.—EOS.

[65466.]—**Mahomet's Coffin.**—I made one of these some years ago to form an attraction for a shop window. The coffin was made of thin tin (so-called), and covered with black cloth. It had two fine black threads attached underneath it, one near each end. These were fixed at their lower ends to the frame on which the whole was mounted. On top of the frame, and hidden from view, was placed a permanent horse-shoe magnet of considerable power. The coffin was then lifted until it was sufficiently attracted by the magnet to remain suspended in mid-air, the two silken threads preventing it touching the poles. A black board was placed in the background, and at a short distance it was impossible to detect any means of support. The fact of the observer insisting there is no support only proves that the illusion has been properly performed.—ALADDIN.

[65467.]—**Gloomy London.**—I have often observed, from Wandsworth Common, the appearance noticed by "Z.," especially at sunset—the sky beautifully clear on every horizon except on the London side, which shows a murky, coppery tint. It is the smoke which causes the appearance (aided at morning and evening by the mist from the river), for though the smoke at Sheffield is much denser, if equally spread over the whole of the Metropolitan area it would be imperceptible. When approaching from the east there is a thickness of at least ten miles of this imperceptible smoke, which, by absorbing the light, appears dark and gloomy, just as the bottom of the sea is darkened by the absorption of light by a sufficient depth of apparently transparent water.—REYMOND.

[65468.]—**Astro. Eyepieces.**—Where did the querist read those statements about eyepieces? Nothing much above 60 will take in sun or moon.—ARTHUR MEE.

[65469.]—**Choice of Specula.**—I should choose the speculum of longest focus (assuming its perfection to be equal to the others), as it will take more work off the eyepieces than will the mirrors of shorter focus. A 10in. mirror should theoretically bear a magnifying power of 1,000.—ARTHUR MEE.

[65471.]—**Electric Tests.**—TO MR. BOTTONE.—Not knowing the instrument, I cannot reply in a satisfactory manner. It is, however, very evident that the switch bar is used to lower the sensibility of the galvanometer and enable you to test for C. instead of E.M.F. I should hardly think the cracked insulators would account for the deflection in dry weather. For the amount of leakage along the line, which has been tested by Prescott and Hughes on a line 300 miles long, and found to be, with mean insulation, one-third of the current sent, see Kemp's "Electric Testing," or "Testing Instructions," by Schwendler.—S. BOTTONE.

[65472.]—**Problem.**—Taking the formula for train resistance $R = 12 + \frac{v^2}{114}$, we find that the value of R at 55 miles per hour is 38·53lb. This, multiplied by 200, gives 7,706lb. as total pull, and, multiplying this by 4,840, the number of feet passed over in a minute, we get 37,321,040ft.-lb. as the work done on the train by the engine in that time. To give a mass of 200 tons a velocity of 55 miles an hour would require an amount of force varying inversely as the time during which it is allowed to act, and unless the time be distinctly specified the force cannot be calculated. The energy of the train is not the above amount of work, but is considerably greater. The gun experiment described by Mr. Griffiths has not been tried, and in all probability will never be tried; 1lb. of gunpowder evolves 705lb. degrees Centigrade of heat on burning; 1lb. of sulphur gives 2,220. I have not the numbers for dynamite and potassium at hand. Saltpetre will not burn at all, so it is impossible to answer the query respecting it.—WM. JOHN GREY, F.C.S., Analytical Chemist, Newcastle-on-Tyne.

[65473.]—**Survival.**—"B.'s" idea is no doubt correct—the "survival of the fittest" means the survival of the masters, or as he puts it, the "biggest bullies" and "most slippery weaklings," for which you can read the "physically strongest" and the "mentally cleverest." In a state of nature, or barbarism, where does he suppose the namby-pamby imitations of men would go to? Does he think they would survive? Those who are opposed to Darwinism (I wish they would copy Darwin's method of arguing) might consult a series of papers by Prof. St. George Mivart in the *Tablet*. Here is a bit from last week's number: "Therefore, intelligent purpose acts, and must act, in Evolution. It is evident, *à priori*, that the Genesis of Species, at the very least, may have a non-physical cause. But if its cause is in fact non-physical, then it must necessarily for ever remain unknown and strange to all merely physical science. But if, as philosophy assures us, it is due to a cause which is also the cause of our own intelligence and power of volition, it must be a non-physical cause. No wonder, then, if men devoted to physical science, but who are no philosophers, seek to explain Evolution by causes within their own province, but which are hopelessly and necessarily inadequate, so that they may even come to accept as a scientific truth that most absurd of all absurd propositions—namely, the proposition that 'natural selection' is the cause of 'the origin of species.'" And yet I venture to think that natural selection (in its fullest meaning) is the cause of the origin of species. If it is not, what is? and why should not that cause act more directly?—NUN. DOR.

[65474.]—**Mercury Pump.**—There is a mercury pump illustrated on p. 193, No. 1158. There is another simple one on p. 34, No. 886, and there is any amount of information in back numbers. The construction of a Sprengel is fairly within the capability of an amateur glass blower; but he really should not ask what is the best diameter of tube, or which glass to use, for it depends entirely on his taste.—T. C. L.

[65475.]—**Field Winding.**—TO MR. BOTTONE.—Many years ago I wound a dynamo with sheet-iron bobbins. The result was a complete failure. Two years ago I was called to see a dynamo (amateur made) set up for a plater at Clerkenwell. This one had wire wound on split brass bobbins; result very poor. My experience is to avoid bobbins as far as possible, as the distance which is placed between the iron and the coils is so much power lost. Continuous bobbins, especially if of sheet-iron, are bad. The only ones I should advise you to use for a small dynamo would be firm, brown-paper tubes, made like a rocket case.—S. BOTTONE.

[65477.]—**Size of Condenser.**—TO MR. BOTTONE.—You might use 100 sheets of tinfoil 5in. by 7in. See also my book, "Elect. Inst. for Amateurs," on this point. If the distance is very short, you might use No. 22; but the resistance of this is very high—viz., 8 ohms per pound, while its carrying power is low, about 1·5 ampère, without heating. I should therefore advise not a less gauge than 20; No. 16 if the distance is over ten yards.—S. BOTTONE.

[65482.]—**Geneva Watch.**—Look well to the teeth of the barrel, and see that they are not bent, or centre pinion defective. Also the stop work, if it should have one.—B. G. H.

[65484.]—**Nitre, Purifying.**—Dissolve the crude nitre in as little hot water as will dissolve it. Run it, while warm, through Swedish filtering paper, supported on an earthen or glass funnel. Set the filtered fluid aside to crystallise in a cool place, free from dust. The citrate of silver can be converted into a good plating solution by the addition of an excess of solution of potassium cyanide.—S. BOTTONE.

[65484.]—**Nitre.**—On the supposition that you only require to purify a small quantity, perhaps the following will be the best method:—Boil together two parts of nitre and one of water in a glass or porcelain vessel; when dissolved, filter, and allow to cool. The liquid is now poured off, and the crystals washed once or twice with cold distilled water. A portion dissolved in distilled water should give no precipitate with solutions of barium chloride, silver nitrate, or potassium carbonate. The silver citrate might possibly be used in plating, if you have it on hand; but I should not make it on purpose. Perhaps you could get Napier's "Electro-Metallurgy," which would give every information.—PRINCIPIA.

[65485.]—**Electromotor for Coffee Mill.**—TO MR. BOTTONE.—A 1-man-power motor, such as is usually employed to drive a sewing machine, would, I should imagine, suit this, provided the coffee-mill were furnished with a rather heavy fly-wheel to equalise the motion. Six cells of bichromate or chromic-acid battery, one-gallon capacity each cell, would be needed to give satisfactory results. Price of battery about £3; price of motor £1 10s. to £2 10s., according to style and finish.—S. BOTTONE.

[65486.]—**Electrical.**—A good solution for this battery is made as follows:—Water, 1qt.; pot. bichromate, 4oz.; sulphuric acid, 4fl.oz. Dissolve the bichromate in the water, and add the acid slowly. When the action gets feeble add 2fl.oz. more of sulphuric acid. The solution will last about 1½ hour. It is best kept in a stoppered bottle, and will not crystallise unless it is allowed to evaporate.—PRINCIPIA.

[65486.]—**Electrical Battery Solution.**—See also reply 65445, which gives the best results I know for short powerful effects, say two to three hours right off. Trouvé's solution, which is also very good, consists of: Finely-powdered potassium bichromate, 6oz., dissolved in tepid water; 4½fl.oz. of sulphuric acid are then added with constant stirring, and the whole allowed to cool. This solution will also run for three or four consecutive hours. It need only be kept away from dust, and will keep good for years in a glass bottle. When exhausted it is deep bottle-green, and should be thrown away, or used as a disinfectant in the w.c., &c., unless you wish to crystallise out the chrome alum.—S. BOTTONE.

[65487].—**Amalgamating Zincs.**—Add some neutral sulphate of mercury to the battery solution; the zinc will amalgamate itself, forming sulphuric acid as well.—AN OLD LEYSIAN.

[65487.]—**Amalgamating Zincs.**—It does not matter what the zinc is for. Rub it over with glass paper, dip in dilute solution of sulphuric acid, and rub mercury over with a wisp of tow.—B. H.

[65487.]—**Amalgamating Zincs.**—Place the zinc in dilute H_2SO_4, and allow it to remain for a few minutes; take it out, and while wet place on *it a few globules of mercury,* and rub it all over *(face and edge) with a piece of rag* moistened with H_2SO_4. After the operation it should present a uniform silver-like surface.—H. H. B. CHESTERFIELD.

[65487.]—**Amalgamating Zincs.**—Immerse the zincs in dilute sulphuric acid to clean them, then brush mercury all over them by means of a cane brush (a piece of cane split into a brush at one end). If you have sufficient mercury the zincs may be dipped, always keeping dilute sulphuric acid covering the mercury.—H. C. BEAUMONT.

[65487.]—**Amalgamating Zincs.**—Clean them in dilute sulphuric acid, then lay them flat and pour a little mercury on and rub in with the tips of the fingers (for preference). If the mercury will not take (which sometimes happens) sprinkle on a little sand and rub as before. They should be amalgamated with the acid on them.—S. D. SAUNDERS.

[65487.]—**Amalgamating Zincs.**—Lay them in a flat dish, cover them with water, just soured by the addition of spirits of salt. Get an old nail-brush, or 1d. gum-brush, pour an ounce of mercury over the plates, and rub with the brush until the whole surface of the plates looks like a looking-glass. Wash in water, and rear up to dry and drain. Keep the excess of mercury for next time.—S. BOTTONE.

[65487.]—**Amalgamating Zincs.**—Lay the zincs in a flat dish and cover with dilute sulphuric acid (1 : 10). Scrub well with an old tooth brush, and pour on some mercury, which is to be rubbed all over the zinc until it looks like silver. If the zincs are "greasy," rub with a little sand or emery. I always rub the mercury in with my fingers, and find it better than a brush.—PRINCIPIA.

[65488.]—**S.W. Engines.**—I have recently seen in the yard at Nine Elms an engine called "Windsor," apparently waiting to be scrapped, which answers to your description. I do not know number or date; possibly it may be one of Beattie's, built by Beyer, Peacock, and Co. about 1863. There were some engines built in 1885 by the L.S.W.R. Co. with 4-coupled wheels, 5ft. diam.; cylinders, 15in. by 24in. Their numbers were 128 and 129; but the latter has recently been replaced by a bogie side-tank. No. 128 may still be running; but I could not say.—REYMOND.

[65491.]—**Galvanised Iron Wire.**—Yes, galvanised iron wires are coated with zinc. The zinc coating certainly conducts some current, the amount depending upon the ratio between the resistance of the zinc coating to that of the iron wire. "Satine" evidently thinks that if two paths are open to a current it will be entirely carried by the path composed of the metal or conductor having the lowest specific resistance (i.e., the highest specific conductivity). This is not the case. The current will divide and flow through the two conductors in inverse proportion to their resistances (not specific resistances).—H. C. BEAUMONT.

[65495.]—**Volatile Solid.**—For what purpose do you require it? Would ammonium chloride be of any use?—H. H. B. CHESTERFIELD.

Composition of Water.—In a paper "On the Composition of Water by Volume," by Mr. A. Scott (*Proceedings*, Royal Society), the ratio by volume in which oxygen and hydrogen combine at 0° and 760mm. is redetermined. The apparatus used is so arranged that both gases are measured in the same vessel, a separate vessel being used for exploding. After explosion, the residue was analysed by exploding with oxygen or hydrogen, and the impurity—nitrogen and carbonic anhydride—determined. The oxygen was obtained from potassic chlorate and from mercuric oxide prepared from the nitrate; the hydrogen was obtained by electrolysis. The ratio obtained is 1·994 : 1, which with 15·9627 for the density of oxygen, gives 16·01 as the atomic weight of oxygen.

Horse-Power of Locomotives.—In an article on the cost of draught in a locomotive boiler, the *Railway Master Mechanic* assumes that, because "it is not uncommon to have a back pressure in a locomotive cylinder of 7lb. per square inch, the unnecessary, or rather undesirable, loss due to the compulsory back pressure to blow the fires" is the whole of this 7lb., and calculates as follows:—"We will assume an 18in. by 24in. locomotive to be running at 50 miles per hour; the driving-wheels to be 5½ft. in diameter; the revolutions per mile, including slippage, to be about 300; the revolutions per minute to be 50 × 300 ÷ 60 = 250; and the piston speed in feet per minute to be 250 × 8 = 2,000ft. for both cylinders. During this 2,000ft. the piston is working 1½ft. for each 2ft. against 7lb. pressure per square inch. That is equal to three-fourths of the distance, or 1,500ft. The area of an 18in. piston is 254 square inches; the horse-power is then 254 × 7 × 1,500 ÷ 33,000 = 80H.P. This is only an approximation to the average case, yet it is the condition under which many locomotives work."

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

Since our last, "G. L." has replied to 64999; "Reymond," 64999.

64892. Mechanics, p. 112.
64899. Blast Furnace Gases, 112.
64910. Huge Aërolites, 112.
64917. Photo-Litho Transfer, 112.
64926. Band-Saw Machine at New York, 112.
64930. To "Moonstarer," 112.
64938. Spectacle Lenses.

65140. Stirring Gear, p. 200.
65142. L.B. and S.C.R. Locomotives, 200.
65150. Telescope, 200.
65152. Boiler, 200.
65153. Straps, 200.
65159. Compounds on Great Western, 200.
65176. Clockwork recording Cylinder, 201.
65182. Hand Press, 201.
65187. Half-plate Rectilinear Lens, 201.
65189. Polishing Lathe, 201.

QUERIES.

[65496.]—**Violoncello.**—What is the best position approximately for the soundpost of a violoncello, and how is the back taken off?—CABINET MAKER.

[65497.]—**Self-steering Perambulators.**—Can any of your readers inform me as to which of the numerous types of the above are best and cheapest, and adapted for rough and gravelly roads?—GLATTON.

[65498.]—**Rainfall.**—Can any reader inform me what amount of evaporation or absorption of rainfall is allowed per acre? A formula will oblige.—JOHN.

[65499.]—**Amylic Ethers.**—I am anxious to learn how the above are prepared, such as the acetic and others used as essences. Any information on the subject will be received with thanks by—CONFECTIONER.

[65500.]—**Paraffin Wax.**—I have unfortunately splashed my coat and tablecloth with melted paraffin wax. Would some kind friend advise me as to the best way of getting out the marks of the same?—HARRY FRIVOLI.

[65501.]—**Electric Bell.**—TO MR. BOTTONE OR OTHERS.—I wish to ring a bell of the church pattern, 10in. diam., 8in. high, by electricity. Please advise me as to size of magnets, weight of hammer, quantity of wire, &c. Also what number of Leclanché batteries would I require to work the same?—BELL.

[65502.]—**Eyepieces.**—Could any of our optical friends oblige me by describing the shape, size, and focus of a set of lenses for constructing a pancratic or terrestrial eyepiece for a 2¼in. Wray's o.g., 30in. focus? Power wanted about 40. My sliding tube is 1¼in. diam.—J. R. T.

[65503.]—**Gas-Engine.**—Will "Engineer, Torquay," kindly say how many cubic inches I should allow in compression chamber of a 2½in. bore, 4in. stroke cylinder? What proportion of gas to air should be used, and what would be the power of an engine of this size running 150 revs. a minute?—J. M.

[65504.]—**Electrical Tools.**—I am an assistant in a chemist's shop, and have several medical batteries, constant and intermittent, to look after. Will you kindly say what tools would be most useful? If a galvanometer, would Woodhouse and Rawson's "Jolin" pocket one be the best?—VOOGHT.

[65505.]—**Lead Alloy.**—I want to make some toys of lead. I run them in a mould, but cannot get them hard enough. Will any of your readers tell me what to mix with the lead and how to mix it? I have tried zinc and lead; but cannot mix it right.—AN AMATEUR.

[65506.]—**Melted Steel.**—Will some kind reader oblige me with the melting point of steel in Centigrade degrees?—X. X.

[65507.]—**Vulcabestos.**—Will some reader inform me if there is such a material as vulcabestos combining all the properties of rubber and asbestos, or any other flexible material that will stand steam and is capable of being screwed with a fine thread; if possible, where it is made?—VULCABESTOS.

[65508.]—**Culvert.**—Will some reader kindly tell me how much water a culvert in concrete will carry? The distance from one station to the other is 1½ mile, and is 18ft. lower—i.e., there will be a fall of 18ft. in the 1½ mile. The water will also be pumped into a tank 12ft. high, thus making a total fall of 30ft. The culvert is half round, 42in. by 21in.—i.e., if the circle was completed the diam. would be 42in. In answering please give rule for working same.—JOHN PARAMOR.

[65509.]—**Pendulum for Electric Clock.**—I have fitted up an electric clock. The pendulum is to be driven by an electro-magnet under the pendulum bob, but I cannot get the contact maker to act right. I have watched "our" columns a long time, but have not seen one described. Would any of "ours" kindly enlighten me?—MONTE CHRISTO.

[65510.]—**Hot-air Engine.**—Will some reader be good enough to tell me how and of what material to make the displacer of a hot-air engine (model), the diameter of cylinder being 1½in. and stroke of displacer 1½in., length of hot-air cylinder 3in.?—AN AMATEUR.

[65511.]—**Cleaning Velvet.**—Will some kind reader tell me if there is any possibility of cleaning velvet without injuring the pile? Any attempt I have made has always either flattened it down or made it adhere together, so that instead of reviving the velvet I have simply extended the stain. I have not succeeded in dividing the fibres of the pile either by brushing.—VELVET SPOT.

an easy method of getting the antimony out of some old stereotype metal?—NUNQUAM.

[65553.]—**Parrots affected with the Gapes.**—Will some one kindly tell me what to give a parrot affected with the gapes and a difficulty in breathing?—W. H. S.

[65554.]—**To Mr. Bottone.**—Will you please tell me how long an accumulator, with plates 1½ft. by 6in. will light a 2½c.p. lamp, if charged for six hours?—AN OLD LEYSIAN.

[65555.]—**Telescopic O.G.**—TO MR. BRADBURY.—Will you kindly give me your opinion of the following formula, stating how the curves are for correction of chro. and sph. aberration?—Hard crown, 2·485 C. and G. lines, 1·5146 and 15,280; dense flint, 3·66 C. and G. lines, 1·6175 and 1·6453; compound focus 24, ratio of foci 26 to 46, crown focus 10·14, flint focus 17·55. Crown $r_1 = 13·1$, $r_2 = 8·67$, flint $r_3 = 8·67$, $r_4 = 43·35$, diameter of o.g., 1·8.—J. A. CAMPBELL.

[65556.]—**Zinc Paint.**—Would any of your numerous readers kindly inform one in a dilemma which, if any, of the paints may be called permanent and adherent in any way to zinc? I have tried several, but they prove utter failures. I have asked the opinions of others, and they all hold out very poor hopes of success. Now, this is very discouraging, for I have spent the best part of two years and infinite labour in making a zinc model torpedo boat, engines and boilers, and am now woefully disconcerted to find that I am to be baffled by such a trifling (seemed so to me before I undertook it) thing as the painting of the same. I may add that the boat is destined to be used in salt water. Plenty of people seem—nay, are, very willing to criticise and predict that my efforts will prove miserable failures, but none have been generous enough to give me a helping hand out of the mire.—ESCA.

[65557.]—**Spark for Gas-Engine.**—TO MR. BOTTONE.—Will you have the kindness to say which is the best means to obtain a spark for the ignition of the gases of a gas-engine? As the engine is to run ten hours at a stretch, a primary battery and coil is hardly permissible. Would a small dynamo driven by engine be suitable for this purpose, and would it be necessary to have a coil in conjunction with the dynamo? The engine has a self-starter.—H. H. R.

[65558.]—**Land Property.**—I have had in my possession a piece of land which formerly was common land, but was claimed by the lord of the manor. I hired it 30 years ago, and always paid rent for it, but have not been asked for it for 17 years, have paid a property tax and all town dues that come against it, and now lately I have been asked for the rent. Can I claim it for my own, or shall I be obliged to pay rent for it again?—T. W.

[65559.]—**Concrete Floor.**—Thanks to F. Caws for his reply to my last query. He mentions that the floor I specified will be a "quick conductor." Is this because concrete is used? If there is any better mixture, I shall be pleased to have particulars. I note several firms advertise mixtures under different names for fireproof flooring. In what do they differ from ordinary concrete? Mr. Caws also states that the floor I mention would not be sufficiently strong without supports underneath? As I could not well do with columns, I should be compelled to use girders the full width, 30ft. If these were not fireproof cased, would it not make the whole floor useless? What would be the best material to case them with if I had them on the underside of the floor?—J. W.

[65560.]—**Drying Stove.**—I shall be pleased if "Marienberg" will kindly inform me how much coal per 12 hours the steam from a 3H.P. boiler he mentions will mean, the steam to be taken from a 20-horse boiler at 30lb. pressure? I have noticed in a number of last week's papers particulars of a new stove for drying purposes, and think I could use the same principle in drying timber. Will some correspondent kindly say how much coke used in one of these stoves would be equal, say, to 1cwt. of coal in a Lancashire boiler of 20H.P. and 30lb. pressure, the steam from this boiler to be used in coils for heating the air to be used, in both instances the air to be raised from 60 to 100° of temperature?—J. W.

[65561.]—**Shocking Coil.**—I have wound a coil 2½ long, ⅝ core, with six laps of 28 silk-covered wire, and about twelve laps of 36 cotton-covered. I have a separate contact breaker. I have the bobbins with No. 36. Should these be the same No. as the primary on the coil? The reel is made of wood turned down thin. I have not insulated the primary at all—ought I? On the secondary I have one lap of thin paper between each lap of wire. The one I have made will act, but not as strong as I am told it ought to do. I have had six Leclanché cells to work it, but it was not more than a person could hold. I am going to make another 5in. long ⅞ core. What size of wire would be suitable, and how much?—C. F. FOWLER.

[65562.]—**Working Printing Engines.**—I am a printer having three machines in my machine-room all driven off one shaft, the engine being in other premises. I experience great difficulty in working them economically from this cause—that the machines require to be driven at different speeds, according to the class of work on which they are engaged. For instance, a machine may be printing a heavy poster, which would tear the paper if printed at more than 200 per hour, whereas the next job on the same machine may be a light one which can be run at 1,000 per hour. What apparatus can your practical readers suggest for readily getting these variable speeds without stopping the main shaft, and without the expense of "rigger" shafting with three or four speed-pulleys to each machine? Are friction clutches at all available, or cone-pulleys?—S. J.

[65563.]—**Telephone Appliance.**—Could any reader tell me if there is an appliance to attach to the head, so as to hold a Bell telephone receiver about 6in. long to the ear, to obviate holding there by the hand, and so making arm ache? It would be for male or female telephone operator. Any suggestions or drawings will be thankfully received by—VOOGHT.

[65564.]—**Dynamo.**—TO MR. BOTTONE.—I have made a dynamo; the armature is 2in. diam. and the wire space is 1½in. wide and ⅝in. deep, and the length is 6in. What kind of iron must I have it cast with, and would you be kind enough to tell me the quantity and the size of wire to wind the armature and magnets with, and what current it will produce?—as I want a current of great E.M.F. for incandescent and small arc lighting, and I want to know if I could light two arc lamps with carbons 3-16in., and how many 5c.p. incandescent lamps could I light as well as the arcs, and what voltage they must be?—J. H.

[65565.]—**Water Power.**—Molesworth's "Pocket Book" gives the formula for conversion of the power of water-wheels into its equivalent horse-power as—H.P. $= ·001892\,Q\,h$, where $Q =$ quantity of water in cube feet per minute, and $h =$ height of water from tail race in feet. How is the ·001892 arrived at?—PROBLEM.

[65566.]—**Plating Dynamo.**—TO MR. BOTTONE.—Many thanks for the reply to my query No. 65330. May I trouble you once more to make clear the following? Would ⅝in. be thick enough for core of A.? Do I understand it to be a single layer of wire on A., six turns in a coil, as this would be about two yards? Do you supply punchings? I have lately got your book. About what speed should dynamo be driven?—M.

[65567.]—**Ice Cream.**—Would some kind friend answer the following questions? What metal are freezers made from?—they look like zinc, yet zinc is never used for culinary purposes. Do they have a stud at bottom to revolve on? What is the object for revolving when the ice is all round alike? Would some maker of plant advertise his address in Sixpenny Sale Column?—E. T.

[65568.]—**Oil Varnish for Violins.**—Can any of your correspondents tell me how to make an oil varnish suitable for varnishing violins, and the way to lay said varnish on, or where said varnish could be procured?—H. E. S. H.

The Inequalities of Men.—M. Lapouge, of Montpellier, recently delivered before the Faculty of Natural Sciences in that town a series of lectures on inequalities among men, in the course of which he said that the political dogma of equality rests on hypotheses which are utterly false. He distinguished four social types among mankind:—(1) The initiators, who show mankind the way into the region of the unknown, and who go in front. Restless and daring, with an intelligence which is at least equal to the average, men of this type do not travel readily along beaten tracks. New ideas are the breath of life to them. They spend their lives in new creations: they are often wrecked, but the true genius represents the most perfect form of this type. (2) Men of spirit, of intelligence, who, possessing no creative power themselves, yet carry out and perfect the ideas and discoveries of the first type, to which they are really the complement. (3) Men who, with much or little intelligence, can work only with others, who mistrust every new idea not accepted by all the others, but who seize it with avidity when their neighbours adopt it. If intelligent, these men are docile, but they dislike every change in routine, and they represent the dulness of the mass in the face of every reform. (4) Men of this type are not fit to attain even the smallest step in culture. Evidently every man cannot be classed under one or other of these divisions. In human societies clear lines of demarcation do not exist, but for general purposes the distinction is sufficiently evident. The superiority of a race or nation depends on the greater or smaller number of men of the first two classes. The race which is richest in the first type is the blonde dolichocephalic, and this has been the case even when the people among whom they lived were not of this kind. In Egypt, Chaldea, Assyria, Persia, India, and even in China men of this type ruled. In the Greek and Roman world it was the same, and it is so still. In our own day the rank of a nation corresponds with the strength of the blonde dolichocephalic element. The Gallic and Frank elements which made France great were of this type, and it plays the same part in England, Germany, and America. Near these come the Semitic and Mediterranean races, who had reached a high grade of civilisation when the blonde dolichocephalic peoples were still savages. The remainder of mankind must be reckoned the passive races. The brachycephalic races of Europe, the Celto-Slavs, rarely produce men of the first intellectual type. In the social changes of recent years brachycephalic men, who form the lower classes, have been elevated and brought forward, and herein, the lecturer thought, lies the great danger of the future deterioration of the French nation. The existence of the superior blonde dolichocephalic type is threatened by amalgamation with the dark brachycephalic and inferior races.

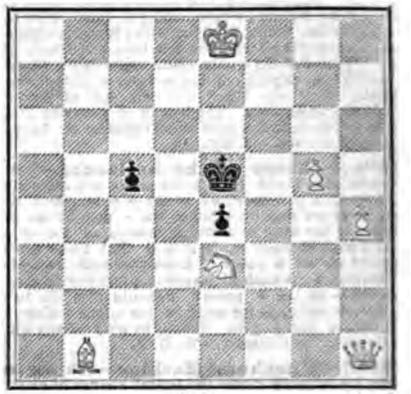
Milk Jelly.—Many invalids, when their food is limited to milk diet, come to loathe it very heartily, but they would find milk jelly a pleasant variation on the form in which it is usually offered to them. Here is a recipe: Heat one quart of milk with one pound of sugar, and when the sugar is dissolved continue the heat, at a boiling temperature, for about ten minutes. Now cool it well, and then add, slowly stirring, a solution of one ounce of gelatine in a cupful of water. Next add the juice of three or four lemons and three wineglasses full of wine, brandy, or other liquor. Set the glasses containing the mixture in a cold place, so that the contents may set. It is necessary to have the milk quite cold before the other ingredients are added, as it would otherwise curdle.

CHESS.

ALL communications for this department must be addressed to J. PIERCE, Langley House, Dorking.

PROBLEM MC.

Black.



White. [6 + 3

White to play and mate in two moves.

SOLUTION TO 1,098.

White.	*Black.*
1. P-B 3.	1. Anything.
2. Q, R, B, Kt, or P mates.	

(Eight variations.)

This problem has a second solution 1. B takes P.

NOTICES TO CORRESPONDENTS.

CORRECT solutions to 1,098 by J. Kilbee, Black Pawn (2), G. W. Middleton (2), H. Fellows, R. G. Briscoe, A. Wheeler, J. Methuen, and J. Bryden (2); to 1,097 by A. Wheeler, R. G. Briscoe, T. H. Billington, J. Kilbee (but variations not given), Black Pawn, and G. W. Middleton (very pleasing).

H. FELLOWS.—If Black cannot move any piece, it is stale-mate—that is, the game is a draw.

MR. ALLAN GREENWELL of the Newcastle Chess Club, has just published a handy chart of the chess openings.

REV. A. B SKIPWORTH has resigned office as hon. secretary of the Counties Chess Association; and the association will in all probability cease to exist.

MR. J. W. ABBOTT, who was first editor of the Chess column in the ENGLISH MECHANIC, has succeeded the late Mr. P. T. Duffy as chess editor of the *Illustrated London News*.

THE amateur championship of the British Chess Association has been won by Mr. C. D. Locock, Mr. F. Anger winning the second prize; the third and fourth being equally divided between Mr. D. Y. Mills and Mr. G. [illegible] Wainright.

THE British Chess Club Handicap promises to be a great success. Six prizes are offered amounting to £3[illegible]. There is already a large number of entries, including Messrs. Bird, Blackburne, Gunsberg, Mason, Pollock, and Zukertort.

CAPTAIN MACKENZIE and Messrs. Hanham and Loyd are expected to visit England this summer to, participate in the coming International Congress at Bradford.

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ERS TO CORRESPONDENTS.

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HINTS TO CORRESPONDENTS.

on one side of the paper only, and put drawings tions on separate pieces of paper. 2. Put titles and when answering queries put the numbers the titles of the queries to which the replies No charge is made for inserting letters, queries, 4. Letters or queries asking for addresses of rers or correspondents, or where tools or other n be purchased, or replies giving such informa- t be inserted except as advertisements. 5. No king for educational or scientific information l through the post. 6. Letters sent to corre- under cover to the Editor, are not forwarded, ames of correspondents are not given to in-

ntion is especially drawn to Hint No. 4. The ted to letters, queries, and replies is meant for l good, and it is not fair to occupy it with ques- as are indicated above, which are only of indi- rest, and which, if not advertisements in them- l to replies which are. The "Sixpenny Sale ffers a cheap means of obtaining such informa- e trust our readers will avail themselves of it.

ing are the initials, &c., of letters to hand up nesday evening, June 6, and unacknowledged e:—

wn.—R. Gibbard.—C. S. Stock.—J. Boggis.— ner.—E. C. Bousfield.—Zinc Worker.—Clement on.—J. R. M. Thompson.—M. A. C.—J. H. S.— Monck.—Somerset Lad.—B.Sc., Plymouth.— —J. L. C.—R. J. H.—Pater.—A. Bird.—F. A. M. eer, St. Mary Church.—H. C. Beaumont.—G. R. eer.—W. Granger.—Iron Enamel.—H. C.— E., Electrician, Torquay.—W. A. Walton.— J. Parker.—C. Andrews.—An Old Leysian.— . A.—F. Caws.

(The moment that the tentative Greenwich reckoning the 24 hours right round from mid- midnight is adopted, your suggested alteration made. As at present there are two twelves in rnal reckoning, we prefer to employ language standed of the people." Thousands of our use the "Notes," and you are the very first and rson who has found this fault with them. We you know that the moon may even not cross idian at all during the astronomical day? She do so to-morrow (the 9th), for example. *Vide* the *Nautical Almanac.*)—PHILOSPES. (If you ble to consult our back volumes—which you can do in Liverpool—why not procure some of the extbooks now issued? When viewing the rising n the top of a high mountain, it is not necessary the telescope level with the top of the mountain. tter of fact, owing to refraction, the sun, or his is seen before he is actually above the horizon. nply a catch question. 2. If you could take up a as near to the South Pole as North Cape is near North Pole, you would certainly see the sun out the twenty-four hours at the end of Decem- beginning of January. 3. Certainly not, such lines would all be vertical to the centre of the —O. G. B. JONES. (They are "process" blocks. ograph is transferred to zinc, and the "lights" en away by means of acid. Described many n back volumes.)—CHINA. (The effect is the hether the water is hot or cold; but it is impos- explain without examining the pipes, as you at the noise is heard when water is not being and presumably also when it is not passing h the pipes.)—MARTIN GEEGHAN, Sydney. (We what we can to help you.)—PIPE-TURNER. (We try oil—not lacquer. Perhaps white wax would er still. You can stain the wood with a solution romate of potash, which will darken it when ex- o light. Perhaps that will suit, and avoid the ty for polishing.)—A. MARSHALL. (You should given more definite particulars. Perhaps you the blowpipe devised by Mr. Fletcher, Thynne- Warrington. If so, he will give all particulars. e often illustrated his inventions in that line.)— IGBY. (No room for anything about mesmerism w. See indices of back volumes. Read what is pp. 185, 186, last volume, and consult Carpenter's al Physiology," or Braid's "Magic, Witchcraft, l Magnetism," &c.)—J. J. LYNAM. (You nd many recipes for making ink in back es. Most write pale at first. Try this: Galls gum senegal 15oz., distilled or rain water 18 sulphate of iron free from copper 18oz., liquor lae 3 drachms, and spirit (methylated) 24oz. r the galls and gum, mix the ingredients, and stir ntly until the desired blackness is attained. ng the galls is said to improve the ink, and it is "copying" by the addition of a little sugar candy. does not suit, try some of the modern recipes to nd in back volumes.)—J. BEST. (The ivory or bone black is ground up with the oil, treacle, a paint mill—a similar machine to that used for ng up pigments for the house-painter.)—J. W. ITHS. (See pp. 18, 38, Vol. XLV. Ground-ice is ith regularly in various parts of the world, and n the Thames. So long ago as 1677, Dr. Plot, st keeper of the Ashmolean Museum at Oxford, in his work on "The Natural History of Oxford- of the evidence offered by Thames watermen that mation of the ice begins at the bottom of the river. suggested that the action of the running water nically mixes the cold surface water with that until the temperature of the whole is reduced to eezing point. Then the greater tranquillity of the on the bed will account for the formation of ice. ertain that it does so form, because pieces come surface bearing on their under sides stones and h from the bed of the river.)—GREENHORN. inly not. It can be used, but it is better in the mate form of battery. It has been frequently described. The drawback to the Bunsen is the fume.) —A. S. M. (Did we not answer you a short time back, and refer you to one of the libraries in Glasgow, where no doubt you can see the books? There is Bourne's large work, Seaton's "Manual of Marine Engineering," Sennett's "Marine Steam Engine," and several other works. You can surely find them all at booksellers' shops in Glasgow—of all places in the world.) —LEVERAGE. (No such grant is offered. Are you in quest of perpetual motion? It looks like it!)—EVOLUTION. (We regret having to decline inserting numerous letters on Evolution, owing to the evident determination of the writers to drag the religious question into it. If correspondents cannot discuss this matter without imputing irreligion and heresy to everybody with whom they differ, they had better let it alone.)—S. L. (There is no satisfactory method of joining vulcanised rubber.)

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USEFUL AND SCIENTIFIC NOTES.

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A Gas Locomotive.—The Brooklyn Annex Street Railway Company, of Brooklyn, N.Y., has been experimenting with an improved engine, on the Connelly system, with a view to adopting this motor for its lines. The machine is a combined engine and car, the former occupying the place of the forward platform. The car resembles the ordinary four-wheeled street car. The gas is obtained by an admixture of naphtha and air, in the proportion of 1 : 11; the gas is formed by passing air into a naphtha tank, and it is then compressed before being admitted to the engine cylinder, where it is exploded by an electric spark from a small dynamo. The engine shaft drives the car axle by link belting. It is estimated that the amount of naphtha used is about $\frac{1}{10}$ of a gallon per hour. The results of the experiments were very satisfactory. The company which manufactures these motors will guarantee them to make a speed of twelve miles an hour on level roads or on grades of less than 1 per cent., to ascend grades of 4 per cent. when heavily loaded, and to consume not more than one gallon of naphtha when in operation. An engine on this system was operated at Coney Island, N.Y., about a year ago; but the new engine is of an improved type, and its machinery makes less noise and vibration.

Traction Increaser.—Craven's traction increaser, which is a drawbar between the locomotive and tender that automatically transfers a portion of the weight of the tender to the driving wheels of the engine in proportion to the load which the engine is pulling, has lately been tried on the New York, Lake Erie, and Western. The *Railroad Gazette* says it was first attached to No. 604, a consolidation engine with 950lb. less on the rear drivers than on the other pairs. This engine hauled 10 per cent. more than its regular load from Hornellsville to Susquehanna, making running time. Subsequently the drawbar was attached to a 38-ton engine with 4-coupled drivers 5ft. diameter and cylinders 18 by 22. Weight on driving wheels 48,000lb., 2,000lb. dead weight which had been placed on the footboard to increase the adhesion having been removed. This engine took 12½ per cent. above the regular load, and in another case 14 per cent. additional, and made a creditable performance on the round trip between the points before named, on a day when a fine mist was falling during nearly the whole trip, there not being enough rain at any time to wash the rails.

Chlorine as a Disinfectant.—As chlorine is one of the best disinfectants, and is now largely used for sanitary purposes, it becomes a matter of interest to ascertain how it may be most readily and economically produced on a large scale. Dr. Ludwig Vecherkevich has recently made a number of experiments in the hygienic laboratory of the Imperial Military Medical Academy of St. Petersburg with the view of deciding this point. He finds that when one part of bleaching powder is mixed with two parts of sulphuric acid of the specific gravity of 1·535, just enough water being added to cause the bleaching powder to be covered, the yield of chlorine is greatest, being more than three times what it is for the same cost of chemicals when hydrochloric acid of the specific gravity of 1·120 is employed. Of course, common salt, manganese, and sulphuric acid may be employed. In this case the best proportions are four parts of common salt, three of manganese, nine of sulphuric acid (specific gravity 1·535), and five of water. But this process is much more expensive and troublesome than the bleaching-powder method.—*Lancet.*

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Good Value Offered (cash or instruments) for all kinds of Scientific Appliances.—CAPLATZI, Science Depot, Chenies-street, near British Museum. Estab. 1862.

Silvered Glass Specula.—A few of my choicest reserves only left. Exchange Scientific Apparatus.—WITH, Hereford.

Electro-Plating, small plant, suit amateur, consisting of baths, batteries, two gallons silver solution and pint gold, tools and chemicals complete. Exchange to £2 10s. value.—J. S. A., 10, Bath-terrace, Boro., S.E.

Circular Saw, 12in, shaft, bearings and pulleys, 28in. single lathe wheel, crank treadle, 5in. Parallel Vice, want screw. Exchange.—W. SMITH, Bilston-road, Wolverhampton.

Handsome ½-horse vertical steel Field **Boiler**, 50 tubes, 250lb. pressure, all fittings complete. Offers. Bargain. The engine if desired.—HARDWICK, Siddals-road, Derby.

Wanted, **Photographic, Optical, or Electrical** APPARATUS, &c., for exchange on commission. Repairs on the premises.—See below.

The cheapest house for **Scientific Goods**, &c., is the SALE and EXCHANGE DEPOT, 2, King-street West, Manchester. H. W. Harris, agent.

Wanted, a Collection of Postage Stamps, if possible collected before 1880. Exchange offers.—J. W., 28, High-street, Ipswich.

Wanted, Cornet, perfect order. Exchange **School** AND COLLEGE BOOKS.—Particulars R. SMITH, Y.M.C.A., Londonderry.

Stamps, 8,000 old red English postage, clean, suitable for decorating, &c. Bundles 100 each, offers for whole or part.—17, Newland-street, Kettering.

9in. Ebonite **Cylinder**, Wimshurst, with two Leyden jars, gives 5in. spark; almost new; very compact; splendid for exhibition; complete novelty.

¼-plate **Camera**, good, specimens sent. Above instruments, £3, or exchange for first-class ½-plate camera, good maker.—A. SOUTHGATE, 101, Fore-street, Ipswich.

Iron **Bench Screw**, 1½ by 24in. long, 12 outside screw chasers, various sizes. Five ¾ steel slide-rest tools. Exchange lathe appliances.—AMATEUR, 35, Falconar-street, Newcastle-on-Tyne.

Large **Electro-Motor** and Smee's six-cell Battery, with lifting arrangement. Exchange, together or separately.—D., 1, Ealing-road South, Ealing, W.

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The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, JUNE 15, 1888.

EXTRACTS FROM BERGERON.—VI.

Concerning Chucks.

IN speaking of the centre lathe, we recommended the making of a number of tool handles. Our object was to set before the amateur at the commencement a lesson in cutting wood skilfully with the gouge and chisel. Now, as a great quantity of articles are turned in the chuck lathe by a scraping process—as, for instance, in hollowing a box or case—it is well to accustom oneself to cut wood in this way, and to turn work perfectly cylindrical.

A chuck is an indispensable article—generally of wood, but sometimes of brass—in or upon which the piece that is to be turned is fitted; and, as these pieces are infinitely varied in form, diameter, and length, it is necessary to have a large number of chucks so as at once to find one almost exactly suitable, and not to have to cut them to waste in order to render them fit for the work to be turned.

It is always necessary, when making or purchasing a chuck lathe, to take care that there is added a taper screw-chuck. By this name is called a chuck, generally of brass, on one face of which is a screw that fits accurately the mandrel-nose. On the opposite face is a steel pin securely riveted to the centre, and made into a screw similar to those for wood—that is, it tapers, with threads very coarse and rather deeply cut. It is by help of this fitting that all the other chucks are made, which are for the most part of beam-tree, service, apple, or wild plum.

From a very dry log of either of these woods (after having removed a sufficient length to get rid of the cracks and shakes) must be cut as many blocks as it will provide of 2in. to 3in. in length, and of different diameters. The centre must be taken as nearly as the greater or less regularity of the roundness of the piece will allow. A hole is to be made at that spot with a drill smaller than the taper screw of the chuck, and as perpendicularly as possible. This block is to be mounted on the taper screw until the face of the block touches that of the chuck. The circumference is to be roughed down with the gouge, and with another rather long gouge of small size, and sharpened to an acute bevel, the block is to be faced up on the end by holding the gouge on its side—i.e., so that its bevel almost touches the face of the work, and that its hollow shall be a little inclined and not upwards as ordinarily. This mode of facing the end of a bit of wood with a gouge is much the best, as it cuts it very smooth, and without leaving visible any irregularities. Care must be taken that this face shall be just barely concave towards the centre to make it bed more accurately against the flange of the mandrel-nose. The sole of the rest is to be turned round facing the surface that is to be worked, so that the T may be a little below the centre of the piece; and it must be understood that by unscrewing the T its top can be placed at any desired height. The centre is to be marked with a point tool, a hole is to be made two or three lines in diameter with a suitable drill, and lastly it is to be enlarged by successive cuts until it has a little smaller opening than the size of the bottom of the screw-thread on the mandrel-nose. The last touch is to be given with an inside tool for the purpose of accurately dressing the hole, which should be a little deeper than the length of the mandrel-nose, taking great care to have it as large at the bottom as at the orifice, of which the inside callipers will make sure.

It is to the next operation that the amateur must give all possible attention, for we are supposing that he has not yet made either a nut or screw in the lathe. The wedge which is under the brass key is to be removed, which as yet has only allowed the mandrel a rotary motion in its brasses. The key is to be raised which is under the first bit of the guide-screw—i.e., under the coarsest, which is usually of the pitch of the mandrel-nose. The key is to be slightly pressed up against the guide-screw with the wedge, which fits all the keys; the rest is to be drawn back so that when the mandrel and work which it carries advance forwards, it cannot possibly come in contact with it. A male chasing tool is to be taken—that is, one which has its teeth on the side, and having placed it so that half the teeth are outside the hole when the treadle is raised, it must be held very firmly, but without strain, in that position, and the treadle is to be made to descend. It is evident that the chaser can only cut the wood by describing helices inside the hole, and owing to the regularity which the teeth of the chaser should have, the teeth enter all the threads without damaging any of them. In this operation there is a certain slight twist of the hand that a little practice will soon give, in order to cut the wood only as the treadle descends; and as it is with the left thumb that the chaser is held down on the rest, whilst the other fingers embrace the rest, the relief which is to be given to the chaser whilst the treadle is rising is produced by a slight movement of the thumb which withdraws or releases the chaser very slightly. The greater number of threads that take into the key the more certainty there is of the steadiness of the traverse, and the less is the key subject to mutilation. For this reason the first screw-guide is generally made with a double thread. By this plan the traverse is not the less the same as if there was but a single thread; but as they are finer and double, they take a better hold of the key. Should the traverse of the mandrel at each descent of the treadle fail to produce a sufficient number of threads, or, to speak more correctly, if it does not make a screw of sufficient depth for the whole length of the mandrel-nose to become imbedded in it, it must be remedied in the manner following:—The treadle must be kept raised, and, advancing the chaser one tooth, the treadle is to be depressed, and it is evident that one more thread will be made beyond the others; this is to be continued until the screw has attained the desired depth; but if the threads are already deeply cut, the chaser must not be pressed to the bottom of the thread, because the new threads to be formed would offer too much wood to cut away, which would damage the entire screw; therefore only a little at a time must be taken. As soon as the thread is tolerably deep, and equal throughout its entire length, the chuck with the work upon it is to be taken off the lathe, and, without separating them, a trial must be made whether the screw will enter. Care must be taken that it enters a little easily, rather than tightly, because wood in drying and shrinking lessens the size of the hole, and often after a certain time the chucks will no longer go on upon the mandrel. To remedy this defect a tap must be procured, the threads of which are precisely similar to those of the mandrel nose, but of a slightly larger diameter. This tap is to be passed into the hollow screw of these chucks, which will restore the aperture to its original size.

To avoid the inconvenience of having to dismount the work every time in order to try it on, a bit of very dry wood is to be taken of 3in. in length, or thereabouts. This is to be turned to the size of the mandrel nose. At one of its ends a screw is to be cut exactly similar in every way to that on the mandrel-nose. At the other end a like screw, but a full line longer is to be made, from which all the threads are to be removed by turning, leaving only the slightest trace of them. The smooth end serves as a gauge for boring the hole, and the other replaces the mandrel-nose. In order to make this screw well, the chaser must cut perfectly; but as the teeth cannot be sharpened without damaging them, it suffices to rub the tool flat on the oilstone to restore the cutting-edge. Without this precaution, as the wood can only be scraped, there is incurred a risk of damaging all the teeth, and carrying away a great part of them.

If the wood is too old, or has lain about too long so that it has lost the greater part of its sap, sharply-cut threads cannot be made. However, after a certain amount of practice in working, this defect can be remedied. When the inside screw is near its proper size a few drops of oil are introduced, and by causing the treadle to rise and fall the bottom of the threads will be impregnated with it; then, catching the threads very carefully with the chaser, all the threads will be smoothly finished. This oil restores to the wood some of that unctuosity which time has caused it to lose. But if a screw is to enter a wooden nut, the oil would make it tighten and screech. In this case very little oil must be put, so that when the screw is finished very little more will remain than will allow it to dry; and as soap is composed of oil, the screw may be afterwards rubbed with it, as, by reason of its affinity, it will become incorporated with the oil, which will prevent the screw from screeching. If the wood is freshly cut the threads will be marvellously good; but these wooden chucks of too green wood will all split at the end of a few days. One fault which beginners never fail to make in all the screws which they cut in the lathe is to make the entrance of the hole too large, so that the bottom part alone holds as it ought to do. All the attention should be given to make them of equal diameter to their full depth, and for this, from the time that the first threads of the mandrel nose enter, these must not again be touched, but the lower ones alone, unless the nose chance to be slightly conical, as such are sometimes met with. When the chuck will go on the mandrel nose easily and will bed up well against its shoulder, it is to be dismounted from the taper-screw chuck and a final touch given with the gouge both on the outside and face or outer end of the chuck, and it is to be completed satisfactorily, without, however, using the chisel—that is absolutely useless. It is wise, after the chuck is finished, to run a hole through its axis. This precaution prevents the wood splitting.

A great number of these chucks should be made. It will be seen in the long run that there will never be enough. If wood of different sizes is in stock, they can be made as required. The method of arranging them is as follows:—Let there be driven into the wall, as near as possible to the lathe-bed, a large number of nails at intervals of 6in., and in the form of a quincunx—i.e., that in the second rank they fall between those of the first, and so on throughout. The heads of these nails catch into the threads of the screws, and keep the chucks in place. In this way it can be seen at a glance which it is of which the external or internal size is suitable. This task of chuck-making is very wearisome, especially to those who only wish to amuse themselves. Mr. Hamelin Bergeron undertakes to supply them ready made at a reasonable price, and in order to obtain them suitable for the lathe that anyone happens to possess, it will suffice to send a false mandrel-nose similar to that already described. Whilst we are engaged in teaching chuck-making, we must speak of a kind which is exceedingly convenient in use.

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Suppose it is desired to turn on a chuck lathe the ends of a box, or to give a touch of the chisel upon the neck of a box which shuts too tightly, or to give a finishing touch to a bit of work already finished; it is evident that it cannot be driven by force into a chuck, owing to the risk of fracture, or, at least, of damage. The following is a very ingenious and handy kind of chuck:—A bit of sound wood is to be mounted on the taper-screw chuck about 3in. to 6in. in length, and of any desired size, in order to make a rough chuck. An inside screw is to be cut as we have already described. As soon as it will go nicely on the mandrel-nose it is to be placed there, and turned cylindrical of its full size. At 18 or 20 lines from the end which rests against the face of the mandrel, a kind of neck is to be made, which is to be rounded off on each side so as to give to this part a slight diminution of size, and to give an elasticity of which the use will be presently seen. The chuck is to be turned accurately round and slightly tapering towards the end. With a drill of at least two lines in diameter a hole is to be made accurately central and penetrating the entire length, right up to the hole of the inside screw; then gripping it carefully in a vice, so that it shall not be crushed, two saw-cuts crossing each other at right angles are to be made lengthwise reaching to the neck, and for this purpose a somewhat thick saw is to be used so that the slots may be somewhat wide. A ring of iron or brass must be provided, of which the inside face is to be slightly coned on one side, and which shall fit tightly on the small end of the chuck. It is plain that if one has a very slender piece to turn, and fears injury to the surface or fracture by driving it, one will be able, with an inside tool, to render the hole of this split chuck very round and true and of suitable size, and to place the work inside it without subjecting it to friction; then, putting on the ring and driving it on a little, the work will be found to be securely held, since the four sections have the power of approaching the centre by the internal pressure of the ring.

There are some who tighten this chuck in a way that is apparently more convenient and surer, but which is practically subject to drawbacks which the other method has not. They have a ring of brass cast, at the two poles of which are two small buttons or tenons which serve to rotate it. Inside this ring are formed a few screw threads so as to make it a conical nut. On the body of the chuck are made similar screw threads, and it is tightened up imperceptibly by rotating the ring to any required degree. This plan appears to have many advantages over the preceding. In the first place, it grips the work more gently; in the second place, it grips equally—that is to say, always concentrically, instead of which, by the other plan, one can only tighten it at certain spots, and one can never be certain that the chuck is not out of truth.

This reasoning is only true apparently: in practice the screwed ring is not so good as the other. It would hardly be believed that although the chuck be bored exactly centrally and accurately straight, it is seldom that the work is central. If it is secured with the screwed ring nothing will bring it into truth; instead of which, with a plain ring, there is the power with a light blow of the hammer, which sets the ring out to one side or the other, to restore the work to truth. It is as tiresome to make chucks as handles; but when we recommended the amateur to make handles we only had it in view to accustom him to cut wood neatly. Now that he should have acquired this skill, it is chiefly for his own use that we engage to procure him a large number of chucks; but as he cannot do without several, it will be necessary for him to *supply himself as he may* deem fit. With regard to the split chucks, this may seem hardly possible, as these should be made on the lathe with which they are to be used, and upon this subject a special note must be made. Were they all of different exterior sizes it would be necessary to have as many rings as chucks. This can be avoided by making from four to six of one size for the same ring, six larger, and, again, six larger still. It will be readily seen that, in each, pieces of different diameter can be inserted, which is all that is required.

O. J. L.

SOFTENING AND PURIFYING WATER.

THE softening and purifying of water can be accomplished by means of Clark's well-known process; but Mr. G. E. Davis, of Manchester, seems to have improved upon that, for he has patented a method of using tribasic phosphate of soda, which softens the water, and leaves a useful phosphate of lime as manure. Most natural waters contain lime or other substances which render them unfit for use for trade purposes, and inconvenient for domestic use. River-water, or brook-water, or rain water is, of course, an exception, and it is the object of this invention to eliminate most of the lime and other interfering substances, so that well-water, or water containing lime and other substances, may be used for domestic or trade purposes with almost the same ease as the water from rivers or brooks, or rain water. In carrying out the invention, the patentee adds to the water to be treated tribasic phosphate of soda, preferably in a state of solution in water, and mixes it with the water undergoing treatment until the one is well incorporated with the other. The mixture made is then allowed to settle, whereupon the lime salts fall to the bottom of the vessel, mixed with other substances, and the clear water may be drawn off for use, or be pumped away into a store tank. The residue remaining in the tank or other vessel may be used as a manure, as it contains a large quantity of phosphate of lime. The quantity of tribasic phosphate of soda required will vary with the hardness of each water to be treated; but a good guide for the proportion required to each gallon of the water will be five times the amount in grains of the hardness of the water by Clark's scale of crystallised tribasic phosphate of soda—that is to say, a water of 10° of hardness would require about fifty grains of tribasic phosphate of soda per gallon, but where the hardness is of the quality called "permanent hardness," about one-half of this quantity only is necessary, or even less than that.

IMPROVED PROCESS OF TINNING.

AN improved process for coating metals with tin has been recently patented in this country by Messrs. Börthel and Möller, of Hamburg, which is said to possess the advantage of preventing or, at least, delaying oxidation. The process can, according to the patentees, be employed with special advantage for tinning cast-iron cooking utensils, household and other implements of cast iron, as the employment of poisonous enamel is avoided and a much higher degree of polish attained. The process can also be employed for protecting architectural or other iron decorations from rusting by the coating of tin or other metal, without detriment to the sharpness of the form, as is the case with the customary oil or bronze paints. In order to produce a perfectly even coating of tin on cast iron the same is first provided with a thin coating of chemically pure iron regardless of the form of the casting. This coating is produced in galvanic manner in a bath composed as follows: 600 grammes of sulphate of iron $FeSO_4$, are dissolved in 5 litres of water, to which we add a solution of about 2,400 grammes of carbonate of soda Na_2CO_3, in 5 litres of water. The precipitate of ferro-carbonate ($FeCO_3$) resulting is dissolved in small quantities in so much concentrated sulphuric acid until the fluid has a green colour. The bath is then rendered aqueous by adding about 20 litres water. Blue litmus paper dipped in the bath must assume a deep claret colour, and red litmus paper remain unchanged. The objects to be provided with a coating of chemically pure iron are placed in the bath opposite to the anode of cast or wrought iron or iron ore, and both parts connected to the corresponding poles of a dynamo machine, electric battery, or other appropriate source of electricity. In a very short time the objects placed in the bath are covered with a coating of iron, the thickness of which depends on the duration of the action of the bath or the strength of electric current. The coated objects are then well rinsed in clear water, dried, then painted with, or immersed in, a solution of ammonia in chloride of zinc or chloride of zinc alone, and then immersed in a vessel containing molten tin. The tin adheres with great tenacity to the prepared surface, and the surplus of tin can be readily removed by a brush or in other manner. If the object to be tinned is of such size or so complicated in form that it cannot be readily immersed in molten tin, it can be placed in a galvanic tin bath, which can be readily made in any desired size, and be provided with a layer of tin of desired thickness, which, after having been painted either with a solution of chloride of zinc or ammonia in chloride of zinc can be heated to such a degree that the tin is equably melted on to the object. In like manner objects cast or made of lead or other readily melting metal which would lose their form by melting when immersed in molten tin, are, previous to tinning, provided with a coating of pure iron, and are then provided with a coating of tin in a galvanic bath as mentioned above, without being subjected to heat for melting the layer of tin deposited on the same. With objects of wrought or rolled iron, or which do not require the before-described treatment—*id est*, the production of a coating of chemically pure iron—it will be sufficient to carefully clean the same and paint them with a solution of ammonia in chloride of zinc or a concentrated solution of chloride of zinc. This tinning process combines the advantage of simple manipulation and the great durability of the coating with cheapness of manufacture, which is partially attained in the saving in tin.

INSTANTANEOUS SHUTTERS.*

THOUGH, in accordance with English usage, I have adopted the above title, I certainly prefer the American one of "Automatic Exposers," as more correctly describing the aim and nature of the instruments in question. So much has already been written on the subject that it would be difficult to say anything very novel; and probably the most useful thing I can do is to state concisely and clearly the most important mechanical points to be observed in the construction of a shutter, and then to add a few words of description of the most important shutters in the market, pointing out how far they agree with the conditions laid down as essential. Taking these in the order of importance, they may be summed up as follows:—

1. The shutter must not shake the camera.
2. The illumination must be equal all over the plate, or greater for the foreground than for the distance and sky.
3. The shutter must let through as much light as possible during the time it remains open.
4. The exposure must be adjustable to constant and approximately known periods.
5. The shutter must be portable—that is to say, neither too heavy, too bulky, nor too delicate to stand ordinary rough usage. It is convenient that it should also serve for time exposures.

There are three positions in which the shutter may be placed, and it will be convenient to consider their respective advantages before discussing the construction of the shutters themselves. These are (1) in place of the diaphragm; (2) immediately in front or behind the lens; and (3) close in front of the plate. A great advantage of the first position is that it has absolutely no effect on the equality of the illumination other than a stop has. If the lens illuminates evenly with full aperture, it will still do so with any diaphragm shutter. It is, however, well known to photographers that with most lenses a peculiar sort of blurring is produced, if by accident a stop is so inserted as to admit two pencils of light from opposite sides of the aperture, owing to the correction of the lens not being absolutely perfect; and this effect must be produced in a greater or less degree by shutters which, like the Grimston and several other popular shutters, go and return in the diaphragm slit. I must own that it is not generally perceptible; but I should expect it sometimes to be apparent in enlargements and lantern slides, as a sort of slight one-sided blur. It is, therefore, better that the shutter should open centrally, and it is worth noting that this is practically accomplished by a simple drop shutter working in the diaphragm position, since the side of the aperture which was first to open is also first to close. Almost the only objection to such a shutter is the necessity of cutting the lens mount to let it go through. Another advantage of placing the shutter in the position of the stop (or close alongside it) is that here the pencils of rays all cross, and hence pass through the smallest area; and the aperture of the shutter may be small and consequently light. This not only favours portability, but lessens the risk of vibration.

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* By H. R. PROCTER. A communication to the Newcastle-on-Tyne and Northern Counties Photographic Association.

The second position near the lens has most of the same advantages, but in a less degree; it requires no fitting or altering of the lens mount, and is easily applied and removed, and it lends itself readily to giving the sky a shorter exposure than the foreground. In this position the shutter must on no account open centrally, unless the time during which it is fully open bears a very large proportion to that during which it is opening or shutting, for the result of placing a cap with a central hole in front of the diaphragm (or behind it) is to cut off all light from the edges of the plate while illuminating the centre. A shutter attached to the hood of the lens is generally in the most favourable position for shaking the camera if it produces any shock!

The third position, immediately in front of the plate, is in many respects the most favourable of all; but it is probably the least popular, since the shutter is necessarily large and has to be specially fitted to the camera. It has been explained that a shutter near the lens cuts off a portion of light from the whole of the plate during opening and closing, so that a longer total exposure is required than if this was not the case. The special virtue of the position close to the plate is that the portion of the plate which is uncovered receives the light from the whole of the lens for the whole of the time, and hence a narrow slit may be used, and the motion of the screen need not be very rapid, since each portion of the plate is only exposed while a comparatively narrow slit is passing over it. On the other hand, as different portions of the plate are exposed successively, it is quite possible that the picture, though sharp, may be distorted by the motion of the object during the exposure. Thus, a horse, running in the same direction as the motion of the shutter, would be apt to have its body abnormally drawn out.

Leaving now the position of the shutter, we may discuss its construction. The first and most important point to insist on is, as I have said, that it must not shake the camera. With rapid shutters attached to the camera this can only be prevented in two ways: either the moving part must be so light that it bears no sensible proportion to the weight of the camera; or there must be two parts moving in opposite directions, so that the strains produced by the one exactly counterbalance those caused by the other. Of course the most perfect arrangement is one in which both these conditions are observed.

One of the oldest, simplest, and in many respects the best of shutters is the simple "drop," and a little time spent on it may clear many points bearing also on other forms. It is extremely easy to make, even for an amateur optician. In its most elementary shape it consists of a slip of wood, ebonite, or metal, with a hole in its centre, and working in grooves in front of or behind the lens, or in the diaphragm position. When set for action the lower and unperforated part closes the lens, and in exposure it is allowed to drop so that the aperture passes in front of the lens, which is finally covered by the upper end; and the exposure of course lasts while the aperture is passing. So long as the drop falls only under the influence of the earth's attraction it is easy approximately to calculate the time of the exposure, since this attraction is one of the most constant of forces; and even if springs are used to accelerate the motion it is not difficult to estimate their force and their effect. Practically a body may be taken to fall $\frac{2}{100}$ of an inch in the first $\frac{1}{100}$ of a second; and the distance increases as the square of the time. Thus, in $\frac{5}{100}$ of a second the body will fall $5 \times 5 \times 2 = \frac{50}{100}$. It will be noted that the shutter moves slowly at first and more rapidly as it goes down, and consequently the covering of the lens will take place more quickly than the uncovering; and if in front of the lens the upper part of it will be uncovered longest and the sky will be more exposed than the foreground. The longer the aperture in the shutter, and the less obvious this is, and the effect is also diminished if the shutter is propelled by a spring or band which is strongest at first, and weakens as it is relaxed. If the shutter be behind the lens all this is reversed, and the sky gets less than the foreground, which is all right, and if between the lenses of a doublet, or in the diaphragm position of a single lens, the exposure is equal all over. Pumphrey has pointed out that the speed of the shutter may be much varied by turning it on the lens hood, so as to let the drop descend a slope instead of falling perpendicularly, thus at the same time diminishing the force and adding to the friction. If the "drop," or any shutter with only one moving part, be worked with a strong spring, the "kick back" is enough seriously to shake the camera. The lighter the camera and the heavier the shutter the more this will be the case, till, if we suppose a shutter the same weight as the camera, and both at liberty to move, both would move an equal distance in opposite directions. The shaking of the camera may be prevented by having two shutters moving in opposite directions, and a very good application of this idea is that first suggested by Mr. Noton, in which the "drop" consists of a band of thin leather with two apertures, which is passed over a roller so that as one end of it goes down the other goes up, and the apertures pass each other in the opening of the lens. In the original Noton shutter the band was worked by pulling one or other of two silk threads attached to the ends of the leather band, while other modifications, such as Sands and Hunter's, have been devised in which the band is actuated by a spring. This form is excellent in the diaphragm position; but in front of or behind the lens it cuts off the light from the edges of the plates. In this position it is better to have no apertures but two solid shutters, one of which opens the lens as it rises, and the other comes down and closes it, thus giving a longer exposure to the foreground than the sky, as in Mr. Forrest's "Due-ratio" shutter. The Kershaw may also be regarded as a flexible drop shutter, and consists of a mackintosh cloth band with a very long aperture working on a spring roller like a railway-carriage blind. I have not found this to give any appreciable vibration, while it gives exposures for the smaller size of less than the seventieth of a second when fully wound, and the opening is so long that during almost the whole of this time the full light is admitted. Rotating shutters, like the Lancaster and many others, may be regarded as "drops," and are very compact; but unless the rotating part is light and well-balanced they give a very appreciable shake when worked fast, from the centrifugal force of the unbalanced portion. When balanced, the forces all counteract each other, except a slight rotary shock at starting. Lancaster's shutter, when worked in the diaphragm position, gives practically equal exposure to the whole plate. If worked in front of the diaphragm it is easy to regulate this as required, by the form of aperture; but, if used for doublet lenses, it cuts off the corners of the view unless of rather unwieldy dimensions.

"Go-and-return" shutters in front of the lens are very compact, and give good exposure to the foreground, but more or less shock is unavoidable from the reversal of motion at the most critical point of the middle of the exposure. Perken and Rayment have lent me for exhibition their "Plunge" shutter, a very pretty one of this sort, in which the shock must be small from the lightness of the moving part; and there is another and very simple form, which was described in one of the *Year Books*, and which is worked by an elastic band. It would not be difficult to avoid the shock of this shutter by adding a slide between the hood and the shutter frame, so that the whole could have a little play, controlled by an elastic band, as in the home-made shutter which I now show, which is intended for very rapid exposures, and in which the moving "drop" is a mere frame with a flexible leather curtain.

Besides the Noton shutter, there are others which have a balanced motion and central opening, and which are consequently best adapted for the diaphragm position. Of these Wollaston's "Diaphragmatic" is an excellent example, which—thanks to the kindness of the makers, Messrs. Eidsforth and Mudford—I am able to show you. The opening and closure are effected by two light metal segments moved in opposite directions by a spring, so that any shock is practically perfectly balanced, while, having long apertures in proportion to the size of the diaphragm, the proportion of light admitted is very good. The speed of the shutter is controlled by a friction brake, which, owing to its excellent workmanship, is said to give very constant results, and the stops may be altered by simply turning a milled head. To avoid cutting the mount of the lens the lenses are screwed into the case of the shutter, which replaces the original tube, and great care is taken in construction to avoid all risk of disturbing the centring of the combination, which is a weak point of some other shutters on this principle.

Mr. Dallmeyer has just invented a shutter which is perfectly central and balanced, and which actually works inside the lens tube, thus avoiding all risk of this kind. Though slightly different in details, I shall describe it most intelligibly as an "Iris" diaphragm of four leaves, which is worked by an arm projecting through the tube. Mr. Dallmeyer is still engaged in perfecting the details of this shutter, but when completed it will certainly be one of the most perfect in the market, both theoretically and practically.

A shutter with which very excellent work has been done is the "Phœnix" or "Phantom" shutter, first introduced by Messrs. Reynolds and Branson, of Leeds, in which the opening is effected by a flap, which liberates a drop which descends and closes the lens. The shutter at its best was a little cumbrous, and not capable of very rapid exposures, though I have seen a very fair photograph of flying seagulls taken with it; but it has now had so many contrivances and complications added to the original that I confess I should myself prefer a simpler form, especially as I think that a light flap will practically accomplish as much.

The regulation of the speed of shutters is difficult to do satisfactorily merely by varying the tension of a spring, or by adding elastic bands (which are always to be avoided because they vary so rapidly in strength). We can only double the speed of the shutter by increasing the power fourfold; or, more mathematically, the force is proportioned to the square of the velocity, and if one elastic band gives an exposure of $\frac{1}{10}$ second, four stretched to the same degree will be needed to give $\frac{1}{20}$; nine for $\frac{1}{30}$; and sixteen for $\frac{1}{40}$ second! Thus it happens that no great range of exposure can be got by merely adding bands or tightening springs, since such large variations of power are required to produce moderate changes of velocity, and recourse must be had to friction in some form to reduce the speed for slow exposures. It is practically impossible to get a constant friction between solids, and there is an element of uncertainty in all shutters slowed by brakes pressing on a moving part. A happy thought of Mr. Newman was to utilise the American pneumatic door-check principle to control a shutter. In this case a piston works in a cylinder, the top of which is covered with a cap with holes of graduated size, corresponding to the required exposures through which the air has to pass in and out of the cylinder as the plunger goes up and down. The special form of shutter now on the market has some faults inseparable from all to-and-fro shutters; but, as regards regularity of exposure, it is probably one of the best, as air cannot wear smooth like a brake, and its friction in passing through a given hole is practically constant. Another very simple and satisfactory application of fluid friction to check a shutter is that of Kershaw, who, by sticking a card into the spindle of the roller on which the screen winds, forms a fan, which reduces the velocity by a quite constant amount. Light flap shutters, when working with a weak spring, are greatly checked in the same way by the resistance of the air, so that by diminishing the power it is possible to reduce the speed more than in most other types of shutter, and the air greatly cushions the shock. This form of shutter may also be made to give what shock it does produce straight back against the camera, so that, considering its convenience as a hand-exposer, it is a very useful shutter for moderate speeds.

I must not omit to mention that various shutters are in the market which regulate the exposure by a train of clockwork—such, for instance, as Addenbrooke's and Boca's. Each of these first sets free a shutter, which uncloses the aperture, and as the train reaches a given point a second shutter is liberated to close it again, just as an alarum clock liberates the striking mechanism at a given hour. If such shutters are accurately made, and the moving parts are balanced or so light as to avoid vibration, they will perform well; but their necessarily high cost must always be a bar to their extended use.

Altogether there is room for further invention in the timing of shutters, which is just as important as the timing of longer exposures. The great point, however, is to use a shutter which may be trusted to give the same exposure every time it is set to the same tension, and to know approximately what that time is in each case. Many ways have been proposed for measuring the speed of shutters, all more or less troublesome and difficult. Probably the simplest is that proposed in principle by Mr. Albert Scott, in which a plate is exposed through the shutter, and again at a greater distance, to the same source of light, for the time giving an equal amount of density on development. I manage it in this way: In the first place I cover a dark slide with a piece of card covering all but a strip down the centre of the plate, and at, say, 10ft. from a batswing gas-burner turned to give a flame, say, 2in. wide. I expose successive portions from one to ten seconds by drawing the slide out about a ½in. for each tick of a clock. I then take another piece of card twice the length of the slide, and cementing on a bung the same size as my lens hood, to take the shutter, I cut a hole through it and the card, say ½in. by 1in., and fold the card over the slide so that this hole will come on the part of the plate which in the previous exposure had been covered, while, by pushing the slide along the card, which is secured to it by elastic bands, a considerable number of exposures can be made on one plate. Now, making these exposures with the shutter at a carefully-measured foot from the same flame, and remembering that the intensity of the light varies as the square of the distance, we have only to develop the whole plate, and cutting in half for easier comparison, to find which of the exposures give the same density, and for every second of the time exposures we have 100th second of the shutter. Of course the size of the flame must be regulated so as to give exposures which can be well compared, and if the plate can be exposed at 14ft. 2in. instead of 10ft., two seconds may be counted to 100th instead of one. Though this method is not capable of very exact results, they are dependable as far as they go, and that is quite far enough for the practical purposes of the photographer, who really only wants to compare exposures.

ELECTRICAL INFLUENCE MACHINES.*

I HAVE the honour this evening of addressing a few remarks to you upon the subject of influence machines, and the manner in which I propose to treat the subject is to state, as shortly as possible, first, the historical portion, and afterwards to point out the prominent characteristics of the later and more commonly known machines. The diagrams upon the screen will assist the eye to the general form of the typical machines; but I fear that want of time will prevent me from explaining each of them.

In 1762 Wilcke described a simple apparatus which produced electrical charges by influence or induction, and following this the great Italian scientist, Alexander Volta, in 1875 gave the electrophorus the form which it retains to the present day. This apparatus may be viewed as containing the germ of the principle of all influence machines yet constructed.

Another step in the development was the invention of the doubler by Bennet in 1786. He constructed metal plates which were thickly varnished, and were supported by insulating handles, and which were manipulated so as to increase a small initial charge. It may be better for me to here explain the process of building up an increased charge by electrical influence, for the same principle holds in all of the many forms of influence machines.

This Volta electrophorus, and these three blackboards will serve for the purpose. I first excite the electrophorus in the usual manner, and you see that it then influences a charge in its top plate; the charge in the resinous compound is known as negative, while the charge induced in its top plate is known as positive. I now show you by this electroscope that these charges are unlike in character. Both charges are, however small, and Bennet used the following system to increase them.

Let these three boards represent Bennet's three plates. To plate No. 1 he imparted a positive charge, and with it he induced a negative charge in plate No. 2. Then with plate No. 2 he induced a positive charge in plate No. 3. He then placed the plates Nos. 1 and 3 together, by which combination he had two positive charges within practically the same space, and with these two charges he induced a double charge in plate No. 2. This process was continued until the desired degree of increase was obtained.

In 1787 Carvallo discovered the very important fact that metal plates, when insulated, always acquire slight charges of electricity. Following up those two important discoveries of Bennet and Carvallo, Nicholson, in 1788, constructed an apparatus having two discs of metal insulated and fixed in the same plane. Then, by means of a spindle and handle, a third disc, also insulated, was made to revolve near to the two fixed discs, metallic touches being fixed in suitable positions. With this apparatus he found that small residual charges might readily be increased. It is in this simple apparatus that we have the parent of influence machines, and as it is now a hundred years since Nicholson described this machine in the Phil. *Trans.*, I think it well worth showing a large sized Nicholson machine at work (Fig. 1).

In 1823 Ronalds described a machine in which the moving disc was attached to, and worked by, the pendulum of a clock. It was a modification of Nicholson's doubler, and he used it to supply electricity for telegraph working. For some years after these machines were invented no important advance appears to have been made, and I think this may be attributed to the great discoveries in galvanic electricity which were made about the commencement of this century by Galvani and Volta, followed in 1831 to 1857 by the magnificent discoveries of Faraday in electro-magnetism, electro-chemistry, and electro-optics, and no real improvement was made in influence machines till 1860, in which year Varley patented a form of machine which was also designed for telegraph working.

In 1865 the subject was taken up with vigour in Germany by Toepler, Holtz, and other eminent men.

In 1866 Bertsch invented a machine, but not of the multiplying type; and in 1867 Sir William Thomson invented the form of machine shown in Fig. 2, which, for the purpose of maintaining a constant potential in a Leyden jar, is exceedingly useful.

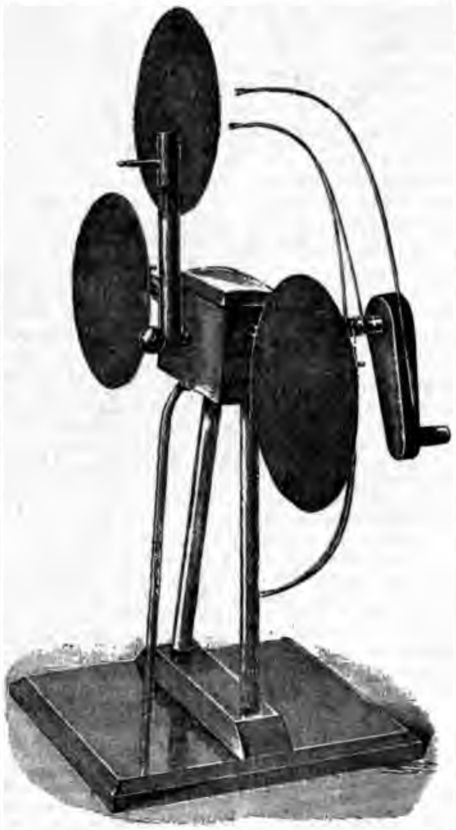

FIG. 1.

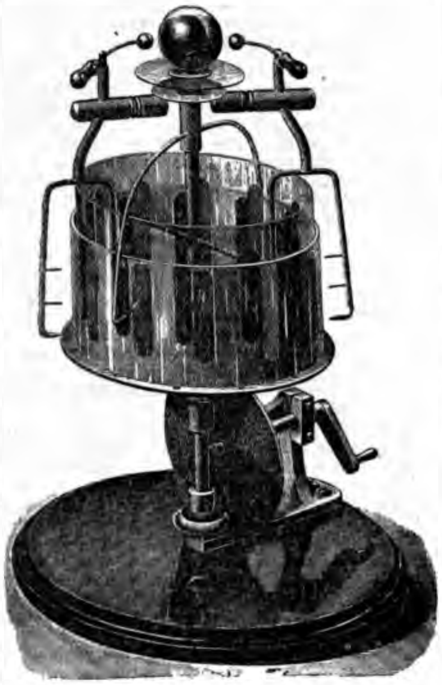

FIG. 7.

The Carré machine was invented in 1868, and in 1883 the Voss machine was introduced, since which time the latter has found a place in many laboratories. It closely resembles the Varley machine in appearance, and the Toepler machine in construction.

In condensing this part of my subject, I have had to omit many prominent names and much interesting subject matter, but I must state that in placing what I have before you, many of my scientific friends have been ready to help an contribute, and, as an instance of this I mention that Prof. Silvanus P. Thomson at placed all his literature and even his private of reference at my service.

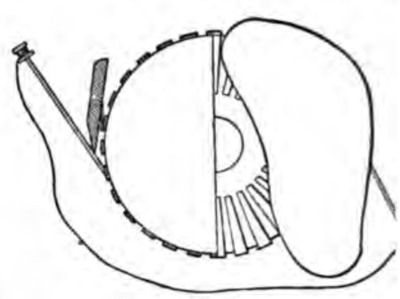

FIG. 2.

I wil now endeavour to point out the more minent features of the influence machines wh have present, and, in doing so, I must a moment's leave from the subject of my lect show you a small machine made by that em worker, Faraday, which, apart from its value handiwork, so closely brings us face to face the imperfect apparatus with which he and of his day made their valuable researches.

The next machine which I take is a (Fig. 3). It has one plate revolving, the plate being fixed. The fixed plate, as you so much cut away, that it is very liable to b age. Paper inductors are fixed upon the ba it, while opposite the inductors, and in fro the revolving plate, are combs. To work machine (1) a specially dry atmosphere is requ (2) an initial charge is necessary; (3) when at the amount of electricity passing through th minals is great; (4) the direction of the curr apt to reverse; (5) when the terminals are o beyond the sparking distance the excite rapidly dies away; (6) it does not part wit electricity from either of the terminals singl

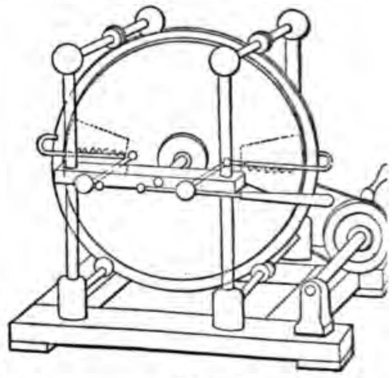

FIG. 3.

It has no metal on the revolving plates, no metal contacts; the electricity is collecte combs which take the place of brushes, and the break in the connection of this circuit supplies a current for external use. On point I cannot do better than quote an e from p. 339 of Sir William Thomson's "Pap Electrostatics and Magnetism," which "Holtz's now celebrated electric machine, is closely analogous in principle to Varle 1860, is, I believe, a descendant of Nichol Its great power depends upon the abolitio Holtz of metallic carriers and metallic make break contacts. It differs from Varley's and by leaving the inductors to themselves, and the current in the connecting arc."

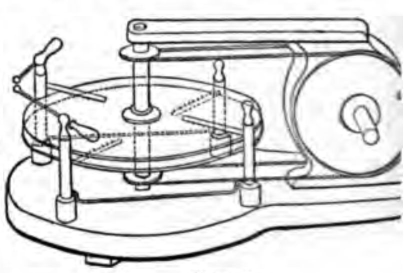

FIG. 4.

In respect to the second form of Holtz ma

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* *The substance of a discourse delivered before the Royal Institution by* MR. JAS. WIMSHURST.

(Fig. 4) I have very little information, for since it was brought to my notice nearly six years ago I have not been able to find either one of the machines, or any person who had seen one. As will be seen by the diagram, it has two discs revolving in opposite directions, it has no metal sectors, and no metal contacts. The "connecting arc circuit" is used for the terminal circuit. Altogether I can very well understand and fully appreciate the statement made by Professor Holtz in *Uppenborn's Journal* of May, 1881, wherein he writes "that for the purpose of demonstration I would rather be without such machines."

The first type of Holtz machine has now in many instances been made up in multiple form, within suitably constructed glass cases; but when so made up great difficulty has been found in keeping each of the many plates to a like excitement. When differently excited the one set of plates furnished positive electricity to the comb, while the next set of plates gave negative electricity—as a consequence, no electricity passed the terminals.

To overcome this objection, to dispense with the dangerously cut plates, and also to better neutralise the revolving plate throughout its whole diameter, I made a large machine having 12 discs 2ft. 7in. in diameter, and in it I inserted plain rectangular slips of glass between the discs, which might readily be removed; these slips carried the paper inductors. To keep all the paper inductors on one side of the machine to a like excitement, I connected them together by a metal wire. The machine so made worked splendidly, and your late secretary, Mr. Spottiswoode, sent on two occasions to take note of my successful modifications. The machine is now ten years old, but still works splendidly. I will show you a smaller sized one at work.

The next machine on which I make observations is the Carré. (Fig. 5). It consists essentially of a disc of glass which is free to revolve without touch or friction. At one end of a diameter it moves near to the excited plate of a frictional machine, while at the opposite end of the diameter is a strip of insulating material, opposite which, and also opposite the excited amalgam plate, are combs for conducting the induced charges, and to which the terminals are metallically connected; the machine works well in ordinary atmosphere, and certainly is in many ways to be preferred to the simple frictional machine. In my experiments with it I found that the quantity of electricity might be more than doubled by adding a segment of glass between the amalgam cushions and the revolving plate. The current in this type of machine is constant.

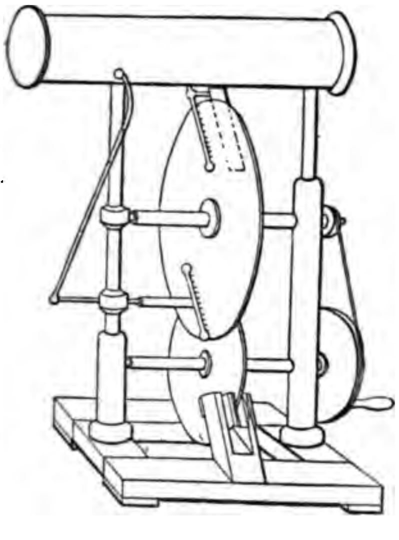


FIG. 5.

The Voss machine has one fixed plate and one revolving plate. Upon the fixed plate are two inductors, while on the revolving plate are six circular carriers. Two brushes receive the first portions of the induced charges from the carriers, which portions are conveyed to the inductors. The combs collect the remaining portion of the induced charge for use as an outer circuit, while the metal rod with its two brushes neutralises the plate surface in a line of its diagonal diameter. When at work it supplies a considerable amount of electricity. It is self-exciting in ordinary dry atmosphere. It freely parts with its electricity from either terminal; but when so used the current frequently changes its direction, hence there is no certainty that a full charge has been obtained, nor whether the charge is of positive or negative electricity.

I next come to the type of machine with which I am more closely associated, and I may preface my remarks by adding that the invention sprang solely from my experience gained by constantly using and experimenting with the many electrical machines which I possessed. It was from these I formed a working hypothesis which led me to make the small machine now before you. The machine is unaltered. It excited itself when new with the first revolution. It so fully satisfied me with its performance that I had four others made, the first of which I presented to this Institution. Its construction is of the simplest character. The two discs of glass revolve near to each other, and in opposite directions. Each disc carries metallic sectors; each disc has its two brushes supported by metal rods, the rods to the two plates forming an angle of 90° with each other. The external circuit is independent of the brushes, and is formed by the combs and terminals.

The machine is self-exciting under all conditions of atmosphere, owing probably to each plate being influenced by, and influencing in turn its neighbour, hence there is the minimum surface for leakage. When excited the direction of the current never changes; this circumstance is due probably to the circuit of the metallic sectors and the make-and-break contacts always being closed, while the combs and the external circuit are supplemental, and for external use only. The quantity of electricity is very large and the potential high. When suitably arranged the length of spark produced is equal to nearly the radius of the disc. I have made them from 2in. to 7ft. in diameter, with equally satisfactory results. The diagram (Fig. 6) shows the distribution of the electricity upon the plate surfaces, when the machine is fully excited. The inner circle of signs corresponds with the electricity upon the front surface of the disc. The two circles of signs between the two black rings refer to the electricity between the discs, while the outer circle of signs corresponds with the electricity upon the outer surface of the back disc. The diagram is the result of experiments which I cannot very well repeat here this evening; but in support of the distribution shown on the diagram I will show you two discs at work made of a flexible material, which when driven in one direction, close together at the top and bottom, while in the horizontal diameter they are repelled. When driven in the reverse direction the opposite action takes place.

I have also experimented with the cylindrical form of the machine; the first of these I made in 1882, and it is before you (Fig. 7). The cylinder gives inferior results to the simple discs, and is more complicated to adjust. You notice I neither use nor recommend vulcanite, and it is perhaps well to caution my hearers against the use of that material for the purpose, for it warps with age, and when left in the daylight it changes and becomes useless.

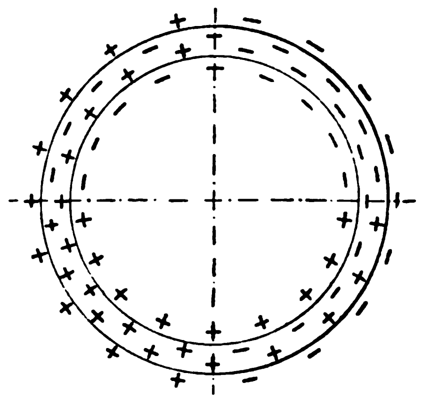


FIG. 6.

I have now only to speak of these larger machines. They are in all respects made up with the same plates, sectors, and brushes as were used by me in the first experimental machines, but for convenience sake they are fitted in numbers within a glass case. This machine has eight plates of 2ft. 4in. diameter; it has been in the possession of the Institute for about three years. This large machine, which has been made for this lecture, has twelve discs, each 2ft. 6in. in diameter. The length of spark from it is 13$\frac{5}{8}$in. During the construction of the machine every care was taken to avoid electrical excitement in any of its parts, and after its completion several friends were present to witness the fitting of the brushes and the first start. When all was ready the terminals were connected to an electroscope, and the handle was moved so slowly that it occupied thirty seconds in moving one-half revolution, and at that point violent excitement appeared. The machine has now been standing with its handle secured for about eight hours; no excitement is apparent, but still it may not be absolutely inert; of this each one present must judge, but I will connect it with this electroscope, and then move the handle slowly, so that you may see when the excitement commences and judge of its absolutely reliable behaviour as an instrument for public demonstration. I may say that I have never under any condition found this type of machine to fail in its performance.

I now propose to show you the beautiful appearances of the discharge, then the length of sparks, which appear to be almost continuous, and then, in order that you may judge of the relative capabilities of each of these three machines, we will work them all at the same time. The large frictional machine which is in use for this comparison belongs to this Institution. It was made for Napoleon in 1822, and its great power is so well known to you that a better standard could not be desired. These five Leyden jars are of equal size; I will connect one of them only to the large frictional machine, while I connect two jars to each of the two large machines of the influence type. The difference in power of the machines is then seen to be very marked. The exhibition may be considered as a miniature thunderstorm with almost no intermission between the lightnihg flashes.

In conclusion, I may be permitted to say that it is fortunate I had not read the opinions of Sir William Thomson and Prof. Holtz, as quoted in the earlier part of my lecture, previous to my own practical experiments. For had I read such opinions from such authorities I should probably have accepted them without putting them to practical test. As the matter stands, I have done those things which they said I ought not to have done, and I have left undone those things which they said I ought to have done, and by so doing I think you must freely admit, that I have produced an electric generating machine of great power, and have placed in the hands of the physicist, for the purposes of public demonstration, or original research, an instrument more reliable than anything hitherto produced.

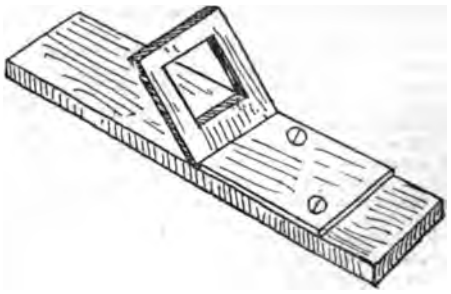
SOAP-BUBBLE SOLUTIONS AND A SLIDE FOR OBSERVING SOAP-BUBBLE FILMS.[*]

A SIMPLE means for showing soap-films, by means of the microscope, may consist of a thin strip of wood (3in. by 1in.), or other material, with a metal plate secured to it. The plate should have one end bent upward from the strip at an angle of 45°, and have a square hole through it. The film increases in brilliancy as it grows thin. The light should be thrown on the film from above, so that the beam will be reflected up the tube of the instrument. The proper angle can readily be found by trial.

Following are some directions for making soap-bubbles:—

I. Shave Marseilles (Castile) soap and dry thoroughly in the sun or on a stove.

II. Put the dried shavings of soap in a bottle with alcohol of exactly 80 per cent. strength (specific gravity 0·865), sufficient to form a saturated solution at 60° Fahr., the solution then marking 74° on the centesimal alcoholometer, with a density of 0·880. The solution must be made cold, as warm alcohol would dissolve too much soap, and the solution would solidify when cool.



III. Make a mixture of glycerine and water, so as to mark 17·1° Baumé, or have a density of 1·35 at 68° Fahr. This solution can be made of equal parts of the most concentrated glycerine and water, and it is well to heat the solution in a water bath.

IV. To make the final solution, take 100 parts, by volume, of the glycerine solution (III.) to 25 parts of the soap solution (II.), mix and boil to expel alcohol. When cool, pour into a graduate and add water to equal 100 volumes. Then filter several times to remove oleate of lime. Common glycerine is apt to make the solution turbid on account of the presence of gypsum and lime. A funnel with a plug of cotton makes the best filter, as the flow can be regulated by the tightness of the cotton in the funnel. Soap bubbles, not more than 4in. in diameter, and supported on a tripod under a bell-glass, are said to last for an hour. The preparation is suitable for Plateau's experiments with thin films, soap bubbles, &c.

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[*] A paper by F. T. CHAPMAN. Read before the Washington Microscopical Society.

Plateau's soap-bubble solution is prepared as follows:—

Dissolve one part of Marseilles soap in 40 parts of water (rain or distilled), which may be warmed. When cool, filter through very porous filter paper and add Price's glycerine in the proportion of 11 parts of glycerine to 15 parts of the soap solution. Shake thoroughly, and allow the solution to stand for seven days where the temperature will not fall below 67° Fahr. Then cool to 37° Fahr. and filter, keeping a bottle of ice in the funnel. The first parts filtered should be refiltered, using very porous filter paper.

Halbrook's brown oil silk soap, or his Gallipoli soap, and Sheering and Glatz's glycerine work very well.

Long standing and decantation from sediment may take the place of the second filtration. After all the trouble, the mixture may not give very good results.

An excellent soap-bubble solution may be formed by a compound of oleate of soda and pure glycerine. Bubbles 2ft. in diameter may be blown, and bubbles have been kept, under glass, for 48 hours.

A good and easily-prepared solution may be made by shaving 4oz. of Marseilles, or better, of pure oil soap, and placing it in a quart of distilled or rain-water. Shake until a saturated solution is formed, and let it settle for a few hours. The solution should then be clear. If otherwise, pour off the water, and add fresh water to the same soap and try again. To the clear solution add about one-half the quantity of glycerine that is absolutely pure. The presence of the least quantity of acid in the glycerine is fatal to good results, and, therefore, it is recommended that for any soap-bubble solution the ingredients be the best and purest obtainable, and that chemically pure glycerine be used. It costs about 75 cents per pound.

STEAM BETWEEN SCRAPED SURFACES: BRANDON'S PISTON PACKING.

As the principle of the creeping fluid is not well understood, and is even emphatically denied by some engineers, the apparatus shown in the accompanying sectional cut was constructed for the purpose of showing the force of steam between working surfaces, such as piston rings and slide-valves. The device was invented by James Brandon, 390, Eleventh-avenue, New York City. It consists of the outer casing A, bored and truly faced and bolted to the base-plate, B, which is also truly faced. The core C is turned to fit the casing A, its base resting on B. The contact faces have scraped surfaces.

The upper part of C is made in two parts for the purpose of experiment, the parts being equal in area. A, B, and C are steam pipes, and D, E, F, and G drip-pipes, all having stop valves; L is a lever fastened to the core C, and S a lever or scale-beam with a scale-pan or weights on the long arm.

Now, if steam pressure is admitted through C it will raise the core C by steam creeping in between the scraped surfaces of B and C; and by the lever S and the scale-pan it is easily found what that force is.

Other points demonstrated by the apparatus are as follows:—

1. If steam is admitted in the steam-pipes A and B, the force required to turn the core C by means of the level L is a measure of the friction.

2. If steam is admitted in A, B, and C, then the action will be like that of a packing-ring having steam on the whole inside surface, as in the old steam-packing, and as the steam creeps in between the scraped surfaces of B and C the friction is less than in the first case.

3. When steam is admitted in B and C, it will be like a packing-ring having steam and one-half the inside surface, and by comparing the friction of this with that of the second case, the difference in the friction will show the advantage of having steam on one-half the inside surface of the ring.

Mr. Brandon has also experimented with the action and application of piston packing, and has become satisfied that when a piston moves forward, the inertia of the ring, and also the friction between the ring and cylinder, tend to make the ring bear tight against the rear flange of the piston, leaving a slight opening between the packing-ring and the front flange of the piston. From this it will be understood that in pistons having packing rings cut for expansion, made in the usual way, when *acting as pumping* or compressing pistons, the working fluid will get on the inside of the rings, forcing them radially against the cylinder with a force equal to that of the pressure of the working fluid acting on the whole inside surface of the ring. A certain amount of fluid under pressure creeps in between the rings and cylinder, tending to force the rings off their seat, this force being equal to about one-half of that of the fluid under pressure acting on the whole inside surface of the ring.

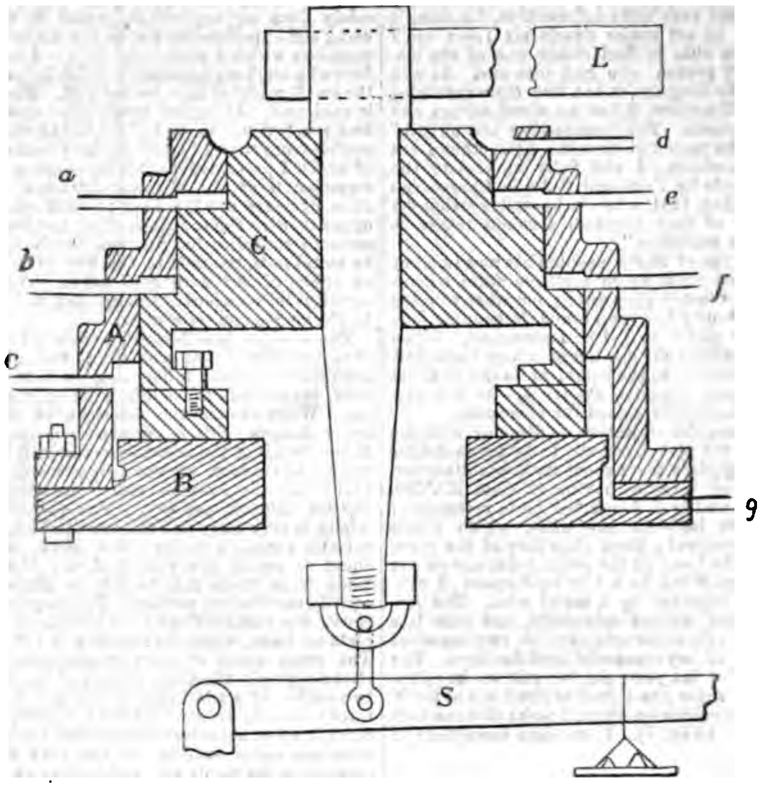

FIG. 1.

Prof. S. W. Robinson read a paper a few years ago before a meeting of the Society of American Engineers, which explained the theory of this action together with some experiments on the same.

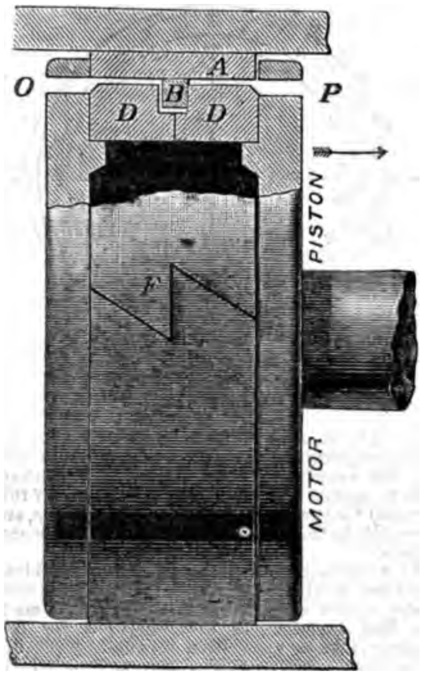

FIG. 2.

The piston packing shown in Fig. 2 was constructed by Mr. Brandon after careful study, and the theory and operation of which may be understood from the following description. The piston is represented in section in the cut, in which A is the main packing ring cut for expansion, and a piece set in to break joint in the usual way, as shown at F. D, D may be regarded as part of the body of the piston, made in two parts, as shown, or in one part, or solid with the piston heads, as may seem advisable. B is a small ring fitted in the groove in the central part of the body of the piston D, D.

The ring B is cut for expansion, and a piece set to break joint in the usual way. It is made to bear against the outer ring A the same as a packing ring bears against the cylinder. O and P represent two of several holes in the flanges as shown.

The ring A is fitted in the usual way between the flanges of the piston, and B in the grooves, the spaces on the side being left open, so as to more easily understand the working from the engraving. The construction is not, of course, limited to that shown, which is intended to explain the principle involved. The aim is to provide a piston that shall be self-packing against pressure, but in which the pressure shall be so balanced as to permit neither the forcing the rings outwardly so hard as to rapidly wear out the rings and cylinder, or the forcing them inwardly so as to permit the fluid to pass by them. Mr. Brandon has submitted the results of a large number of experiments he made in determining the proper proportions to secure the desired ends, to Prof. Robinson, who finds them to be in accordance with theory, and with experiments which he has made.

Now, assume the piston to be moving forward as from left to right in the engraving, and that it is used for a steam-engine. The outer ring A will take the position in which it is shown. The steam pressure being behind the piston, will pass in through the holes O, between the ring A and body D, forcing ring B against the forward side of groove in D D. It may be seen that the pressure of the steam forcing the ring radially against the cylinder is limited to that of the inside surface of ring B, and that part of ring A lying between ring B and the rear flange of piston, leaving that part of ring A lying between ring B and the front flange of piston relieved from internal pressure.

Assume the piston is used for a pump. Then, as the pressure is in front of the piston it will pass through the holes P, or between the front flange and the ring A, forcing the small ring B against the rear side of the groove in D, D. Now it may be seen that when it is used for a forcing piston the pressure on the inside of the ring, forcing the ring to the cylinder, is limited to that of the inside surface of the ring B, and that part of the inside surface of the ring A lying between B and the front flange of the piston, leaving that part of ring A lying between ring B and the rear flange of the piston relieved of internal pressure through the holes O.

Packing of this description which has been in actual use, has resulted, we are told, in a direct saving power to operate.—*Industrial World* (Chicago).

SOMETHING ABOUT REAMERS.*

The shop well supplied with small tools, in good condition and always readily accessible, has a great advantage over the shop not so equipped, and any one having the direction of a machine shop and

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* By FRANK H RICHARDS, in *American Machinist.*

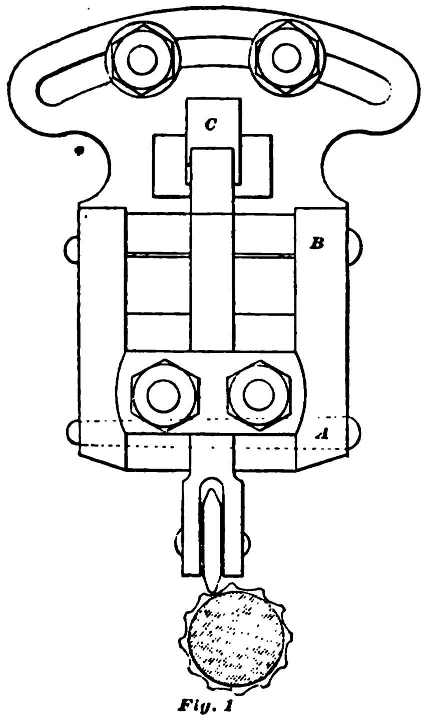

Fig. 1

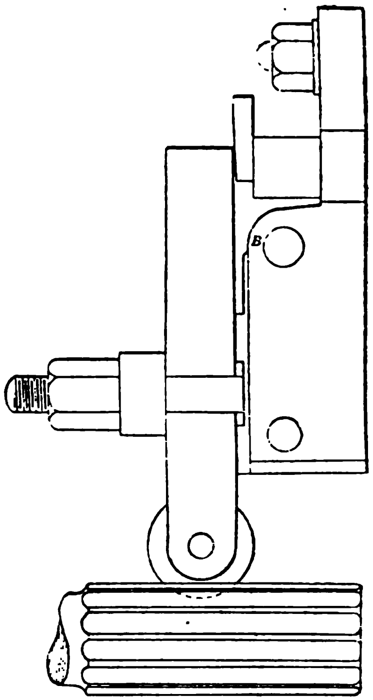

Fig. 2

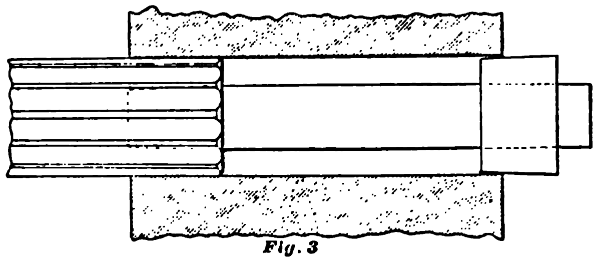

Fig. 3

its well being at heart, should see to it that such tools are provided—good tools in generous variety, well used and well kept. There are those—not generally practical machinists themselves—who, in equipping a shop, will buy the best of large tools, lathes, planers, drills, &c., and then think their duty done, and expect to see good and abundant work turned out. They don't see it. It is not much exaggeration to say that in a machine shop for general work the cost of the small tools should be as great as that of the large. In this, as in everything else, the big shop has the advantage over the little one, the relative cost being less in the former, because the same tools may be used by so many different hands.

Frequently machine shops come to an end, and are sold out, and you see catalogues of their machinery, and you seldom see any mention of small tools. The fact usually is that the small tools do not exist. The shop has not had the modern means, nor the modern methods that accompany them, and so has come to grief, as it ought to. The prosperous shops, of course, are better supplied, and would make a more various catalogue.

Now, when it comes to the getting of the tools it is not a fair statement of the whole subject to say that small tools, reamers, for instance, can be made better and cheaper in factories specially equipped for that purpose, and that, therefore, you should buy instead of making them. There are few shops where all the men can always be most advantageously employed. If the shop be ever so busy all cannot be carried along evenly, and some must sometimes be slack. Advantage of these slack spots may be taken to make up or repair necessary articles, and many conveniences, if not made in this way, will not be got at all. It is not the question whether to buy or to make the article, but whether to make it or go without it. When it comes to that there is but one answer; and so if you can't buy reamers, make them. Make them when you can, make them as well as you can, and if those who have made them can offer any points, don't despise them, but improve upon them all you can. No better appreciation of a good thing can be shown than by suggestions of improvement. Nobody ever improves a worthless article. It is your veritable stick-in-the-mud, when stuck in the mud, who will not thank you for showing him more solid ground near by, but will challenge you to argue with him that he is not standing in the very best place he could possibly stand.

The worst think about home-made small tools is that usually there is not enough system followed in their production. We come to a place where we must have some tool for a special job, and we make it in size and proportion as best adapted to that particular case. In a few days we want another size for another job, and we find an odd piece of steel which will work in and make a tool that will satisfy the emergency; but the last made tool is far from corresponding in proportion with the earlier one. Additions to the collection by the same no-system make it still more incongruous. By and by, when we realise the convenience of these things, and undertake to complete the series, we begin to appreciate the result of our lack of foresight. With this appreciation will naturally come the remedy, and the sooner it comes the more valuable will be the series of home-made tools produced.

If we undertake to make reamers I do not know anything better than to follow the practice of the best makers. Their lengths and proportions are generally good, although I think that shell reamers are usually too short. The cutting face should be radial. The shape of the flute should be a continuous curve, with no sharp angle to invite a crack in hardening. The bearing faces should be narrow. There should be very little clearance from the circle, but that little is necessary. With no clearance the dust will pack upon the face and make the hole rough, and the reamer will pull hard. With much clearance the reamer has more chance to chatter, and the cutting edge will wear away fast and the reamer rapidly lose its size. For brass or bronze the reamer should have more clearance, and should be as hard as possible.

Chattering is always a nuisance; it probably causes as much trouble in the machine-shop as anywhere, and a chattering reamer is among the worst of its exhibitions, and should not be tolerated. Cutting the flutes spirally does not necessarily tend to prevent chattering, and is only of any practical value when there are longitudinal slots in the hole to be reamed. An irregular spacing of the flutes undoubtedly does not help the matter, and should always be adopted. The difference of spacing is none the better for being excessive. If we have a reamer factory, and put our drummer on the road to talk up the goods as loudly as possible, it may be well to make the difference enough to be readily visible so that he, waxing eloquent, may hold it up and say "Behold!" but the minute differentiation of what I may call a regular irregularity, making the spacing of each flute slightly different from that of every other, covers all the possibilities of the case.

Here we have a 1¼in. reamer in which I wish to cut 13 flutes. The dividing head upon the milling machine has a worm wheel with 40 teeth. To divide 40 by 13 we must turn the worm $\frac{40}{13}$ or $3\frac{1}{13}$ times. We use an index circle of 39 holes, and the normal movement required will be three turns and three holes. We then make a list of the series of 13 movements required to complete a revolution of the reamer, taking this three turns and three holes for the central one of the series, and increasing by one hole upon one side, and decreasing by one hole upon the other, until the total number of 13 flutes or movements is provided for. The list will then be like this:

	Turns.	Holes		Turns.	Holes.
1	2	36	8	3	4
2	2	37	9	3	5
3	2	38	10	3	6
4	3	0	11	3	7
5	3	1	12	3	8
6	3	2	13	3	9
7	3	3			

Upon our 1¼in. reamer with 13 flutes cut by this list, the smallest flute would measure the space from one cutting face to the next ·289in., the largest flute would measure ·317in. The difference between each flute and the next would be ·0025in. The smallest number of corrugations or chatters in the circle that could coincide with all the teeth, and so make chattering possible, would be 1,560.

If we wished to cut an even number of flutes there would, of course, be no central one for our list, and we would make the two nearest the centre alike. Thus to cut 14 flutes we would use a 42 circle, and the normal movement would be two turns and 36 holes, and our list would be—

	Turns.	Holes.		Turns.	Holes.
1	2	30	8	2	36
2	2	31	9	2	37
3	2	32	10	3	38
4	2	33	11	2	39
5	2	34	12	2	40
6	2	35	13	2	41
7	2	36	14	3	0

In cutting our reamer we would naturally begin at the top of the list; before cutting the first flute, seeing that all the slack or lost motion is taken up in the direction we propose to turn. When all the movements have been used the revolution is completed, and the reamer is brought around to the starting point, and if we wish to go around again we begin anew at the top of the list. We mill the reamer backward, that is, after one flute is cut we mill next the flute behind it, and then we can see how deep the cutter should be set to leave the required thickness at the cutting edge. The depth must increase a little with the increase in the spacing.

Of course reamers, like everything else, will wear. When they are much used the wear will soon cause serious trouble; and to maintain a standard size, or a satisfactory approximation to it will require watchfulness and decision. The allowed limit of wear should be established by placing two collars of different sizes in the tool room, the larger for the beginning size, and the reamer to be retired or restored when it gets down to the smaller size. The difference to be permitted would vary with the shop and its line of work. In some shops ·001in. would be enough. The average shop would be contented and happy if it could keep the limit within ·005in. I am inclined to think that two sizes of reamers would be found useful, the larger for loose fits, the smaller for tight ones, and when the reamer has done service for the larger it may be reground and used for the smaller. I believe some have insisted that the size of the reamer should be maintained and the difference of fit made in the turned shaft, which is good practice for the better class of work; but for the general work of to-day, where so much factory-made shafting is used, and where that shafting is produced with so great accuracy of size as it now is by the best makers, the two reamer sizes will save a great deal of trouble.

It seems sensible to assume that the more a reamer has to cut the more it will wear, and the way to save it and maintain its size as close as possible, is to leave as little as possible for it to cut. The reamer with the patent screw upon the ends of the teeth to feed it through the hole, is, in my opinion, a mistake, because it assumes that the reamer is to have what I should call a heavy cut where it should have, in the interest of its longevity, a light one. Certainly if I wished to use a reamer under what I would call most favourable conditions, I would not let it cut enough for the screw teeth to take hold of. To save the reamer, and in a way insist upon having the hole in which it is to be used bored as perfectly and as near the size as possible, I would not taper the point of it very much. This would make it necessary to bore the hole large enough, or the reamer could not be comfortable used, and the machinist dearly loves comfort, and his instinct is correct. Where the reamer is used to follow chuck drills this would help to enforce their maintenance in good condition, and that would be a blessing.

When the reamer has worn so small that it is no longer of use, don't let it lie around long in memory of the good it has done. It should be annealed, re-turned, re-cut, and finished up for a smaller size. Or the reamer can be enlarged by upsetting or swaging the teeth, and thus be brought up to its original size. I have made reamers as good as new by working up the teeth with a roller, as shown in the cut. This, I think, will require little explanation. The reamer is mounted upon the planer centres. It should usually be blocked up under to support the pressure we have to put upon it without springing. The reamer is run back and forth under the roller a few times, and the roller is fed down as hard as may seem necessary, which a little experience will determine. The roller is also moved a little sidewise one way or the other after each stroke. Ten or twelve strokes will usually be enough.

In using this roller tool for this purpose it will of course be necessary to fasten down the tool holder. I call attention to a method of doing this. I do not know whether this "kink" has ever been in the papers, but it should certainly be known and universally adopted. Put a taper hole right through the tool holder block and the sides at A, and when you want to block the tool down put in the taper pin fitted to the hole and kept for the purpose, and you will hold everything down with perfect safety. Upon most planers if they have a weak spot it is likely to be at B. I have often seen a tool block fastened down to plane with an angular or hooked tool under a projection, by blocking or wedging behind the top of the tool as at C, and if anything had happened to make the tool catch, the tool-block would certainly have been torn up by the roots. I must confess I never saw the accident occur, but I have often clapped my hands over my eyes and run away in shuddering horror in anticipation of such a catastrophe. Builders of planers should put in such a pin as here suggested, or provide some other safe means of fastening down the tool-holder when so required.

When we look over and admire the handsome reamers of the factories, and note their perfection in every particular, we are glad to believe that their makers know it all, and as they know it all they cannot possibly have any trouble, as we poor mortals do. For instance, when the reamer is hardened, of course, for them, it will always harden perfectly straight. For me it will not, although for reasons entirely unaccountable. I am inclined to believe steel behaves for me a little better than it used to. But still a reamer is apt to be a little crooked after hardening. When I find one so I can usually make it true enough upon the centres for grinding by altering the centre in the top or wrench end of the reamer, and I leave this end of the reamer a little large to allow of turning it true after the centre has been corrected.

After tempering, the reamer can only be accurately ground to size and neatly finished upon some suitable grinding machine, and such a machine for many purposes is a necessary appendage of a well-equipped shop. I have used with satisfaction for a wide variety of grinding the Brown and Sharpe universal cutter and reamer grinder, and I can best testify my appreciation by finding fault with it. It is a tool so good and convenient that I find myself constantly wondering why it is not better than it is. The centres for holding a reamer to be ground are mounted upon a turn-table of small diameter graduated to degrees, and when set to the mark as accurately as eyesight can adjust it, its inaccuracy for straight reamer grinding is exasperating, and it is a tedious job to keep trying and adjusting the machine until it is brought to grind parallel. When next the machine is required for the same purpose the same tédious process must be gone through with.

Reamers to be used in the lathe should have a hole large and deep, fitted to a pin or parallel centre instead of a conical one, and then there will be no tendency to draw in or to pry off sidewise out of line with the hole. Everybody knows this; but it is one of those things that we have to keep telling all the same, and then it is only followed sometimes.

A very desirable thing, and sometimes seldom used or thought of, is a means of starting a reamer straight with the further end of the hole. If a shell reamer, the stem may be prolonged, and if a solid reamer it may have a taper hole in the end of it (Fig. 3), and to this hole a pin or stem may be fitted with a collar sliding easily upon it. The outside of the collar should be turned taper, to fit the hole, and when pushed into place will serve to make the reamer point central until it is far enough in to guide itself. The taper should be slight; it is purposely exaggerated in the drawing.

ACCORDING to a naturalist, oysters feed twice a day, and at no other times do they open their shells. The new method of "muzzling" is based on that *fact.*

DECOMPOSITION OF WATER AND ABSORPTION OF CARBON DIOXIDE BY CAUSTIC SODA.*

THE apparatus generally used to illustrate the decomposition of water by the electric current consists essentially of two plates of platinum immersed in a vessel containing water acidulated with sulphuric acid. The object of the acid is to impart sufficient conductivity to the water, and platinum electrodes are used because they are not attacked by sulphuric acid. There are several objections to the use of this apparatus for general demonstrations. It is somewhat expensive: the platinum plates are extremely fragile, and are not easily connected with the wires from the battery. In the apparatus illustrated iron wire is used in place of platinum electrodes, and a solution of caustic soda is the electrolyte (Fig. 1).

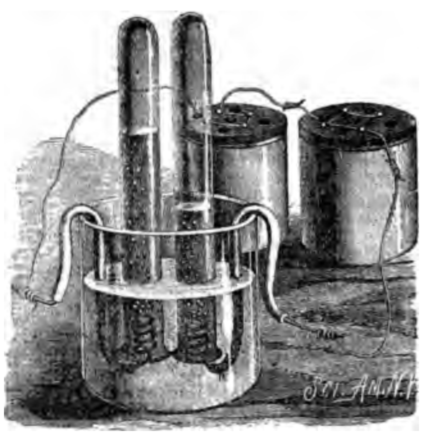

FIG. 1

The two pieces of wire, which may be $\frac{1}{16}$in. to $\frac{1}{8}$in. in thickness, have one end bent into a spiral of about $\frac{1}{2}$in. external diameter. Over the rest of the wire a piece of indiarubber tubing is slipped of such length as to leave about an inch exposed. At the end nearest the spiral the tube is tightly wrapped with a few turns of fine wire or even string, which is then secured. The electrodes are then bent as shown and hung over the edge of a suitable vessel. A couple of test tubes may be used to catch the gases evolved.

As caustic soda solution is an unpleasant substance when it comes in contact with the hands, the apparatus is best set up in the following manner:—The cup is filled with water, and the electrodes are put in place. The test tubes are then filled, one at a time, also with water, and inverted over the electrodes in the usual way, their ends being closed by the experimenter's thumb. Next some of the water is removed by careful pouring,

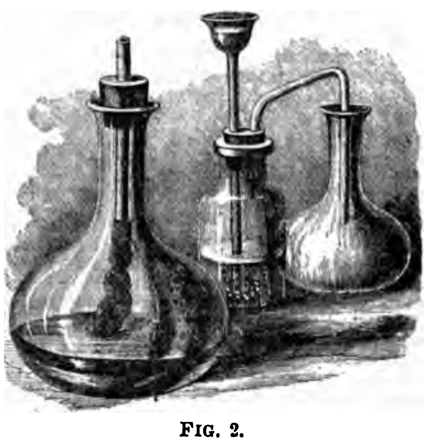

FIG. 2.

so as to leave the vessel but one-half full. Some strong solution of caustic soda is now poured into the vessel, and stirred or mixed with the water as well as possible. If the terminals of an active battery of sufficient voltage are now attached to the electrodes as shown, the water will be rapidly decomposed, and the hydrogen and oxygen gases evolved will rapidly collect in the tubes. In simplicity and cheapness this apparatus cannot well be surpassed, and on account of the very large surface of the electrodes its resistance is low, and the water is decomposed with very great rapidity. For purposes of demonstration it may be pronounced superior, all things considered, to the usual form with platinum electrodes passing through the glass.

A very interesting experiment illustrating the absorption of carbonic acid gas or carbon dioxide by a caustic alkali, and one that is susceptible of various modifications, is illustrated in Fig. 2. A strong bottle or a round-bottom flask fitted with a tight perforated cork is required. A glass tube is arranged to pass tightly through the aperture in the cork, and a common Indiarubber balloon is tied to the tube, the lower end of the latter passing within its neck. The tube now is in communication with the interior of the balloon. If one were to blow into the tube, the balloon would become inflated. A strong solution of caustic soda or potash is made, and when perfectly cold is poured into the flask. Some water is now poured very slowly and carefully down the side of the vessel, so as to collect upon and float over the heavy solution of alkali. This it will do in virtue of its lower specific gravity. The separation of the two fluids is evident on inspection. If, however, the experimenter is unwilling to risk this separation, he may use kerosene oil in place of water. The latter will inevitably float on the caustic alkali. The point to be attained is to have the solution covered with a second liquid which is without action upon carbonic acid gas.

Carbonic acid gas is now evolved in the ordinary way from limestone and hydrochloric acid or by any other method, and is conducted into the flask. Great care must be taken not to disturb the two layers of liquids in the manipulations.

When the flask is full, the conducting tube is lifted out, and the cork with empty balloon attached is placed in the neck as shown. The cork must fit accurately. Now the flask is shaken. The caustic alkali solution at once comes in contact with the carbonic acid gas, and absorbs it. In an instant the absorption is complete, and under the influence of atmospheric pressure the balloon inflates and either fills the vessel or bursts.

It is not necessary to use a flask. Any transparent bottle may be used. It is necessary to have the alkaline solution cold before introduction, as otherwise it may crack the flask.

In general terms a chemical vacuum is thus produced, and it may be demonstrated by the height of a mercury column which it can support, or in many other ways.

The particular one described is particularly well adapted for demonstration, as it is very simple and demonstrative. The balloon should be so large that it will not burst, as the effect is better when it inflates and fills the vessel lying closely against its sides.

USEFUL AND SCIENTIFIC NOTES.

Sizes of Heads.—"Seven" being the average size of a man's head as measured by his hat, it appears that out of 14 distinguished personages, two (Lord Chelmsford and Dean Stanley) were below, while other two (Lord Beaconsfield and the Prince of Wales) were exactly up to the average. Of the others, Dickens, Selborne, and Bright required $7\frac{1}{8}$, Earl Russell $7\frac{1}{4}$, Lord Macaulay, Gladstone, and Thackeray $7\frac{3}{8}$in., Louis Philippe $7\frac{3}{4}$in., and the Archbishop of York 8 full. Of 23 distinguished men whose actual brain-weights are known, four, including the late Prof. Hughes Bennet and Hermann, the philologist, were distinctly below the average, showing that a well constituted brain of small dimensions may be capable of doing much better work than many a larger organ whose internal constitution is, from one cause or other, defective.

IT is well known probably that Michigan is one of the States possessing a coupler law. Under the Act of 1885 railroads were required to put some form of automatic coupler on all new cars and on cars sent in for repairs, and the Commissioner selected seven couplers as fulfilling the requirements for safety. By an amendment passed in 1887, the railroads are allowed to use any coupler which comes up to the standard fixed by the
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* By T. O'CONNOR SLOANE, PH.D., in the *Scientific American.*

SCIENTIFIC SOCIETIES.

ROYAL ASTRONOMICAL SOCIETY.

THE June meeting was held on Friday, the 8th inst., Mr. W. H. M. Christie, president, in the chair.

Mr. Knobel read a note, by Prof. Grant, on the Glasgow Star Catalogue, which was published about five years ago, and has been made use of in connection with extra-meridional observations of minor planets and comets. Prof. Grant proposes a reobservation of all stars where there is any discordance between the Glasgow places and Bessel's places. Mr. Knobel also read a communication from Prof. C. H. F. Peters, giving some observations of the minor planet Sappho. In connection with proposed observations for determining the solar parallax

Mr. Bryant said: That he had been engaged since 1884 on an ephemeris of Sappho. Unfortunately, owing to the bad weather during the last opposition, comparatively few observations had been sent to him. He had been investigating the perturbations of Sappho due to Venus, the Earth, Mars, Jupiter, and Saturn from 1872 to 1890, and had calculated the disturbing effect of Venus at intervals of every twenty days, and he hoped to proceed in the same manner with respect to the other planets, and to obtain by this means a new determination of Jupiter's mass. At Washington they are endeavouring to obtain a correction of Jupiter's mass from the perturbations of Polyhymnia—both of these minor planets approach comparatively near to Jupiter, and his disturbing effect is consequently very great. He trusted that he might also be able to determine the mass of Sappho. For the secular acceleration of one planet on another is represented by a fraction which has for its denominator the difference of the major axes of the two orbits. Sappho and Melpomene (another of the minor planets) happen to have orbits whose major axes are nearly equal, and if the diameter of Sappho were only forty miles, and it was made of similar materials to our earth, he had calculated that in the course of a quarter of a century the perturbation of Melpomene by Sappho would amount to 50 seconds of arc.

Dr. Copeland read a short paper by Dr. L. Becker on Comet Sawerthal, in which he had observed a remarkable increase of brightness and change of colour between the 21st and 23rd May. The paper was accompanied by a drawing showing two large curved projections on either side of the head of the comet.

Mr. Turner said that the observations made at Greenwich had been chiefly for the purpose of determining the comet's position; but he had been much struck by the sudden change in brightness of the comet referred to by Dr. Copeland. The sky was rather thick on the 23rd of May, and he had hardly expected to see the comet. Instead of being like a star of the 9th magnitude, its nucleus appeared like a star of the 4th or 5th magnitude, and at first he thought that the circles must have been wrongly set, and that there was some new object or comet in the field. From a pale white colour it had changed to a brilliant yellow. The shape of the two wings on either side of the head of the comet was very well represented in the two drawings which had been shown. A post-card had been received at Greenwich saying that the sudden increase in brightness of the comet was noted in Russia, and that they had estimated the nucleus as having increased so [illegible] compare with a star of the second or third [illegible] tude; but there are very wide differ[illegible] estimating the brightness of a comet [illegible] moonlight. The comet has now [illegible] to somewhere about the ninth magnit[illegible]

The Astronomer-Royal: This [illegible] in brightness is a very [illegible] only regret that the [illegible] to determine whe[illegible] of the light stri[illegible]

Dr. Copelan[illegible] of the Gre[illegible] of the n[illegible] well-kno[illegible] seen i[illegible] false[illegible] cur[illegible] [illegible] its position repeatedly since, and have no doubt about its existence.

Mr. Ranyard: What dispersion have you measured it with?

Dr. Copeland: With a prism of 60°; but it is a very fine one, with which we are able to see every line in Angstrom's map. The spectroscope was made by Cook, of York, and has a collimator and viewing telescope of 2in. aperture, and 2ft. long, to correspond with the equatoreal, which is 15in. aperture and of 15ft. focus. It is a most beautiful and satisfactory spectroscope, its only drawback being its great weight (160lb.), which makes it awkward to mount on the equatoreal. It has divided circles and a variety of prisms—one of 20°, another of 35°, one of 60°, and a compound prism by Grubb of much greater dispersion.

Mr. Common said: I should like to make a few remarks upon the remarkable photograph of the nebula in the Pleiades, which has been taken by the Brothers Henry, and of which a steel plate is given in the last report of the Paris Observatory. Nothing illustrates so well the advance which photography has made, and is likely to make, in physical astronomy. The nebula, as it was first drawn by Prof. Tempel, was restricted to a single patch of light near Alcione. In 1880 I discovered a second patch of light with the 3ft. reflector, and traced it extending to some distance round the group. This bright region of the nebula near Maia was then photographed by the Brothers Henry, and it has since been seen under very favourable circumstances by one or two people. As Sir William Herschel pointed out, it is much easier to rediscover anything than to see it for the first time. When photography leads the way, the eye can pick up what was not certain before. Then we come to Mr. Isaac Roberts' photographs, which greatly extended the nebula, and showed light extending through the whole group. And now we come to this beautiful photograph of the Brothers Henry, which shows some very remarkable details. There is a line of nebulous light which threads four stars, and nearly passes through a fifth one. Now that we have seen it in the Henry photograph, we can see that it is just shown in Mr. Isaac Roberts' photographs; but it was not sufficiently distinct to be discovered upon Mr. Roberts' photographs. However, the main details of the Henry photographs can be distinctly recognised on the photographs taken by Mr. Roberts.

Mr. Ranyard said: There are one or two points about the wonderful photograph of the Pleiades nebula, taken by the Brothers Henry, to which I should like to call attention. The narrow streak of nebulous light referred to by Mr. Common, really threads together nine stars, including the star just off the line to which Mr. Common referred. There is another long streak to the south of Maia, parallel to it. This second streak threads four stars, and they are both parallel to the arm or streak of light passing through Maia. None of these three streaks of light are quite straight, and the larger stars are not quite central upon them. They seem to have moved a little to one side, and yet one can hardly doubt that there must be some physical connection between these stars and the nebulous threads. There are three sets of more or less parallel lines in the nebula, making a considerable angle with one another. And if you examine the small stars all over the plate, there seems to be a sort of meshwork of stars extending all over the group—where you see lines of large stars, and you look more closely, you see that there are small stars—and these streams of stars surround areas where there are no stars. It would [illegible] seem as if the light of the stars had been [illegible] in [illegible] as by dark bodies cutting [illegible] light [illegible] nd the Pleiades group.

[illegible] like to make a remark [illegible] nyard has said. I am [illegible] at random would not [illegible] as looking to-day at the [illegible] the pa[illegible]tones, and [illegible] ce cu[illegible] gst them. [illegible] fr[illegible] her. In [illegible] urves in [illegible] nise on [illegible] m; but [illegible] rves on [illegible] raised by [illegible] ttempted [illegible] istributing [illegible] lways some [illegible] ning the stars [illegible] hardly doubt [illegible] nt at random. [illegible] bably has some

[illegible] presented to the [illegible] J. Tebbutt, "Ob[illegible] de at Windsor, New [illegible] "Physical Observa[illegible] 8"; Sir G. B. Airy, [illegible]"; A. B Biggs, "Ob[illegible] 8, made at Launceston, Tasmania"; Dr. L. Becker, "Note on Comet Sawerthal"; "Radcliffe Observatory Observations of Comet Sawerthal"; "Greenwich Observatory Observations of Comet Sawerthal."

SCIENTIFIC NEWS.

TWO notable statisticians have recently died. Mr. Bernard Cracroft was well known on the Stock Exchange, and his tables of fluctuations attracted much attention, as did his manuals on finance. He was sixty-one. Dr. Gryzanovsky, who died at Lucca, was formerly an attaché to the Prussian Embassy at Rome, and was an intimate friend of W. S. Landor, Browning, Trollope, and Mrs. Somerville. He devoted his talents mainly to the elucidation of social and hygienic questions.

Mr. J. Y. Watson, F.G.S., who practised as a mining broker some years ago, but latterly had retired, and appeared only as a county magistrate, is also dead. His writings in connection with mining and geological investigations were considered of much value.

From Dun Echt Circular No. 156 we learn that Comet Sawerthal was observed there on May 21·6 to have a brightness of 9·1, the same magnitude being estimated on May 23 and 24. It is a pity that so extraordinary a change of brightness was not observed at many places. The corrected time of perihelion passage is now given as March 17·00380 G.M.T., and the period is calculated as 2,378 years. The position on June 18 will be, for Greenwich midnight, R.A., 0h. 50m. 8s., N. Dec. 44° 56·4′.

It is stated that Baron Albert Rothschild has purchased the largest mirror telescope constructed at Paris for 40,000 florins and presented it to the Vienna Observatory. A gallery for it has also been built and endowed by the Baron. The total cost of this scientific gift will amount to upwards of £8,000.

At recent meetings of the Belgian Photographic Association a number of prints of the lunar eclipse of Jan. 2, and also of the solar eclipse of August last, were shown. M. Niesten, of Brussels Observatory, exhibited prints of the solar eclipse at the meeting of the Brussels section; while at the meeting of the Antwerp section several members showed photographs of the lunar eclipse, M. Prinz in particular exhibiting a series of the phases before, during, and after totality, as taken with the new Grubb lens belonging to the Brussels Observatory. These prints are sharp, and have a diameter of 30 millimètres (1·18in). M. Staffers exhibited some prints from negatives taken with a portrait lens and a microscope objective, the images being 20 millimètres (·79in.) in diameter. Several prints of lightning flashes were also shown.

At the last meeting (for the session) of the Society of Telegraph Engineers and Electricians Prof. Silvanus P. Thompson read a paper on the influence machine from 1788 to 1888, in which he traced the history of the apparatus, and followed much on the same lines as Mr. Wimshurst in his discourse at the Royal Institution, which we print on p. 344. According to Prof. S. P. Thompson, Varley, in 1860, gave a full description in a patent specification of an influence machine. The name "influence" was actually introduced by Holtz, who devised numerous machines in 1865-67-83. In 1865-80 Toepler brought out his well-known invention in which two discs were used. Holtz, it should be mentioned, abandoned the use of metallic carriers and used glass instead, the latter being electrified by means of points. Poggendorff improved the Holtz machine by doubling the plates. In the Holtz machines the parts had to be connected together in the first instance, as the machine was not self-exciting. Norton in 1866, Thomson in 1867-68, Carré in 1868, Kundt in 1868, Swendorff in 1871, Voss in 1880, and Wimshurst in 1881-88 continued the subject down to the present date. [illegible] machine of Thomson, called the "m[illegible]" was, he (Prof. Thompson) po[illegible] an almost exact analogue to the [illegible] in that it possessed field exci[illegible], commutator, and brushes. T[illegible] the influence machine is, how[illegible] Canton, of Stroud, Gloucest[illegible] it may be said to have been "perfected" by James Wimshurst in 1888, though the latter is doubtless still working out the subject. It is usual to speak of Nicholson's doubler as the first machine of the kind, and as that was invented in 1788, we are now celebrating the centenary of the influence machine.

The Council of the Institution of Civil Engineers have made the following awards to the authors of some of the papers read and discussed at the ordinary meeting during the past session, or printed in the Minutes of Proceedings without being discussed, as well as for papers read at the supplemental meetings of students: A Telford Medal and a Telford Premium to Mr. R. A. Hadfield, to Mr. E. Hopkinson, and to Mr. J. Pierce, jun.; a Watt Medal and a Telford Premium to Mr. P. W. Willans and to Mr. E. B. Ellington; a George Stephenson Medal and a Telford Premium to Sir Bradford Leslie: the Manby Premium to the late Mr. H. Goodall; a Watt Medal and a Telford Premium to Prof. V. A. E. Dwelshauvers-Dèry; and Telford Premiums to Mr. W. M. Thompson, Mr. J. W. Wyatt, and Mr. D. Drummond. The following Miller Prizes have been given: to Mr. D. S. Capper, to Mr. L. Gibbs, to Mr. H. M. Martin, Wh.Sc., to Mr. J. H. Parkin, to Mr. A. Chatterton, to Mr. J. Holliday, to Mr. A. W. Metcalfe, and to Mr. R. J. Money.

At a recent meeting of the Aristotelian Society, Prof. Bain read a paper "On the Definitions of the Subject Sciences, with a view to their Demarcation." Starting from the position that a science is an aggregate of kindred topics—that is, topics more closely related among themselves than they are to any others outside—Prof. Bain considered the best mode of securing this condition in the sciences of the subject world. There was a standing temptation among the professors of any one science to overstep its boundaries, from the desire of including some pet subject, to the consequent derangement of the unity of the science. A contrasting illustration was given from the position of Aristotle, who included in his grasp the whole circle of the subject departments, by which he was freed from the temptation to aggrandise one at the expense of another, and, in point of fact, kept their several provinces distinct to a degree that was quite remarkable at his stage. The course to be pursued, as suggested by this example, would be to review the round of the subject departments by taking them in couples—namely, psychology-logic, psychology-ethics, psychology-philosophy, and logic-psychology, these four couples being sufficient for the particular purpose of the paper, which was to isolate the topics most proper to make up a department of philosophy, as in a great degree synonymous in its present usage with metaphysics and ontology. As regards the treatment of the successive couples, the plan would be to fasten upon the most typical and universally received matters in each, and from these to shape a provisional text for judging of the admissions of the more ambiguous topics.

Two physicists and two biologists have been recently added to the list of Foreign Members of the Royal Society. Prof. Becquerel, of Paris, well known for his researches on the effects of light on bodies, especially with reference to phosphorescence, and Prof. Kopf, of Heidelberg, distinguished for his researches on atomic volumes and boiling-points, are the representatives of physics; while animal physiology is represented by Prof. Pflüger, of Bonn, and vegetable physiology by Prof. Julius Sachs, of Würzburg.

One of the electrical papers learns that a "scheme is being set on foot for the purpose of thoroughly exposing the shams connected with the sale of so-called electro-medical appliances." That is good news, and it would be interesting if it were followed by the announcement that the sham electricians and electric-light promoters were about to be exposed—by the electrical papers.

Another process of making aluminium has been patented in this country, and has been protected by patent. It consists in immersing solid sodium or other decomposing metal in molten cryolite or other aluminium compound mixed with common salt. It is the invention of Prof. C. Netto, of Dresden (4228, 1887), and is based on the displacement of aluminium from its ores by metallic sodium. Cryolite is a double fluoride of aluminium and sodium: it is ground to a fine powder, and is fluxed with common salt. The ore is then melted in a reverberatory furnace, and when quite liquid is run into a ladle. Pieces of solid sodium are forced to the bottom of the ladle, and are there held until they become volatilised. The gaseous sodium rising through the molten cryolite displaces a part of the aluminium, which collects in a metallic form at the bottom of the ladle. The greater part of the slag is then skimmed off, and the remainder poured into an iron crucible to cool. When the mass is turned out a solid ingot of aluminium is found at the bottom. The whole of the aluminium in the original charge of ore is not obtained at each operation, and the slag is therefore returned to the furnace with more cryolite. After the first charge the addition of salt is not required, as the slag serves the purpose of a flux. For each pound of aluminium there is required about 3½lb. of sodium, so it is important that the latter metal should be obtained cheaply. The process is being worked in this country, and will have some effect on the operations of the Cowles company and other corporations, which are working the new method of producing aluminium and sodium.

Another submarine torpedo boat is mentioned. It is being built by Major Cabanyes, of the Spanish army, and is to be fitted with a 60 horse-power electric motor, and a battery of 60 accumulators. It is said that "profound secrecy" is maintained as to the construction of the accumulators.

The Duc de Feltre has, it is said, designed an instrument, which he calls a phonozenograph, intended to indicate the direction of any distant sound. A microphonic plate of peculiar construction is fixed in a vertical plane, and is in circuit with a battery and a telephone receiver, or a Deprez-D'Arsonval galvanometer and a Wheatstone bridge. The microphone is more or less affected by a distant sound, according to the angle that it makes with the source. By moving the plate about until the maximum effect is obtained the observer is enabled to exactly locate the direction of the sound—at least, so it is said.

The monthly meeting of the Royal Archæological Institute was held at the society's rooms in Oxford-mansions last week, Mr. J. T. Micklethwait, F.S.A., in the chair. The papers read were (1) "On the Discovery of a Curious Structure, supposed to be the Cell of an Anchorite," at Ongar, between Epping and Chelmsford, Essex, by the Rev. E. S. Dewick; and (2) "On Norman Masonry and Masons' Marks," by Mr. J. Park Harrison. Each of the papers was followed by a discussion. Among the objects exhibited were a large collection of Hittite and Phœnician objects, including seals, rings, statuettes, &c., by the Rev. Greville Chester; and also a snuffbox which belonged to Beau Nash, and an authentic portrait of that uncrowned "King of Bath," by Mr. R. S. Ferguson, F.S.A.

The following paragraph is appearing in the columns of the "intelligent" newspapers:—"M. Jovis's proposed balloon trip across the Atlantic is outdone by the Transatlantic scheme of a monster airship to carry 100 passengers, which is actually to be favourably reported on to Congress. This construction would be a steel cigar-shaped vessel 600ft. long, which, when the air was sufficiently exhausted, was expected to have a lifting force of over 100,000lb., apart from the weight of the ship and the machinery." As a specimen of "English as she is wrote" it is not bad; but it is much better as a specimen of the mental pabulum provided for a nation which requires technical education.

The Norwegian Snow-shoe Expedition to Greenland are in high hopes of a favourable season for their experiment. The members are gathering at the Faroe Islands, and Dr. Nansen, the leader, hears that the drift-ice from Eastern Greenland has been driven away towards Iceland by strong north-west winds. The West and north coasts of Iceland are fairly beset with this ice, and Dr. Nansen thinks that this movement of the ice augurs well for an open season.

The Birmingham meeting of the Photographic Convention of the United Kingdom will be held in the Masonic Hall, the headquarters of the gathering, on the 23rd of July, when the evening exhibition, which forms an important part of the programme, will be opened. There will be an inaugural address by the Mayor of Birmingham, and a conversazione, besides the reading of papers, lantern displays, a dinner, and a smoking concert. An entire week will be devoted to the proceedings, which will include an organised series of excursions to interesting places in the environs and adjoining counties, visits to manufactories, and so forth.

At a recent meeting of the Scientific Society of Upsala, Dr. C. Aurivillius read a paper on the skeleton of the so-called Swedenborg whale (*Eubalena svedenborgii*, Lillj.), discovered last November in the province of Halland, in a layer of marl 50ft. above the sea. Remains of this species of whale have only been found once before—viz., early last century, when some parts of one were discovered in the province of Western Gothland, 330ft. above the sea, and 70 miles inland. It was at first believed that they were the bones of some giant; but it is said that Swedenborg discovered their true nature. The skeleton has been presented to the Upsala Museum.

Saccharin is said to be not merely an excellent substitute for sugar in the diet of diabetic patients, but a positive curative agent.

LETTERS TO THE EDITOR.

[*We do not hold ourselves responsible for the opinions of our correspondents. The editor respectfully requests that all communications should be drawn up as briefly as possible.*]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, *332, Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

⁂ *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

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GREENWICH IN THE REAR IN THE PHOTOGRAPHIC RACE—IN SEARCH OF A GOVERNMENT GRANT—TABLES FOR THE CONVERSION OF THE SUN'S LONGITUDE INTO RIGHT ASCENSION—"F.R.A.S." AND THE SCRIPTURES—RED SKY AT SUNSET—OLD TELESCOPES.

[28839.]—EVERYONE who is familiar with the manner in which science (so-called) is subsidised out of the national funds will read without the slightest surprise, albeit with extreme regret, that the modest demand of the Astronomer Royal for a photographic object-glass to enable the Royal Observatory to take its part in the International scheme for photographing the heavens has not been complied with. I grieve to find that the question of the iniquitous cost of the *Challenger* expedition has been suffered entirely to slumber. The merest fraction of that cost would have sufficed to thoroughly equip Mr. Christie with the necessary means of sustaining England's credit in that invaluable chart of the heavens to which all astronomers are anxiously looking forward.

And this brings me to remark that there is something plaintive in Mr. Espin's story (in letter 28811, page 326) of his own futile application to the Royal Society for a very little of the Government grant Why, bless my life!—all he has done is to make series of observations of great value and interest to science. Does he—can he—imagine that he is going to obtain Government money upon such plea as that? If so, his simplicity must b Arcadian. If he could only get hold of son Editor, now, whose literary ethics and low scienti morality would suffer him to insert anonym articles (written by Mr. E. himself) lauding marvellous industry, the originality of tho and the remarkable discoveries made by the T. E. Espin; and if by systematic puffing, b creatures dependent upon him, he could name perpetually brought before the publi great astronomer," "a well-known astronom so on, and so forth, in the Mussel's Pow Screecham's Ointment style, then there m chance for him; but to suppose, as I have said, that merely laborious and valuable scientific work confers any claim for pecuniary aid from the Government, is strongly suggestive of the small girl at the Sunday-school, who upon being asked what faith was, responded, "Please, teacher, believing what you know isn't true."

I am indebted to Mr. Dixon for the information that tables for the conversion of the Sun's Longitude into Right Ascension are to be found in Pearson's "Practical Astronomy." This work has been for very many years out of print; but I have no doubt that my original querist "Finsbury" could obtain a copy through Mr. Quaritch for £5 or £10. It may perhaps be worth while to add that "Finsbury" required tables to convert the R.A. and Dec. of stars and celestial bodies generally into celestial longitude and latitude, and not merely to transform one solar co-ordinate (reply 65096, p. 239).

If Mr. Moy (letter 28831, page 331) will read letters 28821 and 28821 preceding his, he will find two of the orthodox readers of Scripture contradicting each other's interpretation of the legend of Genesis point blank. Presumably, Mr. M. is not ignorant of the immortal definition of "Toleration."

In answer to "Alpha" (query 65516, p. 337), the sky is red at sunset on account of the passage of the solar rays, through so considerable a thickness of aqueous vapour, which transmits the red rays of the spectrum, but stops out (and reflects) the blue ones. When the sky is very red the moon may even look green from contrast.

I am afraid that the telescopes of which Mr. Mee speaks (in query 65523), on p. 337, possess but very little value, either in a pecuniary or archæological sense. We have a 3ft. non-achromatic telescope with an oak tube, by "Samuel Scatliffe, London," among our collection of instruments at the Royal Astronomical Society, and the late Mr. John Williams, our quondam assistant secretary, was the owner of two or three specimens with wood and paper tubes of the same type of instrument. I suspect that there must be a good many of these old telescopes kicking about in old-fashioned brokers' shops and similar localities.

A Fellow of the Royal Astronomical Society.

SAWERTHAL'S COMET.

[28840.]—IN compliance with your announcement of last week, I send the following observations upon the comet, made with a $4\frac{1}{2}$in. refractor (dialyte), low power.

June 3rd, 12.30 p.m., very clear; comet found while sweeping for Andromeda Nebula; nucleus very bright, elongated perhaps, with bright coma, apparently separated from nucleus by faint dark line, suddenly fading to a streamy tail, excessively faint and extending to a great breadth. A faint ray streamed from nucleus, which appeared superposed upon the tail, and could be traced some 15' in length; comet compared favourably with the great nebula, being almost as bright and about 1° apart. Prof. Boss makes it only a few minutes for same date. "E. M." June 1, p. 301.

June 6th, moderately clear, 12.35 p.m.; comet much fainter as compared with nebula; details seen again, but fainter. I thought the nucleus projected somewhat upon dark sky, and it appeared to flicker at intervals.

June 10th, 12.45 p.m., very clear; comet in juxtaposition with a fine aggregation of bright stars, a truly beautiful composition, light of coma more diffused, oval in form, widening tailwards, no long ray or interference line as seen on 3rd and 6th, tail very spreading, but excessively faint, interrupted by lucida of star-field, which obscured these faint details; one component of a wide double just involved in the tail; colour, a beautiful bluish-white. As the comet is rapidly getting into better position for evening observations, any observer with a good telescope and a fair N.N.E. horizon, may pick it up on the dark sky, and it is not improbable that another outburst of brightness may reward the persevering observer sooner or later.

Bermondsey. **D. Packer.**

THE COMET OF 1760.

[28841.]—ACCORDING to the *Annual Register* for 1760, Mr. Dunn observed a comet on the 1st of January of that year in the constellation Orion. Mr. Dunn is described as of the Academy, Paradise-row, Chelsea. I believe his name was Samuel, that he was a native of Cheriton, Devonshire, and died about the year 1792, having left some money to endow schools at his native place. No known comet was visible at the date given in the *Annual Register;* but there seems to be some reason to think that the first of January is given in error for the 8th, and that the comet observed by Mr. Dunn was that discovered at Lisbon on the 7th. is makes me anxious, if possible, to obtain in- mation as to the original observations of Mr. mn, or some other contemporary record of them. e was the discoverer of an otherwise unrecorded comet, if the *Annual Register* is correct, and it occurred to me that some of your numerous readers might be able to throw some light on the subject. There seems to be no reason for supposing the 1st of January to be a mistake for the 8th, except that it would enable Mr. Dunn's observation to be reconciled with a known comet.

In the *Annual Register* for the following year there is an account of a comet seen from the deck of the *Princess Royal* at the Nore on the night of July 23rd, 1761. This probably was not a comet, but a phenomenon of a different kind. I should be glad to hear whether there is any other contemporaneous note of it.

Dublin, June 4. **W. H. S. Monck.**

MARS.

[28842.]—J'AI pensé que les lecteurs de l' "E. M." recevraient avec plaisir quelques nouvelles des observations que j'ai faites de la planète Mars et que je continue encore utilement en ce moment avec mon réfracteur de 8 pouces de Sir Howard Grubb. Dans une lettre précédente (28717), j'ai déjà fait allusion à la difficulté de l'observation des canaux, spécialement dans les conditions défavorables de position et de distance où se trouve actuellement la planète. A force d'attention et de persévérance je suis parvenu jusqu'à ce moment à reconnaitre en toute certitude les canaux suivants: Antæus, Erebus, Cerberus, Styx, Eunostos, Hyblæus, Triton, Lethes, Thoth, Nepenthes, Astusapes, Phison, Orontes, traces d'Hiddekel et Gehon confondus, Indus se continuant dans l'Oxus, Ganges, Nectar, Agathodœmon, Protonilus et Deuteronilus avec lacus Ismenius, Callirrhœ, Tanaïs, Nilokeras, Nilus. J'ai vu également le Sinus Titanum, une trace d'Atlantis, la baie du Lœstrygonum, Hesperia, Syrtis minor, Mare Tyrrhenum, très pâle, Elysium, Libya, Propontis avec Herculis pous, Ætheria, Alcyonius, Syrtis major, Nilosyrtis, Boreosyrtis, Sinus Sabæus avec la baie du Phison et de l'Euphrate, Edom promontorium, Aryn promontorium par le dédoublement de Dawes "forked bay," Deucalionis regio, Margaritifer Sinus, et Auroræ Sinus avec Pyrrhæ et Protei regio confondues, Solis lacus et Tithonicus lacus, Niliacus lacus, Achillis pous, Mare Acidalium et un petit lac situé entre cette mer et la tache polaire, lac auquel M. Schiaparelli, depuis ses dernières publications, a donné le nom de Lacus Hyperboreus, Lunæ lacus, Ceraunius, Mare Sirenum, Mare Cimmerium, Trivium Charontis, Argyre, Tempe, etc. . . .

Les géminations semblent beaucoup moins fréquentes jusqu'ici qu'en 1881-2; du moins il ne m'a pas encore été donné d'en observer avec certitude; en présence de la difficulté d'observer les canaux eux mêmes, je dois rester ici dans une grande réserve; c'est seulement au commencement de juin que j'ai cru constater une apparence de dédoublement dans le Phison, mais le fait a besoin de confirmation.

Le Trivium Charontis et Elysium (Fontana land) se trouvent dans la moitié orientale du disque on pouvait observer deux phénomènes intéressants: d'une part trois petits points blancs, au bord occidental, sur le prolongement de l'Erebus, devenant de plus en plus blancs et brillants en approchant du limbe, où ils finissaient par déborder par irradiation et rivalisaient, d'éclat avec la tache polaire; d'autre part un petit fil ou canal noir comme de l'encre qui se montrait à l'intérieur de la calotte polaire; pour moi ce filet noir etait la bordure de la calotte polaire proprement dite, et à son extérieur se trouvait une petite terre hyperboréenne neigente et brillante, un peu moins blanche que la calotte polaire autour de la quelle on la voyait tourner par la rotation. Cet aspect de la tache polaire à été etudié non seulement à Louvain, mais à Milan par M. Schiaparelli, et à Nice par M. Perrotin.

Si un changement d'aspect m'a frappé dans la région de Libya, c'est d'une part de pâleur de Mare Tyrrhenum et de l'autre la nuance tres noire du Nepenthes; habitué à voir Mare Tyrrhenum assez noire, j'avais d'abord pris pour cette mer le Nepenthes; en ces points je m'accorde donc avec M. Perrotin. Mais en ce qui concerne la Libya, que j'ai vue fort bien, j'ai peine à croire quelle soit inondée ou disparue. Ces régions se présentents d'ailleurs dans des conditions d'obliquité et de perspective, ou haut du disque, qui les rendent difficiles à bien étudier.

M. Mee apprendra avec plaisir que dans le dessin qui accompagne sa lettre 28742 il à figure à gauche de Kaiser Sea une partie du canal Thoth et en bas et à droite le Protonilus et le Callirrhoe de M. Schiaparelli; on voit aussi en haut, à gauche, une trace du Nepenthes (main sea).

Louvain, le 7 Juin, 1888. **Dr. F. Terby.**

OCCULTATION OF A STAR BY JUPITER.

[28843.]—UNLESS already communicated by one of your regular astronomical correspondents, the occultation of a fixed star by the planet Jupiter on the evening of June 10th is worth recording.

Happening to observe the planet on the 9th inst. at 9 p.m., I was surprised to find it apparently attended by five satellites, further examination showed that one of these was a star of about equal brightness, situated between the second and third satellite on the left-hand side of Jupiter. At 9.44 p.m. the first satellite entered upon its transit, and was lost to sight, so that any casual observer would have recognised the then appearance as a normal view of Jupiter with his four moons. Later on, the shadow of Sat. I. entered upon the disc, and thus rendered it again apparent that there was "one too many." Clouds intervening, I could not continue observations after 11 p.m.

On the evening of the 10th, cirro-strati in the S.E. prevented anything from being done until 9.15 p.m., when the planet was seen with the four Satellites, but the most careful search failed to detect the star, and I could only account for its disappearance on the supposition that it had been occulted. Being called away at 9.30, I returned to the instrument at 9.45 to find the star brightly shining in close proximity to the limb of the planet. I had unfortunately missed the sight of its reappearance, which probably occurred about 9.38, in a position where Sats. I. or II. would have emerged in the shadow of the planet, and remained for some time longer.

Ealing, W., June 11. **R. T. Lewis.**

CONVERTING SUN'S LONGITUDE TO RIGHT ASCENSION.

[28844.] — "A FELLOW OF THE ROYAL ASTRONOMICAL SOCIETY," in letter 28784, page 302, second paragraph, says "He does not know of tables for converting sun's longitude to right ascension and declination before those mentioned in the American *Nautical Almanac* report for 1887. The following have evidently escaped his notice: "Vince's Astronomy," Vol. II., pages 340 to 344 for the sun; Berlin "Jahrbuchs" for 1831 and 1856, for sun and stars. **Tria.**

PRICE'S FRONT-SLIDE LATHE—MODEL GAS-ENGINE.

[28845.]—I WAS very glad to find Mr. Price is endeavouring to put into the market a lathe with the vertical as well as the front slide. I heartily wish him success. His arrangement would have to be somewhat altered to suit my own notions; for instance, I should want his two upper slides reversed, so that the lower one would come on the top. By so arranging matters one of the slides under the milling cutter is got rid of. As at present arranged, it appears to me impossible to turn a bar of more than 2in. in diameter, since, as shown in the drawings, the cross slide is already drawn back as far as it will go, and yet it is within 1in. of the line of centres. Then I should add the screw in the bed with the revolving nut for traversing, even if a self-acting feed and change-wheels were not required at first. Thus, for milling, there would be the long slide of the bed, the vertical, and the cross-slide; and for turning there might be (though it would hardly be required even for cones), the longitudinal slide. In short, I think I would throw out that longitudinal slide, and instead, make use of the front slide of bed by adding a fixed lead screw and revolving nut. Cones could be turned even then by turning the cross slide upon its quadrant, and feed would be given sideways by the front slide. This alteration would enable any diameter to be turned which the lathe will take. It is a nuisance to be cramped for room if you wish to use, for instance, a universal cutting frame which requires to stand out at least 3in. besides the semi-diameter of the work.

I have been busy making up a set of castings of a model gas-engine from J. F. Barker, late Dorrington. I am glad to be able to say the engine went off the first time I tried it, though it is only $1\frac{3}{8}$in. diameter by 4in. stroke. I have no gas-bag yet, and the relighting jet will sometimes go out. I made the ignition orifice $\frac{3}{16}$in. (not $\frac{1}{8}$in. as shown on the drawing), and used a "pipe light" tap for the ignition jet. After working some time I foolishly put oil to the piston, and then had a good deal of trouble with the engine till I found that the *slightest* amount of grease or even of moisture under the ignition flap will prevent its lifting. I now use blacklead put on with paraffin, which latter quickly evaporates, as advised by Mr. Knoeferl, of 100, Bolsover-street. I use no packing rings in the piston, but ground out the cylinder true and smooth, and also the circular valve seating. Tried at the dynamometer, the little thing supports $\frac{1}{2}$lb. at radius of $3\frac{1}{4}$in. = circumference 1ft.; and makes 160 revolutions per min. = 80ft.-lb. $\frac{1}{400}$H.P. You cannot stop it by pinching the $\frac{3}{8}$in. crank-shaft with the fingers. I am amused to find what a noise it makes—as much, I think, as a large one—but that may be because it is screwed down on a work-bench. It's all very pretty in a baby engine, but I should not like to have a one-man engine to drive my lathe making such a row! Wh shall we have castings offered of a silent or c pression engine, and how long will it be before existing patents allow of this?

I may say, perhaps, that Barker's castings were very good—the softest iron I have ever worked; it turned and filed like brass.

June 5. **F. A. M.**

[28846.]—I CANNOT quite see where Mr. F. Carre (28807) has derived his notion from regarding the wear of the front slide, the bearings being extra long—9in., I believe—for the purpose, I presume, of avoiding that one error, and I am sure are far greater in proportion than many other tools that have come under my notice, and which have done good work for an extremely long time. I refer to shaping and milling machines. I think it very unfair of Mr. Carre to state that a purchaser of such a lathe (whose capabilities I have seen and can endorse) will be grievously disappointed. In my poor deluded opinion I think it will be entirely the reverse. All I can say is, I wish Mr. Price success, as I think he deserves it; for his front-slide lathe, to say the least of it, is undoubtedly a step in the right direction, especially for those amateurs who require a "useful and accurate" tool; the price being very reasonable (in fact, cheap) for the workmanship supplied, and I think likely to suit mechanics, as well as amateurs, who require such a tool at a small outlay. Its accuracy is so good as to be able to drill a hole easily (so steadily does it run) edgeways through a brass blank the size and thickness of a sixpence—a feat not so readily accomplished on some lathes at triple the cost. The lathe in question is only 8½ centres; therefore the wear and tear is in accordance with its size and weight. It supplies a long-felt want, as with such a tool wheel-cutting, milling, and fluting can easily be done. For clockmakers and electricians I should think it would prove itself invaluable.

London, June 6. **W. H. Taylor.**

THE FRONT-SLIDE LATHE.

[28847.]—IF "H. F. C." will read again the second paragraph of my letter, page 308, and have the inclination to study the matter, he may possibly see the reason for the conclusion the correctness of which he doubts. The lathe in question is stated to have a bed 3½in. wide, and presuming that the drawing is correct, the top V of front slide is less than ½in. wide. On this ½in. bearing surface the whole wear and tear of all work, except what may be done on the hand-rest, comes. It does not need much consideration to decide that such a small surface cannot long remain true, and that it will soon become hollowed near to the mandrel-head, where most of the work is done. "The front of the bed will" *not* "take the thrust" when large diameters of eight "or nine" are being turned. What occurs on the front of the bed, then, is a greatly *increased pressure*, because of the leverage of the tool, and all this increased pressure is superadded to what the top V has to bear, when the tool is vertically over it. As to this lathe lasting as long true if made screw-cutting, as the same lathe if fitted in the usual way: since the wear is directly as the surface and the pressure, the life for surface alone would be as one to seven. This, compounded with the pressure, which, if we put it as low as two or three, the result of increased leverage, would give as much wear in *one* year of this lathe as in from 14 to 21 of the ordinary top lathe.

Let "H. F. C." by all means get a front lathe if he seeks convenience; but if he desires any lasting accuracy in the self-acting part, let him see that the lathe he buys is constructed on sound principles.

A word now to "Comparison." I cannot see what occasion there is for his reference to *fair play*. I think nothing unfair was said of Mr. Price's lathe. He deserves great credit for his enterprise, and I have hailed with pleasure his effort to supply to amateurs what other makers are so far blind they cannot see they are standing in their own light in trying to ignore. If the regular lathe-makers will not give us their assistance in seeking what we want, we may yet be able to get it without their aid.

I am asked how is it that practical engineers have found no objections to the front slide as used for large milling and shaping machines? There it is—*milling and shaping machines* can have no other form of bed, but a lathe can have another and *much better* for its purpose, if long wear and continued accuracy are considered. I have been under the impression that all practical engineers are opposed to the front slide for a lathe, and I have also been under the impression that I, along with a few others, have for years been fighting the [illegible]ttle for the front-slide lathe against those who [illegible] themselves practical engineers. But I have [illegible] it *not on principle*, or as being the tool for [illegible] engineers, but simply as being the best [illegible] lathe an amateur can start with. The [illegible] lathe is a *compromise*. I know there are [illegible] despise all such tools, and tell us you [illegible] machine separate; but all the same, in spite of such teaching, amateurs will make and will demand combinations, no matter what the practical hands may say.

"Comparison" says he had accurate work done by a shaper with a V slide 3in. by 24in. which had been in constant use for over eight years. When I hear what the work done was, what degree of accuracy was attained, and what tests were applied, I will be better able to judge whether this instance is anything against what I have stated. But the cases are really not on the same footing. Wear in a shaper-bed is comparatively harmless, because the surface, which would be affected by wear in the bed is generally very narrow. I speak of the shaper in which the head is fixed and the table moves. Further, in the slide lathe the saddle moves while under the full pressure of the cut. In the shaper it should never do so, as the feed is given during the back stroke; therefore, the wear in a shaper-bed is little more than what results from the weight of table and the work on it.

A lathe worth anything for accuracy ought to be able to turn up a bit of shafting of at least 18in. in length. To do this, the tool must be carried at exactly the same level all along. If the bed wears hollow, or the top ½in. V in the lathe under discussion gets worn in one place more than another, the tool is carried at a lower level, and the result is a barrel-shaped cylinder. In a lathe accuracy is mostly required across the cut; in a shaper, mostly along the cut. In other words, a turned surface may be looked on as the result of a great number of short cuts; a shaped surface of a few long cuts. In the planer the cuts are many and long; but I need not write more. "Comparison" and I are agreed that the front-slide lathe ought to be regarded with more favour than has hitherto fallen to its lot; but, then, that it may not be again relegated to the old iron heap, let us avoid the mistakes which brought it to that end. I may say that I have now designed a new form of bed in which I think I have met all objections which have at various times been advanced, and I retain the advantages of those beds which met with most approval. According to Prof. Sweet's statements, it will be 50 per cent. stiffer than the ordinary double-shear bed, the bearing surface for saddle is greatly increased, and the pattern is simplicity itself to make. I am seeing what price lathe-makers will supply it at, and perhaps then I may may have something more to say on it, and on the F. S. lathe generally.

Fredk. Carre.

INTERNAL GEAR FOR LATHE.

[28848.]—WHAT "J. L. D." is looking for is, I think, what was described and advertised in "E.M." eight or ten years ago as Jewsbury's gear. I cannot now describe it for him, nor can I look up back Nos.; but as the same principle has been utilised in the screw-cutting device by *Niblet*, or *Nibblock*, which was described about a year ago, possibly if he looked it up, he might find the slow-motion part would suit his purpose. It was stated that Jewsbury gear was perfectly silent and truthfully smooth. It could be attached quite easily to the single head. You will also, I think, find an internal gearing figured in "Holtzapffel," Vol. IV.; but, as well as I remember, it is more complicated. If you cannot make it out, or get a look at back numbers, I will make a search for you.

I have seen Pfeil's lathe, which I think he calls the "Unique." It is a beautiful little lathe; but I thought there was too much to pay for the patent. I am glad to see you, too, are in favour of the front slide. I hope we may yet beat down the opposition, or get rid of the apathy.

Fredk. Carre.

LATHE MATTERS—SUBSTITUTE FOR BACK-GEAR.

[28849.]—I HAVE an idea that the arrangement "J. L. D." alludes to on p. 331 is that by Dewsbury. This was illustrated some years ago in the "E. M."; but I have failed to find it now, notwithstanding a long search. This is the more to be regretted, as I remember the plans and description are very clear.

It is also explained in another periodical, and I shall be happy to lend the number to "J. L. D." if he likes to write to me.

In the mean time, I will have another search among my back vols. of "E. M."

Ramsgate. **J. C. Linscott.**

[28850.]—BY looking through the indices of back volumes, I have found in Vol. XI., the description and drawing of internal back gear asked for by "J. L. D." He will find a good drawing of it on page 349, and more about it on pp. 478 and 524. Now, will "J. L. D." tell us how he arranged his pulleys on the 6in. lathe to which he refers, and which seems to have disappointed him. I have the usual back gear, which gives four treads to one revolution of the mandrel, but though the gear is cut, the rattle is annoying. On a 3½in. lathe I have a 7in. grooved face-plate worked by a 5in. pulley on crank-shaft, which works pleasantly. I think we all admit that back gear is necessary for a regular metal-turning lathe of 5in. centres; but an amateur who works as much in wood as in metal does not, I think, require it, and would find it in the way. I hope someone will give us description of Pfeil's screwing apparatus.

F. A. M.

[28851.]—THE front-slide lathe of Mr. Price seems a very handy tool. I certainly like his arrangement of the V strips better than any previous design. The outside poppet screw is also an improvement. I hardly think it will be found the best plan to make the upper V terminate sharp on the lathe-bed face. Turnings are sure to drop into this channel, and it would seem advisable to undercut a semicircular channel in the bed face below the termination of V, so that no obstruction could be formed to the passage of the saddle.

Orderic Vital.

[28852.]—ON reading the letter of "J. L. D." (28826) on the above in last week's issue, the paragraph *re* the gear inside the pulley reminded me of an arrangement I saw some fourteen years ago, and which, to the best of my recollection, I will endeavour to describe.

On the mandrel, in the place of the usual spur wheel, is keyed a recessed plate or disc, the recessed side towards the cone pulley, and having teeth cast on the inside of the rim; on the front of the cone pulley, which runs loose on the mandrel in the usual way, is an eccentric block, the ring of which has teeth cast on it to gear with those inside the recessed plate. The eccentric being fast to the pulley revolves with it, the toothed ring engages with the internal teeth of recessed plate, and rolling around in the same imparts a slow motion to the mandrel; the depth of recess in the plate corresponds with the thickness of eccentric block. When the slow motion is not required, the cone pulley can be made fast to front plate by screwing a bolt through same into the front of cone pulley, when the whole concern will revolve together.

St. Mary Ch., Torquay. **Engineer.**

OBJECT-GLASSES AND OTHER MATTERS.

[28853.]—MR. J. A. CAMPBELL (query 65555) has got his figures a little mixed. Foci 10·14 and 17·55 are not as 26 to 46, and the shorter crown curve should be r_1, not r_2. For this combination of glass I do not think Mr. Campbell can do better than follow, as far as he is able, the instructions of "Prismatique" given some time ago. These were to make the crown curves as 2 to 3, and the interior flint curve a little deeper than its convex neighbour, and then compute the flint back curve from these conditions. Practically, we might say the crown curves should be as 2 to 3, and the flint as 1 to 5. Your correspondent has apparently computed his curves on this assumption; but the deeper curves are in their wrong places. Should not the crown values be 8·8 and 13·2? In a small objective of this kind, it will, perhaps, be better to make the inner curves alike, and cement them.

With regard to the correction, little can be said. Theoretically, the ratios I have mentioned should give a minimum of spheric error; but as regards the chromatic error, I fear nothing but practical experiment will show how it is to be balanced. When Mr. Campbell has had some practice at o.g. working he will, no doubt, discover that the skill in "figuring" which the workman can employ is a more important matter than any precise theoretical ratio of radii. I am not saying this to discourage the querist in his calculations; but what I would wish him to understand is, that he must expect his lens to require considerable final correction if he goes in for best definition, no matter how carefully the curves have been computed.

As regards optical glass, the price of discs seems to be lower. Not many days ago I received from one who does, or did not long ago, advertise in the "E. M." a circular, dated August, 1887, entitled "Price-List of Optical Glass suitable for Astronomical Telescopes, &c. If found defective, will be exchanged free." The price of 3in. discs is 7s. 6d., and 4in. discs £1 each. I mention this, not from a desire to advertise anyone, but simply because I feel certain there are numerous amateur opticians who will gladly welcome a reduction in the cost of material for object-glasses.

Optical correspondence seems almost to have ceased in the "E. M." Where are our friends, Mr. Wassell, Mr. Brashear, and "Prismatique"? Was it not stated some time back that Mr. With intended to publish his method of working his exquisite specula in book form? Has such a work been issued?

I have some recollection of a correspondent asking something about the new Abbe glass. I do not know where it can be obtained in England;

r have I seen any details comparing the ppearances given by it and by a first-class ordinary glass. If any correspondent has t, we may, perhaps, see some particulars in olumns. **Orderic Vital.**

PENSATED PENDULUMS AND TURRET CLOCKS.

54.]—I ADVISE Mr. Hutchinson (letter and 28834) not to attempt any such comed pendulum as he describes—nor, indeed, nd of mercurial pendulum. The 28 years' ence at Westminster and somewhat less at wich seem to be decidedly in favour of the ıd steel compensation with a lead or iron bob; ıe difficulties of joints and other things in ndulum of mixed mercurial and other kinds pensating metal are insuperable and at least to accuracy. I see the Greenwich report of estminster clock for the past year is as good ıal, and I suppose better than of the best omical clocks.

ve lost the copy which "Star" refers to of l *Illustrated News* description of the Westr clock; but I doubt very much if it conas much detail as Lord Grimthorpe's book, also gives a great many details of other locks, and far more than any other book; e last (7th) edition contained some new ones, ı some other books contain more information watches. **Horologus.**

TURRET CLOCKS.

355.]—I BEG to thank "Star" very much for ıd offer of the illustration of the Westminster which I would be glad to have a sight of, h I doubt if it would help me much, as I ıot say I am not likely to attempt a great like it. I have in "Clocks, Watches, and ' an illustration of it by Beckett himself; cept the number of teeth in the wheels, there w exact particulars such as I want. A clock 4ft. dial (striking on a 5cwt. bell) is all I to attempt. What size of works this would cannot anywhere find. I mean to use cast-heels; but what size the spindle should be, ow much they should be turned down to form vots, I have no idea. I only know if they ot *small* Beckett says the friction is ind.

ve also to thank W. van Eys for the informae gives me; but as the book recommended nothing on turret clocks, it would not, I fear, my purpose much. I have never read a nical book in German, and fear the technical would make the reading hard. However, I emember the book, and perhaps some time ight of it, and thus learn whether it would r use to me.

r, Donegal, June 9. **Fredk. Carre.**

PURE MATHEMATICS.

56.]—"M.I.C.E." asks with regard to the ıids (p. 331)—"After all, what do we know of old times?" Very little indeed, but I submit his little. The absence, in their works, ıer angles than such as have very simply ical tangents, implies designers to have ıt little, if at all, of the simplest Euclidean ms. These, of course, are not, in the bulk, l's own. He was a collector of past science, ıe 47th Proposition, so necessary to nearly ond, is ascribed to an earlier hand, but none than Pythagoras. Such designers as those amids, if acquainted even with this, would often, or sometimes, chosen angles the doubles h as above described, so as to have all their ons numerical, especially the simplest of ıaving them 3, 4, and 5. But in Vyse's great his is nowhere approximately found. Even iquot parts of the circle, as 60° and 30°, do cur. Neither did they once choose, as Lord horpe has remarked, the 50° 44′ that is far eliest for geometers to have given a pyramid, g its faces equilateral. Once only do we find, great pyramid of Dashoor, an angle with nsurable functions; but by no means the st—rather seeming hit upon by chance.

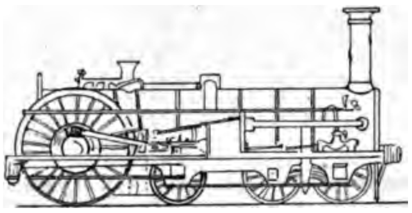
n "M.I.C.E." has demonstrated the inclosgiven sphere by the shortest two slope lines, he will proceed to show the steeper slope ramid faces must have, to inclose it by the um of surface. **E. L. G.**

E LITTLE KNOWN PLANTS OF THE FLORA MEDICA.

57.]—"GARCINIA," order Guttiferæ, a nteresting group of tropical trees, nearly all m producing "gamboge," the yellow gum ılly sent from Cambodia, Siam, hence the of this drug. *Vismia guianensis* of South ca resembles the above in all its qualities. des the Siamese species, there are many iferæ," yielding true "gamboge." Ceylon, ar, and the Indo-Chinese Forests (on the frontier of Assam). G. Pictoria, of Southern India, yields "gamboge" which, when fresh, was found superior in colour to the Siam article, but its medicinal quality was not tried. *G. pedunculata* attains a height of 60ft. and is a beautiful object, being very symmetrical in growth, the foliage brilliant green, and resembling a delicate laurel with golden orange-like fruits, containing a wholesome acid juice, much used on the spot to acidulate curries. Moreover, I have seen a fine jelly made by an English lady from the same. Strange, too, that *G. Mungostana* should yield an edible fruit so fine that it baffles description, from the rind of which fine gamboge has been extracted. In small doses the gum acts as a hydrogogue, cathartic, and diuretic; in large doses, very dangerous effects are produced. The drug was formerly much used in the treatment of apoplexy and dropsies. A vendor of patent pills employed it as the basis of his nostrum. On moistening one of these an artist got a "good yellow." I believe this gum has never been collected in India. There are, or *were*, three varieties of Siam gamboge: (1) Solid cylinders; (2) Hollow cylinders; (3) Cakes. Dr. Christison published a very elaborate analysis of the three sorts, No. 1 being the richest in resin, of which 5 grains produced great results, without pain or uneasiness. The trees of this order are only found in dark, swampy, virgin forests. All the young specimens I removed died very quickly, though well protected in transit by canoe. **Eos.**

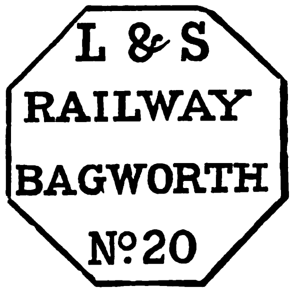
THE "LIVERPOOL" LOCOMOTIVE.

[28858.]—A CORRESPONDENT, letter 28680, p. 149, asks for a sketch of the "Liverpool." I beg therefore to inclose one. The dimensions were given in Vol. XLIV. p. 244. **F. W. S.**



AN ANCIENT RAILWAY TICKET.

[28859.]—THE annexed illustration is a full-sized representation of the old brass railway tickets used on the Leicester and Swannington Railway from the opening of the line, 17th July, 1832, to 1846, when it became the property of the Midland Company. If a passenger were going from any station—for instance, to Bagworth, perhaps—ticket No. 20 would be issued to him, and this number and the amount of fare paid would be duly recorded in a book.



The guard of the train carried a leather bag, somewhat in the form of a collecting-box, having a separate division for each station, into which the tickets were placed by the guard when collected, and returned to the station from whence they were issued, to be again used.

These tickets appear to be such interesting relics of early railways, that I have lately presented one of them to the South Kensington Museum.

Clement E. Stretton.
Consulting Engineer Associated Society
of Enginemen and Firemen.

Leicester.

NON-MIRACULOUS GEOLOGY.

[28860.]—TO answer "F. S. S." (p. 332), as to whether I regard an event as a miracle, it is necessary to define a miracle, and Locke's definition is the only one I can accept; "a sensible operation which, being above the comprehension of the spectator, and *in his opinion* contrary to the established course of nature, is taken *by him* to be divine." Locke was driven, he says, to make this, by Fleetwood's defining it "an extraordinary operation performable by God alone"; which assumed in somebody the monstrous claim to fix the limits of all power not divine, or of all natural laws, discovered or undiscovered. He said, "Nothing can be taken to be a miracle but what is judged to exceed those laws. Now, every man being able to judge of those laws only by his own acquaintance with nature, and notions of its force (which are different in different men), it is unavoidable that that should be a miracle to one which is not so to another."

Of course, then, I do regard the warning of Noah long before the event, in such way as to lead and enable him to save humanity and animal life in so tremendous an accident (an accident so rare in nature that we can hardly reckon above four or five as great catastrophes probable in an average million years), as a miracle most eminently divine. Dr. Halley, the physicist, first enabled to see and point out the accident's nature, when doing so to the Royal Society in 1794, added, "In this case it will be much more difficult to show how Noah and the animals could be preserved, than that all things in which was the breath of life should hereby be destroyed."—(*Phil. Trans.* 1724, No. 383.) "The foregoing papers having been read before the society 30 years since, were then deposited by their author in their archives, and not published, he being sensible that he might have adventured *ultra crepidam*, and apprehensive least by some unguarded expression he might incur the censure of the Sacred Order. Nor had they now been printed but at the desire of a late committee of the society, who were pleased to think them not unworthy of the Press."

You see it is possible God may intend identical stories to be held miracles by readers in one age and not so by readers in another, and yet attest His hand to both. For very near these two centuries He has caused the naturalness and physical accuracy of this Hebrew story to be clear, or growing ever clearer; and according to a saying of poor Bp. Colenso (which, however, he never acted on) we are not to shelve or keep out of view "any fact that God in His providence has chosen to bring before us." But your "Sacred Order" make themselves judges of that, and say, Let there be darkness, and dark you must remain.

Halley had ended his paper thus:—"If this speculation seem worthy to be cultivated, I shall not be wanting further to insist on the consequences thereof, and to show how it may render a probable account of the strange catastrophe we may be sure has at least once happened to the earth."

The state of knowledge at that time—geological, physical, or even astronomical—would, of course, not have led him to anything like so clear an account as now; but this quackridden old Britishry almost as hoodwinked then apparently by their "Sacred Order," as now by their pseudo-science quacks, were thoroughly prevented looking at anything so eminently "worthy to be cultivated"; and in these two centuries I seem the only individual in Britain to look at it! There has never been any such "task" as "F. S. S." implies "of reconciling the old Hebrew books with modern science," for they have never had any variance to reconcile. The books that cry out to be reconciled, but never will be, with science, are not any Hebrew ones, but the new geologers' ones of this reign—not this half-century in the world at large, but this Britain of Victoria—since their arch-quack Lyell set them at their vain Bible-baiting.

Halley's contemporary, Whiston, doubtless did independently strike out the same obvious theory; but being one of the "Sacred Order," the only one apparently in these whole two centuries honest enough to see it "worthy to be cultivated," he did so not in the true scientific spirit Newton and Halley would have done, but with somewhat of the recklessness Locke rebuked in the above quotation, and brought on himself ridicule that unhappily clung after him to the subject.

In 1767, Edward King, F.S.A., broached in the *Phil. Trans.* the miraculous submergence theory that lasted into our time (being adopted by De Luc and the founders of geology, and retained by Cuvier and Buckland), namely, that of a causeless globe, convulsion suddenly and permanently drowning all that till then had been land, and bringing up our present continents instead. This was supposed to tally with Gen. vii. 11, and that was what led me to retain far too much of the idea in the debate you admitted on this event between Vol. XV. and XX., where "F.R.A.S." and "Sigma" chiefly opposed, and the late Rev. H. C. Key supported me; but in no other verse, observe, does Genesis hint at any other source of waters than the sky, and "the great deep" in that text is quite as likely to mean the sky as the "sea," a word that in the whole Deluge story never once occurs. While always rejecting, then, the miraculous part of King's theory, I have now also abandoned most of the crust movement. He had indeed this one element of truth: I hold that whatever lands the Flood submerged remain still submerged, unless

Armenia was old land, of which there seems no proof.

I still claim, as Mr. Key did, for the Bible and myself against all your Lyellists, "F.R.A.S.," Clodd, Proctor, Grant Allen, "Sigma," &c., the exclusive distinction of geologising without miracle. The Hebrew books have miracles in other matters, but in geology none.

Plenty of allusions by foreign, or at least by French scientists, to the astral cause of the Deluge, might be cited in proof of my position that, outside of quack-darkened Britain, the thing has been taken for granted, and doubtless by many who never heard of either Whiston or Halley; but it may suffice here to refer "F. S. S.," or any doubter of this, to Auguste Comte's "Positive Polity," Vol. I. of English translation, p. 410. As the thought of an atheist, or extreme anti-theologic agnostic, it is well worth examining. **E. L. G.**

THE CHEMIST NOT A CREATOR.

[28861.]—"SATINE" states in his letter (No. 28769, p. 281) that "the religion of a thousand years must surely fall if in the laboratories of to-day there is produced a compound which will live like one of the Monera," and he further states that "science is leading up to such a point" because "she has produced compounds formerly made by plants and animals alone—such as the poisonous base of hemlock, and many others—and why not also protoplasm?" After "Satine's" expression of doubt as to the stability of religion in the event of such contingency arising as above stated, it is very considerate of him to think again, and ask—"Why not also protoplasm?" And I may here say that Professor Roscoe's remarks on this subject will be the best answer to give. They may be found in their entirety in the ENGLISH MECHANIC for September 2, 1887; but are, so far as may be necessary to state in this connection, as follows:—"Protoplasm, with which the simplest manifestations of life are associated, is not a compound, but a structure built up of compounds. The chemist may successfully synthesise any of its component molecules, but he has no more reason to look forward to the synthetic production of the structure than to imagine that the synthesis of gallic acid leads to the artificial production of gall-nuts."

John R. M. Thompson.

IMPOSSIBILITY OF MANKIND BEING DERIVED FROM ONE COMMON ANCESTOR—EVOLUTION.

[28862.]—I CANNOT quite understand the force of "Amateur's" opening remark in his letter last week (28820, page 329). Whether he thinks that the fact of animals, when very closely interbreeded, becoming small and sterile is a theory I know not; but, as it is, it is a fact, which has been proved scores of times—the case of pigeons is proved every day almost. I strongly suspect that "Amateur" has written his letter, not because he knows anything about the subject, but because the theory of Evolution is against the facts mentioned in the fairy legend which forms the beginning of his Bible. Thus, he says, "Man and pigeons are not governed by the same laws, because the former was made in the image of God." What laws he refers to I don't know—neither does he, I believe; also I think that "God was made in the image of man" (as the latter could conceive no being of a form higher than himself) is a truer phrase than "man was made in the image of God"; for, as I have said in other letters, men—especially uneducated men—put down every inexplicable thing to a spirit. Man has certainly not withered up; but he would have done so if he were created as by "Amateur's" theory. No doubt "Amateur" thinks himself a noble animal; but I don't see that a lion, for instance, is any nobler than a man—especially some men; neither do I see that an animal has to work less than men to get his bread. I shall be very pleased to hear that I am wrong in supposing that "Amateur" has written merely out of blind devotion to religion, which, in itself, is very laudable, but unscientific.

I believe that most people fancy that we are all descended from one common ancestor. "E. L. G." (letter 28821, p. 329) argues, from the Bible and other legends, that we are not derived from one parent; what, then, does he think we are derived from? He maintains that we are descended from a number of men, and I suppose, as a "Bible-reader," he does not believe that we have sprung from the lower animals. Does he, then, think that a whole family of men were separately created? There is no radical distinction between slow and fast breeding animals; the difference being that in a fast-breeding animal the original parent may beget from twenty to a hundred offspring in a year, so that after the first few years there is such a quantity of animals that close interbreeding is avoided; while with slow-breeders not more than twenty at the utmost are born in forty years—thus close interbreeding is an absolute necessity. *"E. L. G." says that the expression* "derived from one common ancestor" goes outside of known nature. I presume that he means by that that it may imply that we are derived from God, which I deny, neither is it stated in my letter. It is the second alternative I mean, which I was led to try and refute, on the ground that it is the popular version of the Scriptures, caused, no doubt, by the second chapter of Genesis and such poetical books as "Paradise Lost."

"Dens" (letter 28822, p. 330) asks how long it would take for the highest ape to learn a little English. The answer, I think, to this is that they would never learn the language. Evolutionists do not think we are descended from any ape, now living; what they do think is that some ancestor, probably resembling the anthropoid apes, had a family, one of which slightly varied from the rest, and so became our progenitor. The brothers of this animal perhaps varied in another way, and so became the ancestors of the apes. Now the way our ancestor varied from his brothers was, most likely, that the tongue and mouth were improved, so that he could utter sounds, half articulate. For once being possessed with a means of expressing his thoughts and wishes, his whole mind would improve, he would be able to see how to protect himself in danger, and from rain. If he could understand how to protect himself from wind, rain, and cold, his hairy covering would become useless, and so begin to be rudimentary. In fact, I believe that language was the first improvement which animals had to make themselves men. That animals can get this improvement in the tongue and throat is proved by some birds, such as the parrot and others, having it. But then these birds have not a corresponding brain; thoughts must come first, then language, so they would very readily pick up a language which could express their thoughts better than their own could do.

That the common skate, anthropoid apes, men, and other animals have the same periodic functions, is a case of the pertinacity of inheritance. Thus the common ancestor of these animals either had such functions, or was prone to them, and this has been lost by most animals, inherited by a few.

Satine.

POSSIBILITY OF BIBLE-READERS SUPPOSING US DERIVED FROM ONE COMMON ANCESTOR.

[28863.]—I THINK few people who read the Bible in a common-sense way—that is, attaching to words and sentences their usual, every-day meanings—will be likely to accept the extraordinary interpretation "E. L. G." offers regarding the word "Adam" as signifying the name of a race, and not that of an individual. Nothing, to my mind, can be plainer than that the author of Genesis—assuming his book to have been fairly translated—wishes us to understand: that, on the sixth day (or period), God created *one* man, whom He called Adam, and that He afterwards furnished him with a wife, or mate, by the transformation of one of his (Adam's) ribs into a woman. The whole story of the sojourn of this pair of human beings in the Garden of Eden, comprising the incidents of their eating the forbidden fruit; of their being clothed in skins by the Deity; of their being ultimately expelled from the garden, &c., is evidently intended to apply to two people—Adam and Eve—alone. When God said "Let us make man," He made Adam, and, later on, Eve. No hint is given in the first chapter of Genesis that God willed the existence of any other stock than that which descended from this one original pair. I think I may fairly assume that the clergy, as a body, accept, or at least profess to accept, this account of Adam's creation in its plain, literal sense; for if, besides Adam and his family, there were thousands of other men and women — God's creatures, but having no blood-relationship to Adam — what becomes of the doctrine of original sin, on which the clergy base so much of their church religion? The original sin was the sin committed by this one man and his wife, and we cannot conceive the Author and Ruler of Cosmos visiting on people whose origin was wholly independent of that of Adam a transgression with which they had nothing to do. The Bible narrative may not be supported by the evidence derived from human knowledge of God's laws and what man, in his finite wisdom, believes to be reasonable deductions therefrom; but, as a story, it is told in very plain words (assuming our English translation to be fairly correct), and no one has a right to ascribe to certain passages meanings which, but for the recent revelations of science, they would never have been thought to possess. One great difficulty in reconciling the Biblical account of the Creation with the facts (as most searchers after knowledge consider them to be) of geology and astronomy lies in the plainly-worded statement that the whole of the Divine work was performed in six days—each day, we are expressly told, consisting of an *evening and a morning*. The words "evening and morning" occurring, as they do, in the record of each day's work appear—at least to me—to render the clerical hypothesis of a day signifying an indefinite period of time totally untenable. Possibly "E. L. G." may be able to throw some light on this point.

Charing. **J. R. C.**

NOAH'S DELUGE.

[28864.]—SOME of your correspondents are very earnestly introducing the subject of Noah, his sons, and the Ark into their letters; but it seems to me that before accepting the legend it would be well to look broadly at the main features necessarily involved therein. They come, perhaps, in the following order:—First let us determine the dimensions of the Ark, the system followed in its construction; then approximately the number of animals carried by it. We may next endeavour to puzzle out how it would be possible to carry so many, together with food and water for their use.

The details of anchors, hawsers, pumps, sails, rudder, and possibly steam steering gear are not mentioned; but then the good men who wrote were not of the nautical type; they did their best according to their lights; besides, it was before the days of the Plimsolian legislation, and there were neither the Classification Societies nor Board of Trade officers to worry one with all this modern refinement. Therefore, for the present purpose we need not trouble ourselves with it; grant that all was ready.

Then we may for a moment consider from whence came all the water to furnish so great an increase in depth over all the world. Let us think of the tempestuous weather which must have existed during this great increase of water, and with this let us picture the consequences which would ensue to one of our largest and strongest modern vessels if lying ashore waiting to be floated. We need not assume the sailor, I think, and talk about the bad weather she would make of it, loaded with cattle, and lying at the mercy of the winds and the waves. In this part of the matter we may assume an entry in the official log, "The weather and sea very bad; vessel rolls and labours heavily; pumps regularly attended."

Even then we have some knotty points to think over, for we have to settle how such a great excess of water was taken away, and where did it go to? We must suppose that it evaporated; but evaporation requires heat, and, in fact, so much heat would be required that the water would need to be at boiling temperature; while at such a temperature, what becomes of the fish? The Ark and its inmates would, of course, fare no better.

Then comes another consideration—viz., the stranding of the Ark, and the holding together till the animals left her. We must first endeavour to form some comparison between her and one of our large steel or iron vessels, in point of relative strengths, and, having done so, look to see the consequences of a modern ship stranding. It will be readily seen that with all our modern appliances what little chance there is of such a vessel lying for an hour, or for a day, without being broken, or without serious loss of life. The only way of getting over this difficulty is, it seems to me, to assume that the Ark stranded in the good old times, when people were free to do as they liked, and no evil consequences ensued, and that the evil which so certainly follows the stranding of a modern vessel arises from the superfluous introduction of anchors, chains, tug boats, lifeboats, and rocket apparatus, the Classification Societies, Board of Trade officers, and the Wreck Commissioner.

Delta.

EVOLUTION.

[28865.]—THE first half of "Satine's" letter (28823, p. 330) is just a touch of the special pleading of Darwin, and to which his followers have added nothing worth mentioning, but in regard to which it may be said, that when Darwin put the "missing links" to death he virtually "threw up the sponge," because if evolutio[illegible] were true there is no more need for the links to [illegible]ie than for a grandfather to die that the grandson might live; they should be in swarms over the whole world. But the museum which "Satine" d[illegible]es exists already, so far as the human period i[illegible] concerned, said period covering in time from [illegible]00 up to 800,000 years (according to the variou[illegible] [illegible]thorities). This museum is to be found in the [illegible] Lyell's "Antiquity of Man," Figuier's "Pr[illegible]ve Man," Boyd-Dawkins's "Cave Hunting," an[illegible] "Literature of Kent's Cavern, Torquay," &c [illegible] "Plants of the Bible," by W. Carruthers, [illegible] British Museum; but "Satine" will find n[illegible] record of the very curious animal described in [illegible]arwin's "Descent of Man" beginning with, "M[illegible]n [illegible] descended from a hairy quadruped furnished w[illegible] a tail and pointed ears." In regard to th[illegible] [illegible] explanation asked for as to how men conduct [illegible] their business avocations with confidence, becau[illegible] plants and animals don't alter in the space [illegible] fifty years "Satine" will understand that the [illegible] fifty years don't begin to count from to-day; at the [illegible] past the counting began 7,000 years ago. H[illegible]ow long does ant for his evolution? Unlimited "bank of time" won't do in place of her the moa, sea-cow, dodo, or great anything; they have left nothing lute extinction. It would be more in every way if "Satine" or other would leave such small matters as or the present, and direct their atten- fundamental basis upon which evo- o evolution has to be determined; the fundamental was once settled, against, the hairs and other co-laterals themselves into their proper place need for discussion. This basis may be -First, every living thing in all nature ife and organism which make it abso- it is—therefore it is not something no living thing (not even man) has move out of the order of its being, no amount of variety or variation there d, there is no such thing in nature as type (it's a relative statement needful o far) of any living thing, because a l or plant has the life and organism life it has to live and the part it has to omy of nature—the most complex does nor less. They are both on the same t advancement from a lower to a impossibility—so much so, that no has ever been able to show such a where it is to be found, besides being n in terms; for if the lower con- gher (so as to be able to advance), how w? And, although we were told by a t that evolution had advanced from sis to the theory," it really remains has always been—viz., "a conclusion ts premise;" and in all the Evolution ere is a continuous putting of the e *propter hoc*, because evolutionists to go upon.

Dens.

RE OF MOLECULES—A AUGHING PLANT.

NOWING how things that have been get stored up in the mind, yet are l are suddenly turned out again as conceived by the mind, therefore I tain that my theory of molecules is t nevertheless, to my knowledge, I en such a theory, or heard of one like gma" had any arguments about it? hey in favour of it, or against it? objections to it? Whoever, in the first ed it does not matter; but, anyhow, em to be much known; therefore a such a paper as the "E. M." would good and bad points in it. "Sigma" let the cat out of the bag in giving book he has written.

e old newspaper cuttings I had col- l this from the *Figaro*, dated April, aughing plant' grows in Arabia, with g effects like those of laughing-gas (!). re of a bright yellow, and the seed- and woolly, while the seeds resemble nd only two or three grow in a pod. dry and pulverise them, and the ten in small doses, makes the severest like a circus clown or a madman, for sing, and be in an uproariously ridi- ion for about an hour. When the ases, the exhausted exhibitor of these leep, and when he awakes he has not remembrance of his frisky doings." s" can give particulars about this st likely correct a good part of it.

wood. **E. H. L. Schwarz.**

BES FOR COMPENSATED PENDULUMS.

OME few years ago I constructed a nc and steel compensated pendulum t 30lb., and soon after setting it to that it had an increasing losing rate with a few short intervals for about d a half. I could attribute this only g and consequent shortening of the hich is ½in. outside and ¼in. inside aving recently seen in Britten's hand- nt of a supposed similar defect in ter pendulum, and being about to ther pendulum, I decided to test the zinc tube before making it up, and aced it between two iron plates pro- rewed tie-rods and nuts for drawing r, and thus powerfully compressing ength of which was carefully gauged er the operation, when it was actually in. shorter. The tube is a substantial outside, ¼in. inside diameter, 28in. ded for a bob of 31lb. weight. The d was just short of that which would the tube to bend or buckle in its nsideration of the above result it sirable to subject all such tubes to a eration for the purpose of "taking up the slack" before they are used for pendulums. Probably the drawing of the tubes during their manufacture tends to elongate the metal.

London, N., June 5. **Wm. Granger.**

PROPULSION OF STEAMSHIPS.

[28868.]—I DO not know enough for to venture upon a discussion with "J. M." (28818, p. 329); but this I can say, as regards the explanation given (as to the reason of Ruthven's failure) by "J. M.," that Admiral Elliott tried all and everything that could be done for the *Waterwitch* gunboat, and had to give it up at last as a failure; and in spite of the reasoning of "J. M." to the contrary, I still maintain, as a trained mechanic, that the want of stiffness in the columns of water when ejected from the nozzles was the cause of failure, and a practical illustration of this is to be seen in the water ejected from the nozzle of the fire-engine hose. It has power enough to knock over anything in the way of men or animals that it strikes against; it will smash in a window-frame and all, and yet the fireman hardly feels any recoil. At the same time, could hydraulic propulsion be made a success, it would bring the safe and easy handling of a steamship to practical perfection.

Dens.

REPLIES TO QUERIES.

⁂ *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[65019.]—**Gas - Engine.**—ERRATA.—Line 24. Instead of "the gasway being drilled right through at right angles to this;" read "the gasway being drilled right through; at right angles to this the longer part is bored," &c. Line 38, read "spring *on* spindle. — ENGINEER, St. Mary Church, Torquay.

[65029.]—**Brightening Brass.**—If beauty of surface, and not expense, be your aim, you will best succeed by using whiting or chalk moistened with "turps." Rub this on sparingly with a scrap of fine old flannel, and polish dry with a soft linen rag. Acids *do* clean brass well and quickly; but tarnish comes on very soon in consequence.—H. O'B.

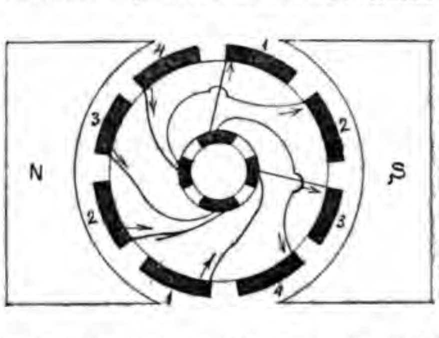
[65042.]—**Cold Bluing.**—To "NUN. DOR."—Quotation from "Enquire Within," recipe No. 341, edition 1865, under heading "Cleansing of Furniture." "The Italian cabinetwork in this respect excels that of any other country. The workmen first saturate the surface with olive oil, and then apply a solution of gum-arabic in boiling alcohol. This mode of varnishing is equally brilliant, if not superior, to that employed by the French in their most elaborate works." It was also in prior editions. Cannot say if it appears in later. But this bogus recipe (?) appears in works issued during the last two years.—J. W. M.

[65056.]—**Sun Shining Through Tunnel.**—Of course! Why not? Who doubts it? Any more than we doubt the cleverness of the old Irishman, who had his gun made crooked so that it could "shoot handsomely round a corner!" Seriously, is there one of those who believe in "Ours," can also believe that the sun ever did shine "through a tunnel which is not straight"? The greatest credit I can give to the story is by supposing that whilst the ray of light beamed into said tunnel for some distance at the east end, the light was carried by reflection some distance further in, and thus deceived the spectator. I can tell of an instance which did really happen; not a doubt about it! Two friends of mine, soon after the completion of the Edge-hill tunnel, were making an early start from Liverpool viâ that tunnel, and saw the disc of the rising sun fill up the far end, looking like an intensely hot fire there. Said excavation is due east and west—was then one mile in length, and emerged in very open ground. Since that time, so many streets have been built to the eastward, I do not suppose such a sight can ever again be witnessed.—H. O'B.

[65119.]—**Horse-Hair Manufacture.**—Is spun like a rope with a machine like the working end of a lathe, with belt wheel and pulley; but in place of screw for fixing block it is a hook, that you lay about ¼in. thick of hair on it—I mean to hook on to it. You must get a boy or someone to turn the handle which is to turn the wheel while you lay in the hair; then it is steeped in water for a few days, then put in oven with slow (60° to 80°) heat to dry it out, then torn asunder like old ropes.—G. M., Dublin.

[65137.]—**To "Chemist."**—A deci-normal solution of Na_2CO_3 is made by dissolving 5·3gram. of the pure salt in 1 litre of water, 1c.c. equals 0·0053gram. Na_2CO_3. A deci-normal solution of HCl is prepared by diluting 180·8gram. of the pure acid, of sp. gr. 1·1 to 1 litre, 50c.c. of this solution are further diluted to ½ litre, 1c.c. approximately equals 0·003646gram. of HCl. This solution will require checking by titration with standard silver solution. For a more full explanation see Thorpe's "Quantitative Chemical Analysis," from which the above is copied.—S. R. CLAY.

[65146.]—**Siemens Armature Winding.**—To "ENGINEER, GOVAN."—I am much obliged to you for calling my attention to the sketch in my former reply to above query, but do not see the short circuit you mention. On following the sketch through I am sorry to find it is not correct, for if the brushes were on segments 2 and 4 respectively, the current in two coils under the same pole-piece would be in opposition. I inclose a corrected sketch, and have marked the direction of the current in each coil by arrows. It will be noticed that all the half-coils opposite pole-piece marked S have an ingoing current, and those under pole-piece N an outgoing current. The positive brush would be pressing on the commutator bar marked C, and the negative on A. If the armature is given a quarter-turn to the right the + brush will press on B; but it will still be found that the four coils under S are ingoing, and those under N outgoing, and the same throughout the revolution. I have wound several of these armatures, but think the Gramme offers many structural advantages, though they are both supposed to have an equal efficiency.—W. A. WALTON.



[65159.]—**Compounds on Great Western.**—There are no compound locomotives on the G.W.R., and there are not likely to be, under existing conditions.—PARSON.

[65165.]—**Violin Repolishing.**—Sandpaper well with fine sandpaper. Use varnish made of orange shellac dissolved in methylated spirit until of the proper thickness. Apply with a camel-hair brush. If the varnish is not deep enough in colour, a little satinwood stain, soluble in spirit, will deepen the colour.—T. CLARKE.

[65188.]—**Non-Sensitive Ink.**—Powdered ebony stain dissolved will stand any amount of heat. We use it at our house in place of blacklead.—T. CLARKE.

[65196.]—**Myopia.**—Short-sight is produced by a change in the shape of the eyeball. Normally, it is round like o, but in short-sight it is elongated from back to front like ⬭. In long sight it is the reverse, and is known as flat-eye, like 0. Nothing but glasses to correct these defects can be suggested, as it is impossible to alter the eyeball, and it is not provided with rack and pinion for focussing.—NUN. DOR.

[65197.]—**Gelatine Moulds.**—A little bichromate of potash is added to the gelatine solution. When exposed to light the bichromate renders the gelatine insoluble. The impression wax may be made of beeswax to which from five to twenty per cent. of Venice turpentine has been added, according to the temperature of the place where it is to be used. But the composition of "impression wax" depends on the use to which it is to be put, and a few experiments will be of more real value than a column of recipes.—NUN. DOR.

[65199.]—**Golf Balls.**—Grind the desired colour up with mineral naphtha.—J. T.

[65199.]—**Golf Balls.**—What properties has the paint to possess?—T. CLARKE.

[65200.]—**Blasting Gravel.**—Use gunpowder; it is better than dynamite for such a purpose, as it splits up the material.—S. P. M.

[65209.]—**Moulders' Wages.**—A moulder working on "piece" is allowed anything his services can command. The question can be of little interest in these pages.—J. T.

[65215.]—**Concrete.**—Where does "J. E. S." think the chlorine would come from in concrete. However, it is a matter for experiment.—G. D.

[65231.]—**Bones for Manure.**—If "The Brae" will elucidate his query, he may perhaps get an answer. He should grind up the bones and use them as meal.—PORTHOS.

[65245.]—**Canvas Belting.**—I would suggest solution of indiarubber.—NEMO.

[65248.]—**Gas-bags.**—The querist asks whether a bag made of ordinary American cloth, and treated with indirubber solution, would be suitable for gas-bag. I don't know what he means by "ordinary American cloth"; but any strong fabric of the linen or cotton series, saturated with indiarubber, is exactly what gas-bags are made of.—AMAZED.

[65249.]—**Gypsum for Garden.**—Sulphate of lime would absorb much of the ammonia, and is useful for manure in itself. What potassium salts contain magnesium?—ANSER.

[65252.]—**Model Injector.**—A working injector to suit a model locomotive is one of those things that no one would expect to work. It would have to be about half the size of the loco. itself; but if the querist must make one, why can't he take an ordinary form and reduce the dimensions to suit? Such queries are ridiculous.—MODEL MAKER.

[65255.]—**Staining Vulcanised Rubber.**—The rubber can be painted, or the pigment mixed with it when in the plastic state.—JEHU.

[65255.]—**Staining Vulcanised Rubber.**—Dissolve, powdered, 4oz. ebony stain in 1 gallon methylated spirit; add 2lb. shellac and 4oz. gum Thus. When the whole is dissolved it is ready for use. This will be of a jet black, will not crack, and will stand any amount of rubbing. It will also wear well.—T. CLARKE.

[65265.]—**Springs for Safety Valves.**—I have to thank Mr. G. F. C. Searle for the pains he has taken to explain how the formula used in certain calculations concerning springs for safety valves is derived. The compression is to be measured in inches, mean diam. of coil in inches, thickness of wire in sixteenths of an inch, and the weight in pounds.—ENGINEER.

[65272.]—**Soldering Fluid.**—The receipt given by W. Norton is the same sent out by Mr. Stanley. I have given it a trial on different metals, and must confess I do not care much about it. It acts well enough on clean tin-plate, but for general workshop use it will not compare with zinc chloride. I gave some to a professional, who used it for a week on all kinds of work. His report was "that it was not strong enough, and not up to much." My own trial, it is only fair to say, was not an exhaustive one; but amongst other things I tried to solder with it as a flux a brass collar on to an iron spindle, but failed to get the solder to run until I touched it with zinc chloride, when it flushed directly. A really good non-corrosive soldering fluid is much wanted, so that I hope some of our readers will experiment in this direction. Would the addition of sal-ammoniac be an improvement? I saw this recipe in print a day or two ago, I believe in a recent number of the "E. M.," but I am too much occupied at this moment to hunt it up; it was there described as being of German origin.—FAL.

[65318.]—**Chloride of Gold.**—I am afraid I cannot treat Mr. Bottone's letter as seriously as it deserves to be. There are two points, however, I should like to mention. The first is that water, while it is water, maintains a constant composition. Mr. Bottone seems to infer that in lessons given by him many years ago he described waters of various compositions. The second point is that calcium carbonate does not form an alkaline solution with water, unless a large excess of carbon dioxide is present. I should like to hear from Mr. Bottone how water acts on bleach, so as to give a solution of chlorine water. Perhaps Mr. Bottone is not aware that authorities on the subject have proved that the bleaching properties of bleaching powder are due to hypochlorous acid, not chlorine. Besides, why is chorine given off by the addition of HCl to a solution of bleach, which is certainly not the case with an ordinary solution of chlorine water.—CHEMIST.

[65330.]—**Plating Dynamo.**—I have read with astonishment the reply of Mr. Bottone to this query, in which he gives a new and original method of calculating (?) the ampèrage and voltage of a dynamo. There have been many wonderful statements made during the last few years with reference to electrical matters; but I question if any surpass Mr. Bottone's assertions that the voltage of a dynamo is calculated on a basis of 1 volt per yard of wire on the armature, and that the ampèrage is obtained by dividing the voltage by the total resistance of the circuit. Most makers of dynamos have their own methods of calculating the electrical dimensions of a dynamo, but all certainly include as elements in such calculations the speed at which the dynamo is to run, the number of turns of wire on the armature, and the number of lines of force passing through the iron core of the armature. I have always found Kapp's formula, with certain modifications, to suit various types of machines, quite accurate enough for approximate calculation. Having taken exception to Mr. Bottone's methods, I must, in justice to the querist, state as briefly as possible the lines upon which these calculations can be made. It is necessary to obtain certain data—viz., the speed at which the dynamo is to run (s); the number of turns of wire on the armature (N^t); the area of the armature core (a); the area of the magnets (A); the mean length of the iron in the magnets, keep, &c. (L); the mean half-circumference of the armature core (l); the distance from the face of the pole-pieces to the outside of the armature core (δ); the area of the pole pieces (λ); the exciting power in ampère turns (P).

Let Z = lines of force (Kapp)
E = E.M.F. in volts.

$$\text{Then } Z = \frac{P}{1{,}500\,\frac{2\delta}{\lambda} + \frac{l}{a} + \frac{4L}{A}}$$

This formula is adapted to single-magnet dynamos. The expression $\frac{4L}{A}$ is about right for magnets working at 14 or 15 Kapp lines per square inch of section. (There are 6,000 absolute lines in a Kapp line.) Now let S be the speed at which the dynamo is to be run, and N^t the number of complete convolutions of wire on the armature; then

$$\text{E.M.F.} = \frac{Z \times S \times N^t}{10^6}$$

The ampèrage of a dynamo is determined by the current the armature winding will carry without undue heating. What Mr. Bottone calls the ampèrage is simply the number of ampères given by a particular dynamo under fixed conditions. It is obvious that a dynamo giving 300 ampères as its maximum current may, by a suitable arrangement of the external resistance, be made to give any number of ampères from 0 to 300, and, therefore, according to Mr. Bottone, any dynamo may have an indefinite number of ampèrages.—H. C. BEAUMONT.

[65357.]—**Cycle Making.**—Would "A. M. M. A." kindly say if ordinary wheels require testing when finished, and if done in the manner he describes on p. 333? How does he propose to join (temporarily) on the road an S.L. or an Abingdon chain? It seems to require the carrying of screw taps and reamers—in fact, a small repair shop.—A. F. SHAKESPEAR, Lüttichaustr. 14, Dresden.

[65366.]—**Repainting Tricycle Black.**—First of all sandpaper well with fine sandpaper until the whole is perfectly smooth. Then give it two coats of drop-black ground in turpentine, thinned with gold size and a little turpentine. This will give a dull jet-black surface; then give one or two coats of the best black japan you can buy.—T. CLARKE.

[65384.]—**Carbons, Lead Capping.**—TO MR. BOTTONE.—The reason why I recommend the addition of a little antimony to the lead, is just because it causes it to expand more than it otherwise would do at the moment of cooling. Hence, as it expands in every direction at this instant, it fills up all the gaps and interstices, nicks, &c., in the carbon, in the most perfect manner; or, as stated by "A. I. E. E.," who regards the expansion from the carbon's point of view, it contracts upon the carbon.—S. BOTTONE.

[65403.]—**Bicycles.**—The head is bored out to suit the tube, making a tight fit; put a pin in to hold tube in its place in the centre; before putting in tube have ends drawn down to suit handles, then bend as shown, if the style is preferred; commence at a, the drop is reckoned from the centre of head and centre of handle as shown at d. Bore out handles to size of handle-bar, less sufficient for driving up to place, ½in. Warm handle-bar and rub a little tire cement on before putting on handles; when on, rivet over end of tube, which should be seamed or countersunk thin enough. The only tool required for bending handle-bar need be a piece of flat iron bent to shape of large bend; the smaller bends can be done without. Fix iron in the vice, and be careful not to get any flat places in the tube. Next braze handle-bar in head; when bent, fix brake-joint. Fig. 2 is a handy tool for drawing off cranks; it is made strong with ⅝ thread to bolt, square head for spanners; the tool is slipped over crank, the claws behind as shown. The screw on being forced against end o
has sufficient power to cause the crank to
with its key. Or a piece of iron may
between the spokes of wheel; behind sh
crank, and with a blow of hammer, the c
perhaps come off; if possible, place th
crank against point of back of anvil while
I believe the straight handles are bette
hands, not cramping the fingers as woul
handle; also the wrist can be turned an
stead of being kept in one position; the e
straight handle will fit the hollow of
which cannot be done with handle crossed.
some experienced rider who has had m
with both kinds will give an opinion. I ha
heard of any book on cycles as asked.
editor of the *Cyclist*—A. M. M. A.

FIG. 1

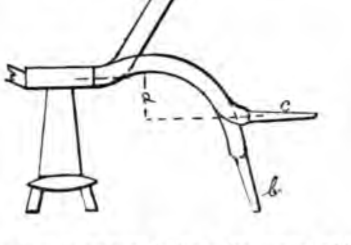
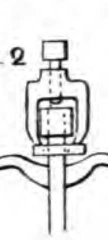


FIG. 2

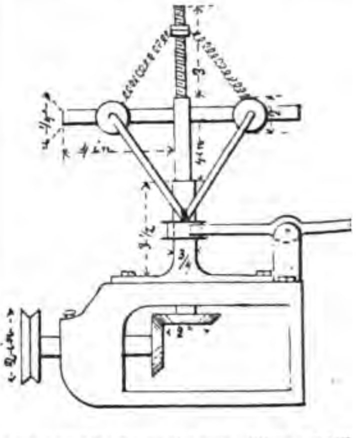


[65415.]—**Photo - micrography.**—Th
screw loose somewhere in "A. J. T.'s"
the condenser is what is required: the a
light has nothing to do with the matter,
have photographed Amphipleura with a f
wide, from an ordinary paraffin lamp, an
oil immersion objective. If "W. H.'s" ¼in
an angle of 90°, and he is working with
stage condenser, he is losing about four-
the aperture of his object-glass, and can e
good results. If he uses a bull's-eye, he
30° of the aperture into work, but not m
he cares to spend a shilling on the matte
better get my little book, "Guide to the S
Photo-micrography" (Kent, London), wher
find the whole subject treated at con
length, and will be pretty sure to get his
removed.—E. C. BOUSFIELD, L.R.C.P.,
Kent-road, S.E.

[65421.]—**Drying Stoves.**—When vis
"Healtheries" I saw an apparatus for he
in rapid motion, and delivering large qua
air at temperatures varying from 200° to
arrangement of this kind would suit "J.
find, on reference to the particulars I hav
that nearly the whole of the heat give
steam or direct fire-heat is available for
the air passing through; that heated
from an exhaust of an engine giving air
that by direct fire, 200° to 600°. If "J.
advertise his address, I will put him in c
cation where he can obtain further inform
C. W. B.

[65429.]—**Hot-Water Pipes.**—Th
should remain in the pipes when the ap
discontinued for the summer, for the re
each successive charge of water carries
matter which deposits in the lowest part—
boiler, which is not accessible for cleanin
quently in time would prevent the water h
well.—C. W. B.

[65443.]—**Governors.**—I send sketch
governors I made, which work well on
engine. You will see there is the ordinar
of bevel gear, which moves a vertical



having two horizontal arms. These arms are
brass rods, with the balls sliding to and fr
spindle. On each side of the balls are linked
so that on rotating the spindle the balls
and, by means of the levers, pull up a flange

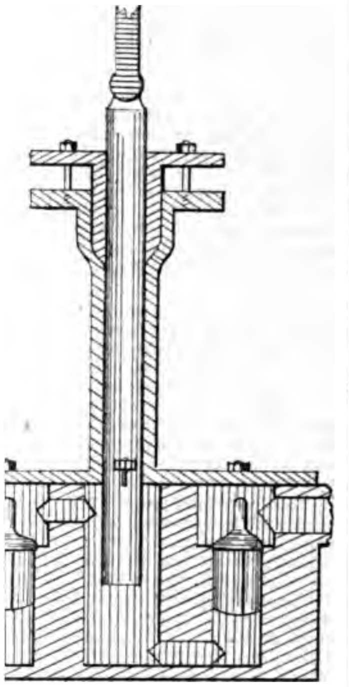
ed to fit the outside of spindle bear- gain actuates a lever connected to the ve. There are also adjustable springs, whose force can be regulated. The at 220 revs. per minute, and governors er minute.—C. ANDREW, Leamington.

-**Cement for Socket Pipes.**—There kinds of cements for socket pipes, but mmend the following, which I find remely well, is very simple, and no cking pipes:—Cast-iron borings, 10lb.; l-ammoniac, 2oz.; flowers of sulphur, with water. When not required for ise a better cement is made by adding rings; use ½oz. sulphur only.—A. BIRD,

-**Ebonising, Renovation of.**—See No. 65255. Make a polish as above, the gum Thus, and using 3lb. of shellac a. Polish in the ordinary way, after e scratches and bruises with plaster of iixture of boiled oil and red lead.—T.

– **Bottle Battery.** — Dissolve the id in the water; when completely dis- ly add the sulphuric acid. This should a jar, and when cool put in bottle, as lways heat generated through the ition set up.—H. H. E., Electrician,

-**Pump.**—As you do not say, should ip is to work from engine-shaft, there- etch as below: Make barrel for ram as



iible; diameter of valves not less than s diameter of ram.—ARTHUR BIRD,

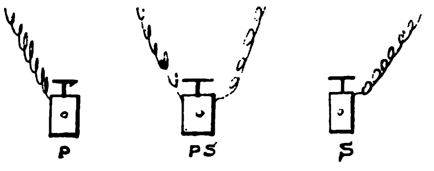
– **Achromatic.** — I can recommend 's "Half Hours with a 3in. Telescope" by Longmans) as pre-eminently the ı to start with; but you will want, if t got, a set of star maps as well. Those l Co., at 3s., will be as useful as any, y are more distorted at places than n on different plans; but they are more ible to an amateur, being clear and omparatively large scale. Mr. Proctor's very good, but on a smaller scale, and g to a novice.—J. C. LINSCOTT.

Flywheel.—Size of flywheel is im- it does not give power to the engine. centric, when it works the valve direct, he travel of slide-valve. To find travel of gether width of steam-port and outside tiply by two. To find a safe working boiler multiply twice the thickness of hes by following constant number livide the product by diameter of shell in tient will be bursting pressure in pounds ich, which divide by six, that is for a new d workmanship, but should advise you hydraulic pressure to double the pres- nt to work at.—A. BIRD.

-**Sensitive Plates.**—Orthochromatic iat you want. You can purchase them 's for almost the price of ordinary plates 's "E. M." you will see a note of Mr. Ive's new chlorophyl plates and how to prepare them. The only difficulty about them is where to get the chlorophyl, as I don't think it is sold commercially. —B. SC., Plymouth.

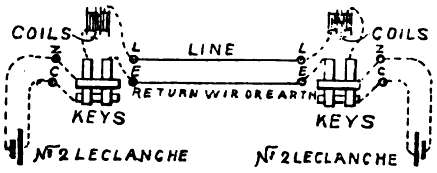
[65455.]—**Medical Coil.**—I expect your coil is arranged so as to have either intermittent primary or secondary shocks. Join the handles to P. and P. S. for primary, and to P. S. and S. for secondary shocks. If this does not work, write again, stating how joined up underneath base.—H. H. E., Electrician, Torquay.

[65455.]—**Medical Coil.**—Your terminals are probably arranged as follows:—To P. is fastened one wire of the "primary," the other is fastened to P. S.; one wire of the "secondary" is also fastened to P. S., the other to S. For a mild shock fasten handles to P. and P. S.; for a more powerful one, to P. S. and S.—AN OLD LEYSIAN.



[65456.]—**Development.**—Scientists are not agreed as to the action of developers and development. I think the theory correct of Mr. Jesse Williams—viz., "That development is the continuation and intensification of an action commenced by light. The exposure in the camera determines a weakened affinity, so that on the application of the developer, separation of the elements of the silver salt is completed where the salt has been acted upon by light before other portions of the film are acted on, and this is only a difference in time. (2) The pyrogallic acid and all other reducing agents take up the oxygen from the water; then the hydrogen thus set free combines with the halogen of the silver salt and the metallic silver, now liberated, darkens the high lights of the negative. (3) "Abney's Treatise"; or, if you can read French, "Monckhoven's."—B. SC., Plymouth.

[65465.]—**S.N. Telegraph.**—Though this question is addressed to Mr. Bottone, I take the liberty of answering it, hoping he will not mind. You do not state what size wire the coils are wound with, but in a short distance, as 10 yards, a No. 2 Leclanché cell each end ought to work it very well. I send sketch, which should explain itself. You must have a return wire or earth, return wire being best for such a short distance. An ordinary covered wire would do very well if it is indoors; if it is outside use G.P. tarred and taped about No. 18. If this is not sufficient information, ask again.— H. H. E., Electrician, Torquay.



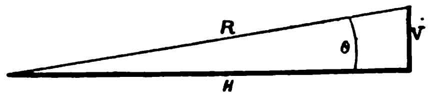
[65470.]—**Hydropathy.**—"T." will find the apparatus he mentiens at every hydropathic establishment; in fact, I know of several private houses where both are fitted up. I do not know that they ought to be called "Dr. Duval's method," as both were in use long ago—the first notably in all large steamers in the early morning.—B. SC, Plymouth.

[65476.]—**Chromic Single-Fluid Cell.**—I have found by experience that the best proportions for single fluid are = 3oz. of chromic acid, 3oz. sulphuric to 17oz. of water. I expect, as you say, you have not large enough active carbon and zinc surface; increase the size in each cell, or try applying heat, which will reduce the resistance of the solution, make it circulate, and consequently generate more current.—H. H. E., Electrician, Torquay.

[65479.]—**Effect of Descending Gradient on Velocity.**—Let θ in annexed diagram be the angle of gradient.

Then if R = dead weight of mass in motion down the slope;
V = motive weight abstracted by gravity from dead weight of mass;
H = weight of mass acting statically during motion.

If V were the only weight moving the mass, the velocity would vary as $\sqrt{V}$. But in the case of the motive force, consisting of V in combination with an extra motive force (as the steam pressure of a locomotive), let us call the extra motive force = W. Then the velocity of the mass down the slope would be, compared to its velocity along the level, as $\sqrt{W + V}$ is to $\sqrt{W}$. R must include weight of locomotive and tender as well as of train.



The W of trains is found to vary approximately as the area of front end, and as the R; and, for high speeds,

$$W = R\left(\frac{\text{velocity in miles per hour}}{3} + 6\right) + \frac{\text{velocity}^2 \times \text{area of front end of train in feet}}{400}$$

or thereabouts.—F. CAWS, Sunderland.

[65481.]—**Games of Patience.**—I think perhaps "Invalid" might find the following games amusing:—"Number Eleven Patience" is played with one pack only. Place twelve packets of four cards each in three rows, displaying the top cards; the last four are to be kept as a reserve. Now remove any two cards that will form eleven; court cards are taken three together—viz., king, queen, and knave, when they are displayed at the same time on the board. When you have found all your elevens, there will be packets with their faces downwards; turn the top cards up and proceed as before. As the packets become exhausted, fill each vacant place with a card taken from the reserve. If you do not succeed in removing all the cards, you have failed in the game. "Sultan Patience" requires two packs of cards, but does not occupy much space. The eight kings and an ace of hearts must be withdrawn, place a king of hearts in the centre, and on either side of it a king of diamonds, an ace of hearts between the kings of clubs above, and the second king of hearts between the spades below. Shuffle the two packs well together, then place four cards on each side at right angles from the centre. The king of hearts in the middle will remain undisturbed throughout the game; but the other kings and the ace will gradually be built upon in their proper suits, commencing, in the case of the kings, with the aces. When, in forming the packets, a suitable card is found on either side, it must be taken and the gap filled up from the rubbish heap, which has the unusual privilege of being turned twice. If the game succeeds, it ends with eight packets of queens, and the king of hearts in centre, as first placed. There are many good and amusing games of Patience in a book by Miss Whitmore Jones, price 1s.—H. C.

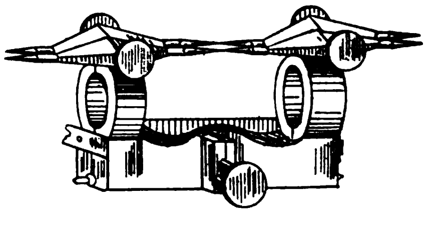
[65482.]—**Geneva Watch.**—Try these. Star wheel perfectly free; barrel perfectly free in holes and at outer edges; centre wheel free; and free with motion work attached.—KEMP BATTLE.

[65486.]—**Electrical.**—See answer to No. 65476, *re* solution. From three to six hours, according to the resistance you work it through.—H. H. E., Electrician, Torquay.

[65491.]—**Galvanised Iron Wire.**—TO H. C. BEAUMONT.—Thanks for reply. Would not the electricity which flows through the zinc outer casing arrive sooner than that coming through the iron core? Or does the small quantity of zinc offer, proportionally, the same resistance as the iron?—SATINE.

[65493.]—**Medical Battery.**—Brush the silver plate over with an acid solution of platinum chloride.—AN OLD LEYSIAN.

[65494.]—**Depthing Tool.**—I send rough sketch of watchmaker's depthing tool. The tool consists of two frames, each somewhat resembling a turn bench, which are jointed together and moved by a fine screw. The centres are perfectly parallel to each other, and their distance apart is adjusted by the screw already mentioned. But I should advise "F. J. B." to get one from any respectable watch-tool manufacturer, as it would probably cost more to make one than he could buy one for. I should recommend him to send to Morris Cohen, 132, Kirkgate, Leeds, where he could get one for about 10s.—WALTER J. PARKER.



[65500.]—**Paraffin.**—Rub with benzoline.—SM.

[65500.]—**Paraffin Wax.**— Hold a red hot poker as close as possible to the cloth without singeing it, and the wax will evaporate.—H. C. S

[65500.]—**Paraffin Wax.**—Cover the parts splashed with thick blotting paper, and apply a hot smoothing iron, until all the wax is removed.—T. CLARKE.

[65500.]—**Paraffin Wax.**—Place several layers of blotting paper underneath and on top of the cloth, and press with a hot flat iron; the heat will melt the wax while the paper will absorb it. If there is any slight stain left, wash with alcohol.—PRINCIPIA.

[65500.]—**Paraffin Wax.**—Place a fold or two of blotting paper above and below the place where the splashes are. Heat an ordinary sad-iron to the temperature usually employed by good laundresses—viz., hot enough just not to scorch. Place the iron on the blotting-paper, and change the blotting-paper several times until the greater part of the paraffin has been sopped up. Now get a piece of sponge, with a little Benzine Collas, and, keeping away from any naked lamp or flame, rub the places over lightly but continuously with the sponge dipped in the benzine; this will remove all the stains.—S. BOTTONE.

[65501.]—**Electric Bell.**—TO MR. BOTTONE OR OTHERS.—Have a single iron core about 4in. long, ⅜in. thick, wound with about 12oz. No. 20 wire. Let there be a pole piece top and bottom, at right angles to core, as in the Jensen bell. The hammer should weigh about ¼lb., but should be very nearly balanced in weight by the armature which hangs fpom the other extremity of the oscillating ∩-shaped lever, the fulcrum of which is situate near the top of the bell, just over the bobbin. Three Leclanchés should ring this well.—S. BOTTONE.

[65503.]—**Gas-Engine.**—The size of compression-chamber would depend upon the extent to which you intend to carry the compression of the gases. There is no hard-and-fast rule; but the one mostly in use is to compress to half the original volume. Your compression chamber would contain 14c.in.; the proportion of the charge, 9 to 10 times as much air as gas; power theoretically, ·237H.P. I should say the actual power (assuming the engine is well fitted, runs freely, and the piston is air-tight) would be about ¼-man.—ENGINEER, St. Mary Ch., Torquay.

[65505.]—**Lead Alloy.**—Get some old type-metal from a printer and mix with your lead. The type-metal alone would be too brittle.—SM.

[65505.]—**Lead Alloy.**—The addition of a little tin and antimony will greatly improve your metal. Try—lead, 5 parts; tin, one part; antimony, 1 part.—S. BOTTONE.

[65505.]—**Lead Alloy.**—Nothing like pure tin, more or less, to give the required hardness—melting them together in a ladle with some powdered rosin. I hardened my bullets with the old metallic capsules I collected from pickle-jars and liquor bottles—rosin already in them!—EOS.

[65505.]—**Lead Alloy.**—Melt the lead with from 5 to 10 per cent. of antimony. A small quantity of tin (say 10 per cent.) would improve quality. Alloys of zinc and lead will not make good small castings, because they will not "run." The moulds must be hot, and the metals well mixed and hot. The right temperature and heat of the moulds is got by practice, and is rather difficult to write about.—PRINCIPIA.

[65506.]—**Melted Steel.**—1,371·22° Cent.—ENGINEER, St. Mary Ch., Torquay.

[65506.]—**Melted Steel.**—It would be rather difficult to define this exactly, as there are different varieties of steel. The fusing point of cast iron is 2,786° Fahr., and that of steel is somewhat below this.—PRINCIPIA.

[65506.]—**Melted Steel.**—If "X. X." will look in Roscoe's "Lessons in Elementary Chemistry" he will see, on p. 178, a table of the melting points of the metals, from whence it will be seen that—

Steel melts at	1,300° to 1,400° C.
White cast iron	1,050°
Grey „ „	1,200°
Wrought „ „	1,500° to 1,600°

—H. M. WARD.

[65507.]—**Vulcabestos.**—Will not "Vulcanised Fibre" do for you, as advertised in "Ours" by Moses and Mitchell?—T. C., Bristol.

[65509.]—**Pendulum for Electric Clock.**—I described an electric clock of my own making in the "E. M." a short time ago, with a drawing of the contact-breaker, which I found to answer extremely well, though I have since changed it for an ordinary "slide" in order to allow a weaker battery to be used. If "Monte Christo" will communicate with me I shall be happy to give any further information about the clock.—CHRONOS, 73, Maison Dieu-road, Dover.

[65508.]—**Culvert.**—If John Paramor's pump maintains the 30ft. head, the culvert will be virtually a pipe flowing full: and John Paramor will need to take care to give his concrete pipe sufficient strength to resist the considerable bursting pressure. The concrete culvert, if properly cast with plenty of *cement*, will have an inner surface offering skin resistance, probably, but little in excess of the skin resistance of iron water pipes in their ordinary condition. $\frac{3{\cdot}5\text{ft. diam.}^2 \times {\cdot}7854}{2}$ $= 4{\cdot}81\text{ft. sectional area}; \; 3{\cdot}5 + \frac{3{\cdot}5 \times 3{\cdot}1416}{2} = 9\text{ft.}$ perimeter; $\frac{4{\cdot}81}{9} = {\cdot}5344\text{ft.}$ hydraulic mean depth; $\frac{30\text{ft. head}}{1{\cdot}5 \text{ mile} \times 5{,}280\text{ft. length}} = {\cdot}0038 =$ sine of fall. Then, adopting Neville's general formula, we have $140\sqrt{{\cdot}5344 \times {\cdot}0038} - (\sqrt[3]{{\cdot}5344 \times {\cdot}0038 \times 11}) = 4{\cdot}9158$ft. per second = 17,697ft. per hour mean velocity of flow: which gives a delivery of 17,697 × 4·81 × 6·232 gallons per cubic foot = 530,480 gallons per hour. Hawksley's formula gives the delivery as = 446,417 gallons per hour. The concrete skin-resistance may have sufficient effect to reduce the delivery below Hawksley's figure, say roundly 400,000 gallons.—FRANK CAWS, Sunderland.

[65511.]—**Cleaning Velvet.**—Black velvet can be renovated after the grease-stains have been removed as recommended in reply 65500, under the heading "Paraffin," by brushing over in one direction only with a strong decoction of logwood boiled in water, with a bit of soda about as big as a pea to each quart of liquor. The velvet, when dry, can have the pile restored by repeated brushings with a proper stiff velvet brush, aided by ironings with a hot iron from the wrong side of the velvet. Some stains in colour velvets can be removed by Benzine Collas; these are the greasy stains. Stains of sticky nature may generally be removed by cold water in which a few drops of ammonia have been placed. If the pile looks rough and uneven, it may generally be restored to its primitive appearance by stroking it lightly with the inside of a piece of raw bacon rind from which the fat has been nearly all cut away.—S. BOTTONE.

[65512.]—**Abyssinian Pump.**—The pipes of these are simply driven down by means of a "monkey," which slides on the pipes as a guide. Get a prospectus from some of the makers advertising in the *Engineer*. A clay subsoil (even if full of stones) is not suitable.—T. C., Bristol.

[65513.]—**Expansion of Coil.**—The wire being a good conductor the pipe was heated to practically same temperature, and so expanded with the coal.—T. C., Bristol.

[65513.]—**Expansion of Brass Coil.**—May I suggest that the coil expanded laterally, and so wedged it against the sides of the tubes that it could not expand outwards?—PRINCIPIA.

[65513.]—**Expansion of Brass Coil.**—Expansion takes time. The thicker the brass coil, the longer the time needed to heat it through. Meanwhile, the red hot bar of iron would cool. If same experiment were tried with a coil of, say, 50ft. of fine brass wire, and a tube of, say, 2in. diameter, and a red hot bar of double the diameter J. Miller tried before, I think, before the bar cooled, expansion of brass would be observable. The tube should also be very thick, as well of large bore; otherwise the expansion of the tube will, to a slight extent, accompany that of the brass wire, and reduce the apparent effect. Moreover, expansion or contraction can be prevented by mechanical pressure. For example, a telegraph wire does not change its dip nearly so much from the summer to winter temperature as it would do if expansion were not mechanically resisted. But the mechanical stress of the wire, due to its weight, acts counter to the expansion, and tends to render constant the winter and summer dips; and it is easy to set an iron wire to such a dip, as that the mechanical stress due to its weight shall be at all temperatures exactly equal and opposite to the stress due to the wire's expansion; so that the dip shall remain absolutely invariable in calm weather, when no weight of ice or snow is added to the wire's own weight.—FRANK CAWS, Sunderland.

[65514.]—**Theory of the Leclanche.**—Why does not "W. H. P." consult the books in which this class of subject is properly worked out? To answer his questions properly the whole theory of electrolytic action is involved. Whether ammonia and hydrogen are diamagnetic or not has nothing at all to do with the question. Chloride of ammonium $ClNH_4$ breaks up at the zinc and forms chloride of zinc, while its ammonium NH_4 is transmitted by electrolytic interchange to the limit of the solution—that is, the carbon plate; there the H finds oxygen to join, while the ammonia NH_3 becomes free. This is only the fundamental reaction; there are other subsidiary ones, which produce compounds of chlorides of zinc and ammonium, &c.—SIGMA.

[65514.]—**Theory of Leclanche.**—What books state that NH_3 is liberated at + pole? To begin with, the gas is not set free at the pole, but at th – electrode. The nascent H from the NH_4 r duces the MnO_2 to Mn_2O_3. The formula of d composition is either—

$$Zn + 2NH_4Cl + MnO_2 = ZnCl_2 + H_2O + 2NH$$
$$+ Mn_2($$

or—

$$Zn + 2NH_4Cl + MnO_2 = 2NH_3ZnCl_2 + H_2O$$
$$+ Mn_2($$

Carbon is used because it is the best suited for th purpose. It is cheap, and there is greater diffe ence of potential between Zn and C than there between Zn and any other element.—SM.

[65514.]—**Theory of the Leclanche.**—Whe the zinc is acted on by the ammonium chlorid solution, zinc chloride is formed, and ammoniu liberated. This being highly electro-positive tend to pass to the negative plate, and actually displaces a corresponding amount of ammonium from the molecule of ammonium chloride lying next to it in the direction of the negative element. This in lik manner displaces another (taking at the same tim its place), and so on, until the end of the chain of molecules reaching to the negative element is reached. As there is no chlorine at this point to combine with the free ammonium as such, thi latter splits up into ammonia and hydrogen, thi latter combining with the oxygen of the manganese dioxide, to form water. The reasons why carbon is preferred are—1. It is absolutely unaffected by the bodies used to charge the battery. 2. Owing to its porosity and irregularity, it presents a very large surface, and therefore very little resistance. 3. It is also the cheapest.—S. BOTTONE.

[65515.]—**Wimshurst Machine.**—The latter part of your query really answers the first part, according to one theory. There being a sligh difference in potential, the machine multiplies i until it is appreciable to ordinary tests.—T. C., Bristol.

[65515.]—**Wimshurst Machine.**—Electrical stress set up in a dielectric is never completely discharged, just as iron once magnetised alway retains traces of magnetism. These residuary traces are raised to large charges in the influence machines, as they are in dynamos, by accumulation of actions. I should recommend "Alpha" to clear his mind of all that rubbish about conductors being at the same potential, and master the actual natural facts which are disguised under that phraseology.—SIGMA.

[65515.]—**Wimshurst Machine.**—The initial charge comes from the fact that the metal sectors being insulated, each obtains some slight difference of electrical charge, even when at rest. Two insulated conductors may at some moment be at the same potential; but this depends altogether upon local causes, for it will be found a few minutes later there is in the same insulated conductors a perceptible difference—in other words, their charges appear to see-saw.—J. W.

[65515.]—**Wimshurst Machine.**—The very friction of the plates against the air, without ever taking into consideration that of the brushes, is sufficient to account for the initial charge. Of course this presupposes that one plate presents a little more roughness than the other, so as to produce some slight difference in potential; and there can be no doubt that it would be almost impossible to produce two plates so exactly alike as to surface as to run with exactly the same amount of air-friction. Let there be ever so little difference of potential once started at any one point, then, by the accumulative effects due to the rapid passage of the induced sectors before that point, the highest possible results from any given machine are soon attained.—S. BOTTONE.

[65516.]—**The Sky and Moon.**—Red light is the result of the transmission of the sun's rays at a low elevation, and consequently through a long stretch of atmosphere always more or less saturated with watery vapour or particles. The more water, the redder the reflection. This is especially seen in total eclipses of the moon, where the sun's rays skirting the earth's atmosphere, when it is laden with moisture, gives to the moon a deep coppery colour, as was seen last year, though I saw the same effect in a far more remarkable degree twelve years ago in South Africa. But this is not always the case, as in the total eclipse of the moon some four years since. The moon's disc was quite invisible to the naked eye, and very indistinct even through my large equatoreal telescope, and I had great difficulty in observing certain occultations of small stars for the Russian Observatory, which found comparatively little difficulty in doing year. The moon, on the other hand, does render any redness of glow to the atmosphere account of its reflected light being of such far power than the sun's rays, and only show same phenomena of redness on its own disc at, and shortly after its rising, and which soon away even while at a small elevation above horizon.—AMATEUR.

[65517.]—**Fire Prevention.**—the ... Steam is a efficient fire extinguisher than wa ... Some s have steam-pipes fitted to the holds hould it break out in the cargo. It y means a new idea.—A. F. SHAKE- ichaustr. 14, Dresden.

Fire Prevention.—The idea is old. ly test it by holding a lighted match aper in the steam issuing from the kettle. Bailey, of Salford, used to s for discharge of steam into a build- and you might write him. If you it steam it will be effective.—T. C.,

Focussing Screen.—Try slightly ss; or, if that will not do, try the as grey glass. Perhaps, as suggested, h hydrofluoric acid would do; you no the way to do it.—PRINCIPIA.

Focussing Screen.—You appear to fficulties where most people don't find can't get ground-glass (of the kind d) in your town, send to London to a r for a piece. I suppose you mean lass when you say "eyepiece," and I you to use it as little as possible. focussed sharp with the naked eye ed to look at the eyes in portraiture; cape work it is only waste of time.— uth.

Focussing Screen.—I have been h the same thing as "Hypo" with eens, so I took two old glass ½-plates emery and water rubbed them one on rinkling fresh emery and a few drops tween them occasionally) until both ground evenly. I had then two eens, finely ground, and giving per- definition. The grinding, if faithfully es about 45 minutes, and the emery d. N.B.—Be careful to lay the bottom level surface, and keep fairly well ith water.—J. A. HALHEAD.

Ventilation.—You do not give suffi- lars as to cause of heat, which may be causes than want of ventilation; but, efficient ventilation is necessary. If the vertical pipes as you suggest and entilators at top, that should suffice. may come from sun falling on tiles or , a false ceiling would aid you.—T. C.,

Ventilation.—If room be lofty, you vertical tubes, as proposed. But, if 2ft. will be high enough to direct the ught in a vertical path. Each tube ld have a regulating flap. You will p the flaps nearest outside air-supply , and the flaps at opposite end wide nearest will do all the work. If your re to be effective, they should be very uld say one tunnel on each side, each ss than 1ft. square, and let the aggre- nings of your wall gratings be not less , and let your flap openings aggre- ss than 3sq.ft. If you can give of grate, tunnel, and flap, so much the flaps should be all lugged to prevent t. Tunnels on floor of room to be lugged flaps in cover direct, would h necessity for vertical tubes, and you colder supply that way than through ed under hot ceiling of room next NK CAWS.

Purifying Water.—Is there not a near, which can be allowed to remain e gas-water pumped on to that would naggots and worms; most likely settle oo; and then, after sweetening in the ter, it would be clean and bear good ump such water into a river would be pid as is the modern system of empty- nto the Thames.—NUN. DOR.

Purifying Water.—The water from lder tank will be a rather strong solu- ide of ammonium, flavoured with tar, ed to run into any stream containing destroy them all for a long distance obably lead to an action for damages, f pumped into a sand-pit or deep hole d it may find its way into neighbour- l lead to several actions. Perhaps the disposing of it is to spread it over grass land or meadow after hay is off, l do good as a liquid manure, and be without nuisance by absorption and This may cause some trouble and is safe.—L. A. S.

Observatory.—It would necessitate tter to give a specification for even a atory for a 4in. reflector; but a very ework of wood, covered with Croggon's would be found very effective. The pe, a frustum of a cone is the easiest, adopted for a 16ft. dome, this revolving iron, which run between two rings ht iron, 1in. by ½in. in size, and fixed to the under side of ring of dome, the edge of the rings resting on the balls, while the balls run on circular cast-iron channel plates, slightly hollowed out. This is the simplest method, and excellent in work, as I have found my dome without a shake in a gale of wind, and when first erected I could re- volve it with one finger only. If the new edition of "Chambers's Handbook on Astronomy" is pub- lished, there is a new chapter introduced upon observatories, and construction of such for the use of amateur astronomers on more economical lines than those for regular establishments, where I have given drawings also according to the above description.—AMATEUR.

[65525.]—**Photography.**—The very thing you want—viz., an orthochromatic collodion process—has just been published in *The British Journal of Photography* for 8th June, in the form of a communication to the Imperial Technical Photographic School of Vienna, by Prof. J. M. Eder.—B.SC., Plymouth.

[65527.]—**Water-Power for Lathe.**—If you do not mind the expense of the company's water, a small turbine will do all you require. Try Bailey, of Salford. These are used in some of the hair-cutting saloons in Plymouth, I think.—T. C., Bristol.

[65529.]—**Cistern Overflow.**—I expect the valve does not fit properly. You do not say where it is placed. I had a flushing siphon tank fitted to a w.c. which worked all right, and it had an ordinary drop valve with leather seat.—T. C., Bristol.

[65531.]—**Dark Room.**—The size given is so small, that a very good way to exclude light would be to line it with two plies of black lining, such as tailors use, and hang a curtain of the same inside the door. A cheaper way is to coat the outside with tar and put indiarubber door tubing all round the door.—B.SC., Plymouth.

[65534.]—**Arithmetical.**—The area of frame = 33 × 22 = 726sq.in. The circuit of picture = 110in., and if we suppose the width of frame = x inches, we have—

$$(110 + 4x) \times x = 726\text{sq.in.}$$

or—

$$110x + 4x^2 = 726.$$

Divide by 4—

$$x^2 + \frac{110}{4}x = \frac{726}{4}$$

add $\left(\frac{55}{4}\right)^2$ to each side

$$x^2 + \frac{110}{4}x + \left(\frac{55}{4}\right)^2 = \frac{5929}{16}$$

Take the square root—

$$x + \frac{55}{4} = \frac{\sqrt{5929}}{4}$$

$$x = \frac{\sqrt{5929} - 55}{4} = \frac{77 - 55}{4} = 5\tfrac{1}{2}\text{in.}$$

Answer 5½in. You can only solve it by trial arithmetically, and it is a simple quadratic in algebra.—T. C., Bristol.

[65584.]—**Arithmetical.** — Area of picture = 33 × 22 = 726sq.in. Let x = width of picture-frame. Then we have $2 \times (33 + 2x)x + 2 \times 22x = 726$, or $66x + 4x^2 + 44x = 726$, and $4x^2 + 110x = 726$; a quadratic equation, the solution of which gives $x = 5\frac{1}{2}$, or -33. Hence required width of picture-frame is 5½in.—J. E. GORE.

[65534.]—**Arithmetical.**—A formula may be obtained thus:—Let x be the width of the frame, and m and n the dimensions of the picture. Then $2x(m + 2x) + 2nx = mn$. This give $x = \frac{1}{4}\left\{\sqrt{m^2 + 6mn + n^2} - m - n\right\}$. Put $m = 33$ and $n = 22$, and we find $x = 5{\cdot}5$. For a square picture $x = {\cdot}21\,m$, where m is the length of the side.—J. R. C., Charing.

[65534.]—**Arithmetical.**—Whenever a picture is exactly half as long again as it is high (or *vice-versâ*), the width of the frame must be exactly one quarter of the smaller measurement, if the area of frame is to equal area of picture. In this case, the measurements being 22in. by 33in., the width of frame must be 5½in., or a quarter of 22in. Ordinary arithmetic does not explain the reason of this; but the proof is readily shown by a quadratic equation.—F. S. S.

[65534.]—**Arithmetical.**—Let x = width of frame; then area of frame, or $4x^2 + 2(22x) + 2(33x) = 33 \times 22$, $4x^2 + 110x = 726$; multiply by 4 and add 55^2, $16x^2 + 440x + 55^2 = 5929$, $4x + 55 = 77$, $4x = 22$, $x = 5\frac{1}{2}$. The answer can also be arrived at in the following way:—The dimensions of the picture are as 3 : 2, area = 6. As the area of the frame = that of the picture, it follows that the area of the framed picture is twice that of the unframed. We have then to find dimensions that will give an area 12 as against 6. The first that suggest themselves are 4 and 3; and as these would give an even width of frame they are obviously right. Multiplying these by 11, we get an outside measurement of 44 and 33—i.e., a frame 5½in. wide.—BANKER.

[65535.]—**Electrical.**—TO MR. BOTTONE.—I should be inclined to think that a well-made dynamo, wound with coarse wire so as to insure a large current, would give satisfaction. I should advise a laminated Siemens armature about 4in. long by 1¾in. diameter, wound with 4oz. or 5oz. No. 12 on the armature, and about 7lb. No. 16 on the fields, in shunt with brushes. This should have a rocker arm to carry the brush-holders and brushes, on a spring swivel. The brushes would occasionally require renewing; but if made up of several layers of thin sheet copper, will last for a considerable time. Gearing would be required to run the armature at from 2,500 to 3,000 revs. per minute.—S. BOTTONE.

[65536.]—**Engine Query.**—If the travel is 4in., and the eccentric rods in line with valve-spindle, the throw or amount of eccentricity of eccentrics will be one-half of this, or 2in. Length of rods or link does not affect total travel of valve. I think you had better start on an elementary work on the steam-engine. Good works are greatly in advance of your present abilities, I imagine; if not, try Zeüner.—T. C., Bristol.

[65537.]—**Ringworm.**—Certainly; it can be carried in the clothes or otherwise. It is a fungus, the germs of which may be transferred in any way, and will grow where they are placed in a suitable soil—a weakly child or one out of health being the most suitable. The best remedy is to cut away the hair and wet the spots with tincture of iodine. I have used this often, and it never fails to stop the disease if applied early; if allowed to gain its position, patience may be required, and the general health require some attention.—SIGMA.

[65537.]—**Ringworm.**—There are many kinds of this common eruptive disease, most of them very contagious. Schoolboys are its favourite subjects; dirty combs and brushes used promiscuously are the suspected cause. Recently a curious discovery has been made that filthy cattle communicate ringworm to children who have touched the trees and rubbing-posts infected by these sick cows. A large school in the North of England has had an epidemic of this nasty complaint, distinctly traced to the cattle grazing occasionally in a large park-like playground. I have also been informed of a similar occurrence and its origin in another district—the gates and stiles causing the outbreak. In very obstinate neglected cases I have seen the head shaved that the remedy might penetrate the skin. Gas water (diluted) once had a great name as a lotion, but I prefer "Jeyes' Perfect Purifier," non-poisonous, mixed with soft soap to a lather, and well rubbed on the scalp morning and evening. Dogs and cats can carry the germs in their coats without catching the disease.—EOS.

[65537.]—**Cure for Ringworm.**—One or two pennyworth of citrine (not citron) ointment. Rub some of this on the spots twice a day, using a finger-tip, rubbing it in well, and always follow the circle of the sore, not missing its centre, nor yet the outer margin, so as to check its spreading. Before rubbing on this ointment be sure to bathe the spots well with soap and water, just a comfortable heat. One week of this treatment ought to effect a cure. I believe that a coating of thinnish mustard, laid on with a feather after the washing, will kill the parasite even more quickly than citrine ointment; but it smarts the skin so severely that it does not answer for young children. No one but the affected individual must be allowed to use the towel, or sponge, or comb, or brush, so easily is the malady spread. The above came to me from a skilful M.D., and I know its value through experience.—H. O'B.

[65541.]—**Turning Indiarubber.**—In rubber works they have a reciprocating knife attached to a special slide-rest. The rubber rotates slowly, and the knife reciprocates rapidly, and has a stream of water running on blade the whole time.—T. C., Bristol.

[65543.]—**Cheap Freezing Mixture.**—I don't think you will get anything cheaper than the ordinary salt and pounded ice mixture. The salt may be recovered by evaporating to dryness. It would be next to impossible to recover the salts named, and they are not much more powerful than the ice and salt mixture.—PRINCIPIA.

[65543.] — **Cheap Freezing Mixture.** — A mixture of ice and common salt is, I think, generally used. NH_4Cl and KNO_3 may be separated by subliming the NH_4Cl, taking care not to heat the mixture too highly, as KNO_3 decomposes at a low, red heat.—H. H. B., Chesterfield.

[65543.]—**Cheap Freezing Mixture.**—A great cold is produced by inclosing a solution of ammonium nitrate in an ice-making machine, consisting of a metal cylinder, in the centre of which is a hollow cone in which is placed the substance required to be frozen; the solution is then placed in the cylinder, and a lid is screwed on to the top of the cone; the whole apparatus is then rotated on its own axis for eight or ten minutes; the substance in the hollow cone ought by that time to be frozen. The salt can be obtained again by evaporating the solution, and thus the process can be repeated over and over again with the same materials. If "Linkum Doddie" will refer to "E. M.," Vol. XLVII. No. 1201 (March 30, 1888), the bottom of the middle column, he will find a description of another kind of ice-making machine producing 5lb. of ice per hour. The following are other freezing mixtures:—(1) Powdered ice and salt will produce a temperature of −18° C.; (2) 6 (Na_2SO_4) + 5NH_4NO_3 + 4HNO_3 (dilute) will produce a temperature of −26° C.; (3) 9$NaPO_3$ + 4HNO_3 (dilute) will produce a temperature of −29° C.; (4) crystallised chloride of calcium, mixed with snow in proportion of 10 parts salt to 7 parts snow, produces a temperature of −50° C; this salt can be used over and over again; (5) $NaSO_4$ + HCl produces great cold; but this mixture can only be used once, as a chemical decomposition takes place. —H. M. WARD.

[65546.]—**Field-Magnet Winding.**—Yes, the same will hold good, because if the thickness be very much increased, the inducing power gets rapidly less, while the resistances increase in like proportion. To obtain the proper resistance, a gauge of wire, such as will give the desired resistance within the limits prescribed, is always chosen. You will find this stated fully in my work, "Elect. Inst. for Amateurs."—S. BOTTONE.

[65547.]—**Poles of Dynamos.**—If the ironwork forms a complete circuit between pole and pole, little or no results can be obtained. There must be a space between the two poles. Even iron bearings are not admissible.—S. BOTTONE.

[65548.]—**The Mint.**—Conceive an ordinary pair of kitchen scales. In one pan is placed a sovereign of exactly the right weight. There are three fingers that sweep over the other pan at three different heights: one when it is level, one when it is, say, an inch too high, the other when it is an inch too low. They are continuously revolving, and sweep into three shoots at different heights opposite three sides of the pan, which we will consider square. Then, according as the coins, which are fed on to the pan one by one, are too light, too heavy, or the right weight, they are swept into the corresponding shoot, by the pan being brought to the right height by the standard weight on the other side. This was the principle of a machine I saw at the Mint many years ago.—BANKER.

[65550.]—**No. of Specification.**—If querist is sure the apparatus has been patented, a patent agent will tell him the number for a small fee. I doubt whether it has been patented, and that would explain his difficulty.—NUN. DOR.

[65551.]—**Dissolving Rosin.**—Turpentine.—SM.

[65551.]—**Dissolving Rosin.**— Benzol, oil of turpentine, methylated spirits of wine, wood naphtha.—S. BOTTONE.

[65551.]—**Dissolving Rosin.**—I think this can be done with ammonia in water. At any rate, methylated spirits will dissolve it.—T. C., Bristol.

[65551.]—**Dissolving Rosin.**—Rosin being the residue of turpentine, you have only to liquefy or soften the former by aid of the latter, very cautiously by artificial heat.—EOS.

[65553.]—**Parrots Affected with the Gapes.**—A feather dipped in salad oil, passed into the throat, will probably expel a worm, if this be "gapes." I have given assafœtida pills with cayenne pepper to poultry, and I do not think they would hurt your bird.—EOS.

[65554.]—**Accumulator.**—TO MR. BOTTONE.—Every square foot of positive plate surface in an accumulator will give 6 ampère hours. Hence, as the surface exposed by yours is about three-quarters of a foot, you may expect to get about four hours' work out of the accumulator. The length of time required for charging will depend entirely upon the quantity of current used.—S. BOTTONE.

[65556.]—**Zinc Paint.**—Have you tried French polish instead of oil as a vehicle for the paint?—SM.

[65556.]—**Zinc Paint.**—I have found any coloured pigment mixed with copal varnish to stick most tenaciously to any metal. The varnish must be good, though. — A. F. SHAKESPEAR, Lüttichaustr. 14, Dresden.

[65556.]—**Zinc Painting.**—Clean off all old paint, and apply the following mixture to prepare the zinc:—In 60 parts of water dissolve one part chloride of copper, one part nitrate of copper, one part sal-ammoniac, and one part hydrochloric acid. Brush the zinc over with this, which gives it a deep black; leave it to dry until next day, and it is then ready for painting. The best paint to use is Beckett's prepared varnish paint, which *cannot be surpassed* for tenacity and durability.—*T. CLARKE.*

[65556.]—**Painting on Zinc.**—Mix 1 part copper chloride, 1 part copper nitrate, 1 part sal-ammoniac (ammonium chloride), 1 part hydrochloric acid, and 64 parts water. Brush over the zinc, and allow it to dry. Then paint away with any paint you like, and it will never strip or blister. I treated my zinc guttering in that way, using the solution inside and out, and painting the outside. That was eight years ago, and it is all as sound to-day as it was first after doing.—SIGMA.

[65557.]—**Spark for Gas-Engine.**—A small dynamo with coil will do this well. To get the best effects, the dynamo should be wound for a large current of low tension, as if this latter exceeds two or three volts it rapidly eats away the platinum contact-breaker of the coil. Personally, I do not like electric igniters on gas-engines, as I find they are rather apt to miss fire.—S. BOTTONE.

[65558.]—**Land Property.**—I think that the Real Property Limitation Act, 1874, will justify you in refusing to give up possession or pay rent after seventeen years' possession, rent free.—B.SC., Plymouth.

[65559.]—**Concrete Floor.**—I do not think there is any considerable difference in the heat conductivity of one kind of concrete and another. Plaster is an excellent non-conductor. There is a kind of wire webbing now used instead of wood-laths for plastering on. If "J. W." were to case his naked girders in plaster on this wire webbing, they would be tolerably protected, and it is not expensive; but he would do still better if he were to cast a solid casing of concrete round his naked girders at same time as casting his floor. Then, if after thus embedding them he were to nail wire webbing under ceiling and girders and all, and plaster over same two coats, he would have a good fireproof job.—F. CAWS.

[65561.]—**Shocking Coil.**—Yes, it is a shocking one: pull it to pieces; use two or three layers of No. 20 primary for use with 1 Smee or bichromate, or say 22 or 24 for two or three Leclanchés, and 28, 30, or whatever you please, for secondary. But do not use cotton covered, and you will need no special insulation. For a larger coil, use 18 for primary in two layers; but do not expect it to work with Leclanché cells.—SIGMA.

[65561.]—**Shocking Coil.**—Your coil is faulty in several respects. First, the wire of the secondary should have been silk-covered, and carefully insulated by soaking in hot melted paraffin wax (such a soaking would vastly improve the present cotton-covered wire, and can be done without unwinding, the whole coil being immersed in melted paraffin wax). There is rather too much wire on the primary to get the best effects, as the secondary is thereby so far removed from the field of the magnet. The bobbins of the contact breaker should not have been wound with so fine a wire as No. 36. No. 28 would have been more suitable. Leclanché cells not much good for coil work. One chromic-acid cell, about 6in. by 3in., would have done the work more effectually. For your new coil you may use about 4 layers No. 22 for the primary, well insulated, and 12 layers No. 36 for the secondary.—S. BOTTONE.

[65562.]—**Working Printing Engine.**—There is nothing positively cheaper and more effective than ordinary coned pulleys, with three or four speeds. Why object to these?—T. C., Bristol.

[65564.]—**Dynamo.**—TO MR. BOTTONE.—I am rather puzzled to answer this. You say you have a dynamo made, and then you ask me what to get it cast in. The F.M.'s should be of wrought iron, the pole pieces in the softest iron your founder can command. An armature 6in. by 2in. will not give much in the way of an arc light. Still, if you use a laminated armature, wound with 1lb. No. 16, it will give you a current of about 6 ampères, at an E.M.F. of about 50 volts. You will need about 10lb. No. 20 on the fields, connected in shunt with the brushes.—S. BOTTONE.

[65565.]—**Water Power.**—1H.P. = 33,000lb. raised 1ft. per min.; 1 cubic foot fresh water = 62·436lb. $\frac{62\cdot436}{33,000} = \cdot001892$.—FRANK CAWS.

[65566.]—**Plating Dynamo.**—TO MR. BOTTONE.—By a silly mistake, the armature diameter at 65330, is given as 7in. The 7in. punchings have 16 sections, and would take more wire. I had in my mind the 6in. punchings, which have 12 sections, and take about two yards of wire, in one single layer to each section. The thickness of my armature punchings is ⅛in. (See my advertisement in Sale Column for sizes and prices.) This dynamo need not be driven faster than 1,300 to 1,500 revs. per minute.—S. BOTTONE.

[65567.]—**Ice Cream.**—Britannia metal. No stud. To keep the contents properly mixed.—SM.

[65567.]—**Ice Cream.**—For plant of every description, consult an advertisement of twelve lines on page 14 of *Weekly Times and Echo.*—W. H. PALMER.

UNANSWERED QUER

The numbers and titles of queries which rem
swered for five weeks are inserted in this list, a
unanswered are repeated four weeks afterwards.
our readers will look over the list, and send what t
they can for the benefit of their fellow contributors.

64948. Regilding, p. 135.
64953. Small Boiler, 135.
64959. To Mr. Lancaster, 135.
64977. Watch-Case Bottoms, 135.
64978. Electro-Motor, 135.
64990. Cycle Spokes, 135.
64994. Glass Beads, 135.

65203. Looking Glass, p. 222.
65208. Electroplating, 222.
65220. Battery. To Mr. Hamilton, 222.
65223. Rounding the Edges of Punched Brass Bi
65228. Pneumatic, 223.
65233. Ventilation of Churches, 223.
65236. Medico-Electrical Apparatus, 223.
65241. Carbon Tracings, 223.
65244. Toy, 223.
65251. Loom Strap Forks, 223.
65260. Fan for Blower, 223.
65261. Taper Rolling, 223.

QUERIES.

[65569.]—**Preserving Milk.**—Could you g
me any idea as to the length of time carbonk
will preserve milk when the air is excluded?—E

[65570.]—**Shafts.**—Would S. F. C. Searle furt
by showing how to find the moment of inertia o
shaft about its diameter, and the method of inve
the combined bending and twisting mom
ENGINEER.

[65571.]—**Shocking Coil.**—I have a small c
½ spark, and wish to know how to get a shock wi
attempting to take a coin from a basin of water.
long would a 7-cell chromic-acid battery light
10c.p. lamp?—CABIN.

[65572.]—**Oxygen.**—Will feel obliged if a
able correspondents will kindly favour me
names of the chemicals (in solution and propo
their order which have the greatest affinity for
—ATMOSPHERE.

[65573.]—**Gazogene.**—I have a 5-pint gaz
the inner thin glass tube which extends from
screw top to bottom of lower vessel has got brok
any reader kindly inform me how to fit a new
—R. J. N.

[65574.]—**Blue Bricks.**—Would some of you
kindly give the best process of making these
clay? Also the material used, where it may be
and cost of it.—BRICKMAKER.

[65575.]—**Staining Bookshelves.**—I hav
set of bookshelves of deal, and now want to st
Will some reader kindly give me a recipe for
mahogany-colour stain, and how to stain shelves

[65576.]—**Chloride of Silver.**—Will som
reader give a good recipe for reduction of above
30th quantities) to the metallic state, with any pr
necessary?—CHEMIST.

[65577.]—**Bunsen Gas-Burner.**—Will so
subscriber inform me the way to tell the amou
that is mixed with the coal-gas?—[illegible]NANIDREF.

[65578.]—**Polishing Steel.**—Ca[illegible]y of you
tell me how to obtain the beautiful bla[illegible]polish
such as we see on the steel portions of sk[illegible]
have tried crocus, red-stuff, and rottens[illegible]
water of Ayr-stone, but have failed to obta[illegible]
polish. I may mention that the articles hav[illegible]
from a hand-saw softened.—A POLISHER.

[65579.]—**Boat.**—Will any reader kindly
length, breadth, and depth of a boat or cano
bear a weight of from 20 to 30 stone, on
water? As lightness is indispensable, please
dimensions. The correspondence of an amat
made a similar boat would be thankfully re
W. S. MCKELVEY.

[65580.]—**Gas-Engine.**—Would "Er
Mary Ch., Torquay," or any other kind s[illegible]
what quantity of gas per hour is requir[illegible]
cylinder 4in. and 6in. stroke, and how t[illegible]
correct quantity? What would be its po[illegible]
flywheel? How many revolutions per mi[illegible]
SET LAD.

[65581.]—**Trust Office.**—My son d[illegible]
New Zealand last August. On 2 Nov., 1[illegible]
cates of my marriage, his birth, &c., to Pu[illegible]
New Zealand. On 6 April, 1888, I sent a[illegible]
place asking if they had received the cer[illegible]
all was going on right. To neither of my[illegible]
had a reply. Ought I to take an further s[illegible]
so, what?—M. A. C.

[65582.]—**Foreign Meat and F**
boracic acid is largely used by shippe
America and elsewhere, to prevent d
transit to this country. What are t
human body likely to ensue from f
of animal food preserved by means
PATER.

[65583.]—**Accumulator.**—Will
formation as to the number and size
to make an accumulator large enoug
rent necessary for lighting ten (16c.p
about three hours? What sort of ce
pose best? How much would it cos

[65584.]—**Gas-Engines.**—Wou
engine make less noise if the igniti

id are there any small gas-engines
hen will the Otto patent expire ?

—Can these be made by uniting
with solution ? I want to make
in. diam., for a model gas-engine.

Picture.—An oil-painting on
e wall, and a jagged tear is the
r it myself ? The size is about
EKIE.

sh to buy a first-class flute. Which
l is be coco, ebonite, or silver ?
—FLAUTO TRAVERSO.

ar Cutting and Polishing.
casion to look over about 30 vols.
course, goes back to an early date
h time I have been a constant
of information they contain !
st back numbers I have been
the fact that, as the years roll on,
alued contributors fall out of the
gret the loss of that cultured and
so much on so many subjects—the
h." Then for a time Mr. Proctor
st us giving so much light, and
courteous—who does not feel his
d name that no longer is seen on
rsonally as an amateur scientist
l more than either. That is Mr.
ner often wrote on subjects that
terest in; yet their articles and
withal so full of information as to
he occasion which has led me to
following. Having, after many
b of Iceland spar, I determined
making a Nicol prism. After
variably found the face some-
t all like the end of the prisms
. The most natural thing that
rind the face true. This I easily
ish it beyond a certain point I
ld get it to a fine granular sur-
but not beyond. The polishing
s putty powder. I worked it on
eather; but no, nothing would
face. Seeing how perfect and
lariscope is, I conceived the idea
glass were cemented to the spar
end would be secured, as the
inequalities in the spar, and so
of light, and make the surface
riment showed that by this means
eatly increased, and so far I was
before I went any further in this
e prism in two and cement it to
nary ray. Now nothing seemed
t could be sawn with a fret saw—
urprised to find utterly impossible.
y, until, like the cobbler's shoe
wn to a leather button. Knowing
e to the matter in the "E. M.," I
ces of 30 or 40 vols. to find a hint
e was no voice, or any that an-
l that the thing can be done only
no satisfaction to me. I feel con-
e, and (shall I say ?) manipulative
e tackled many a thing and ac-
ne through love—to accomplish
ue to start with. Can we call
ep ? Can we command the shade
sit us and lead us through the
not some other patient worker
man in his need ? What I want
nd spar be polished ? If so, how
Are the ends plated with glass
at means is the prism cut in two ?
rade secret in these matters. Will
-DISTRESSED BROTHER.

nd Bands.—Will some reader
neral idea how the four parts
arranged for the instruments
er for singing or quick-step
good full harmony to the band ?
pone will play the treble, the B
he bass, but what parts are usually
mbones, two and three cornet, and
phonium and baritone.—G. R.

l Clock.—Will some electrical
following ? I have an old num-
ut date on it. It was issued the
ition at the Crystal Palace, and in
ock Escapement. I am making a
know the action of his escapement.
push the teeth, and how does the
something wrong in sketch, for
tally. Do any readers know any-
pement, or can they suggest any-

d Iron Signboards.—I re-
turn out 100 super. feet per week.
me in the way of doing so ? I
small plant, but in my inquiries I
ful. I would also like to know
a book giving directions how to
rd purposes. I shall be pleased
chanic would instruct me in this
nstant inquiries, and in my regular
—IRON ENAMEL.

ottone.—Will you be kind enough
d explain with an illustration, the
? 1. A current of ·24 ampères flows
of 72 turns, the (average) diam. of
ntimètres. What is the strength
which the current produces at the
Suppose a current passing through
a deflection of 35° upon a small
l at its centre (the plane of the
etic meridian) at the place where
nt of the earth's magnetic force is
trength of the current in ampères ?

Spiral Grooves in Steel
a number of pieces of 3-16 steel rod spiral grooves 1-16in. width and depth. On each side of the piece of rod a groove, 1½in. long, with a pitch of 1⅛in. to the left, joins about midway of its length another groove of the same length having a pitch of 2⅜in. to the right hand. Can anyone advise as to the most expeditious way of accurately cutting these grooves in the lathe with circular cutter or otherwise ?—J. L. C.

[65594.]—**Fuel and Heat Saving, &c.**—In connection with a works I am interested in, a dense body of gas is constantly produced during working hours and passed in a flame through a revolving cylinder containing clay (so as to calcine the same). It is estimated that the surplus heat on leaving the cylinder is about 500°, and is charged with vapour. When the stoking is done a dense smoke issues from the chimney for several minutes. If any of your readers can and will kindly suggest (1) a method of saving this surplus heat; (2) of reducing the quantity of smoke, and (3) more especially of a use or purpose that said waste heat and smoke can be applied advantageously either in manufacturing or producing any marketable article or commodity or otherwise, I should be much obliged by their so doing.—ENQUIRER.

[65595.]—**Bow-Legs.**—I have a little girl, aged 7, whose legs are unfortunately bowed. Up to the age of 3 they were perfectly straight; but thenceforward the ankles and knees became enlarged, and the legs gave way and have been bent ever since. The knees are now about normal, however, but the ankles are still larger than they should be. I attribute the misfortune to a long period of unsuitable diet (the result of circumstances), although her health has always been good, and she has never had an illness of any kind. I now, however, fancy that the trunk grows quicker than the legs, the latter being shorter than I think they ought to be in proportion to the length of the body, which, if it continued, or the disparity became more pronounced, would be a great disfigurement in future years. What is the remedy ?—PATER.

[65596.]—**On the Magnitudes of the Fixed Stars.**—In reading a book entitled "Scientific Dialogues," by the Rev. J. Joyce, revised to the year 1868, I came across the following statement:—"We do not know the magnitudes, either absolute or comparative, of any of the fixed stars." I should be glad if some of your astronomical correspondents would say if the above statement is true at the present time, or has there been any method since discovered of obtaining the measurements of their diameters. If not, I shall have a suggestion to make when I write again, as I think I have discovered a way of finding the diameter of globular masses at a distance, otherwise than by triangulation. In fact, I have proved it true for short distances.—CAPELLA.

[65597.]—**Bolts.**—Can any kind reader inform me if there is any standing rule for ordering bolts for engineer's use ? When ordering should it be stated from under head to point, or should it be understood, when length is given, from under head to point is length of bolt required ?—NOVICE.

[65598.]—**Tension on Belts.**—A belt having a linear velocity of 350ft. per minute transmits 5H.P. to a pulley round which it passes. Find the tension of the belt on the driving side, supposing it to be double that on the slack side.—STUDENT.

[65599.]—**Water Tank.**—A circular water tank is 20ft. diam. and 25ft. deep. It is constructed of six rings of cast-iron plates. Find the total stress on any vertical section of the bottom row of plates made by a plane passing through the axis of the cylinder, neglecting any assistance afforded by the flanges or connection with the bottom plate. In looking over back numbers I find answers to problems on tanks, and some of them state that the diameter of a tank makes no difference to the bursting pressure round the base. But in Anderson's "Strength of Materials," p. 274, it is there stated that "The diameter has a most important influence on the resisting powers of a tank."—STUDENT.

[65600.]—**Saw-Mill Machinery.**—Will some reader kindly answer the following ? I have a saw-mill. Some time ago the pillar supporting the outer bearing of main shaft of engine gave way, and I was obliged to have it rebuilt, and I fancy that the shaft is not at right angles with the piston rod. How can I find it out ? She does not heat at any part, but has a little knock about the cross head. Also the main driving belt often comes off when the saw is much pressed. I thought the belt had got slack and I tightened it, with little or no effect. I have an idea that the engine shaft and saw spindle are not parallel to each other. How can I prove it ? They are about 31ft. apart.—A SAW-MILL OWNER.

[65601.]—**Preserving Malt Liquor.**—Can malt liquor, made by pressure of water at 180° Fahr., standing three hours, and then filtering, be preserved by any means from forming a fungoid growth, and, if so, what are the means to be employed ?—KING'S MILL.

[65602.]—**Camera-Obscura.**—I am desirous of making a miniature camera-obscura that will show me objects, say, a mile distant, very distinctly, and on as small a scale as possible. The table to receive the objects to be about 6in. in diam. and the mirror, say 5ft. above the table. Will some correspondent kindly inform me what lenses to use, their focus, and distance apart ?—J. W.

[65603.]—**Galvanometers.**—I have a lineman's three terminal detector galvanometer, by Brittain and Foreman, London. Is there any way of getting the voltage of a battery by it ? If so, would you kindly tell me the easiest way of doing so ? When I test a 12-cell Leclanché, No. 3 cell, the needle deflects to 80 for quan. and 30 for intensity. Is that right, and if so, by giving the simplest way of finding the voltage of a battery you would greatly assist ?—NERO.

[65604.]—**Electric Circuit.**—Will Mr. Bottone or any other of "Ours" please help me in this ? I have a small dynamo lighting my house, giving about 10 amp. at 50 volts, and I require to work a bell off the same dynamo. The circuit of this bell I require to be perfectly independent of the dynamo circuit—i.e., no primary current from the dynamo to be allowed to go through the bell. I want the bell off a secondary circuit through induction or other means if possible.—ANXIOUS.

[65605.]—**To Compute Change of Trim in a Steamer.**—Will Mr. Caws kindly inform me in plain figures how this is arrived at ? For instance, if I wish to remove 20 tons fore and aft, say 100ft., what difference would this make in the trim of a steamer of known size and draught ? Also what is meant by longitudinal metacentre, as opposed to the ordinary meaning of that word ?—SAILOR.

[65606.]—**To Mr. Bottone.**—Could you kindly explain the following ? While experimenting with a helix containing about 1½oz. of No. 34 s.c. copper wire, I noticed a peculiar commotion among the wires in the top layer, which had become loose. When I caused a current from 4 chromic-acid cells, connected in series and each containing 16sq.in. of working zinc surface, to pass through the coils, the loose wires moved towards the N. pole of the helix, and when I broke the circuit they moved back to their original places. When I reversed the current the wires moved in the same direction as before. Could this be due to the action of currents, or to the heating and expansion of the wire ?—which I think most probable. I may add that the wire was perfectly free from kinks and flaws and perfectly insulated.—A. G. G. C.

[65607.]—**Natural History Divisions.**—Will some one of your correspondents kindly tell me how the various insects, &c., that come under the natural history division of the "Articulata" are arranged—that is, into what are the articulata divided, and these divisions again divided, and so on down to genus and species ? I should like to have the newest and most approved arrangement. Can anyone give me the name of a good elementary work on entomology by which I could obtain reliable knowledge of the structure, &c., of the various orders, &c. ?—P. R.

[65608.]—**Battery.**—Will any reader kindly help me out of the following difficulty ? I have three 4-volt incandescent lamps which I have fitted up in our house and am now lighting them with 10 quart bichromate battery. I wish to know if there is any other battery that I could light them with, so that I need not lift the elements out of the solution when not in use.—H. LAXTON.

[65609.]—**Germanium.**—Is this a new metal, or is it only the foreign name of an old one ? The *Pall Mall Gazette*, in which I saw the notice of its discovery, said that the atomic weight of this substance—viz, 72·27—was calculated by the wave length in the spectrum. How is this done, or is it only a newspaper story ?—SATINE.

[65610.]—**Dynamo.**—Will Mr. Bottone or some other correspondent kindly help me ? I have made a dynamo which I wish to use for lighting incandescent lamps, but I cannot get it to answer. The field-magnets are wound with 7lb. No. 18, and the armature with 1½lb. No. 20 d.c.c. wire. The armature is 2½in. diam., and 7in. long, is of H section, and made of wrought-iron. I have tried it connected to 7 lamps, 2½c.p. each, arranged in parallel arc. Have also tried with less lamps, but can get no result. There appears to be a strong current generated, as on touching the brushes I get a smart shock. When joined to two Bunsen cells, 1 quart each, it runs well as a motor. What can I do to get a light, and what c.p. should it give ?—V. E. L.

[65611.]—**Shafting.**—Would some of your able readers kindly inform me at what temperature, Fahr., will a shaft running in a good fitting bearing commence to expand ? I would like the lowest minimum for iron and steel, and also when the bearing will begin to be affected. This will doubtless apply to the (say gunmetal) bush expanding as well, but will considerably depend on the shape of the bush, whether round, octagon, or square; but I will be pleased to have the lowest degree of heat that will affect iron, steel, cast-iron, and brass, or gunmetal, or any other metals used for bushes for shafting.—CAUTIOUS.

[65612.]—**Electro-Plating.**—TO S. BOTTONE.—As I want to start electro-plating with nickel, copper, or silver, and electro-typing in copper, I should be very much obliged if you would briefly advise me as to what batteries I had better get and how many of them, and how much they would cost. I should never need to plate anything larger than 6sq.in., or to electrotype more than two coins about the size of half-crowns at the same time. I have been trying for some time, but cannot get on well, I think, owing to my batteries.—C. T.

[65613.]—**To Mr. S. Bottone.**—I have a small electrical machine that turns with a handle, but I cannot get it to give off a discharge with anything like certainty. Sometimes it will work very well for a few minutes, and then cease, yet all the workings appear to be right so far as I can see. In fact, the machine is almost new. I have no practical knowledge of electricity. Will you kindly inform me how to proceed to put the machine in working order ? Should the revolving bobbins be in contact with the horseshoe magnet, or how is the electric discharge obtained ?—G. R.

[65614.]—**Electric Lighting.**—TO MR. BOTTONE.—I have made a 12-cell chromic-acid battery with one zinc between two carbons in each cell. The size of carbon plates immersed in liquid is 5in. by 3½in., and each is ¼in. from the zinc. What would be the best c.p. lamps to use, and how many would it light ? What voltage lamps and of what resistance should you recommend ? Also what size wire should I use for leads, if the lamps are about 15yds. from battery ?—H. G. S.

[65615.]—**Polarisation.**—What apparatus is required to determine whether a given solution is dextro- or lævo-rotatory ? I have the polarising prisms of a microscope, but cannot see how they can be applied to the above. I should be much obliged to any kind reader willing to help me in this difficulty.—YOUNG ANALYST.

[65616.]—**Wheels.**—Will any of our correspondents tell me how to work out the problem of when two wheels will come together how many revolutions each wheel will make—driving wheel 32 teeth, driven wheel 48—without the use of algebra ?—YOUNG MECHANIC.

[65617.]—**Micrography.**—Is the machine for microscopic writing on glass, invented by Mr. W. Peters about 1850, still in existence ? I have a slide bearing an epigram of four lines, the whole occupying 1 160,000sq.in. Has any one of "ours" any smaller slide than this ? If so, I should be glad of particulars.—YOUNG ANALYST.

[65618.]—**Entomological.**—Is there any work published intended specially to assist identification of insects, or any work giving details of the modern classification with the characteristics of each family, so that by a of exclusions, one might be able to limit one's search to a single group?—YOUNG ANALYST.

[65619.]—**Tinning and Cleaning Copper.**—Having a few of the above to clean and tin, I am at a loss to know how to go about them. Would any kind reader give me the simplest and quickest way to do them? They are for preserving fruit.—G. M., Dublin.

[65620.]—**Double Action Round Bellows.**—Will some kind reader help me in this little difficulty? I wish to construct a small round bellows on the double-action principle. A small sketch showing interior construction of outlet pipe, divisions, and valves, would greatly oblige. —BELLOWS.

[65621.]—**Incandescent Wire.**—What is the best E.M F. to supply? What gauge of wire? What length and what metal (platinum, g.s., or platinoid) should be used, and how coiled to produce the equivalent of a small spirit lamp, suitable for heating small quantities of liquid in a glass backer?—AJAX.

[65622]—**Dr. Gasner's Dry Battery.**—TO MR. S. BOTTONE.—I should like to have the opinion of the above battery? What are the elements it is composed of? Can Applegarth's Leclanché equal the ordinary Leclanché battery? Wherein does the difference lie?—METEOR.

[65623.]—**Photography.**—Will any of your readers kindly help me in this difficulty—viz, to get rid of blisters that occur on the prints after being toned? I have tried a great many variety of papers, and also by salt in the washing water and ammonia in fixing solution, but all of no avail.—LIVERPOOL.

[65624.]—**Metals.**—Would some reader give me some information about metals called lawn iron, and H.C.M. iron, and U.H.M. iron? What description of castings are they used for, and what districts they come from?—DUBLIN.

[65625.]—**Boiler.**—Will some reader kindly inform me what should be the dimensions of an upright cylindrical boiler required to work a pair of slide-valve cylinders, ⅝in. bore and 1½in. stroke? Also what thickness of metal would be necessary?—H. P. N.

[65626.]—**Geometry.**—Will Mr. Grey kindly give the title, price, and publisher of some books on geometry giving the definition of "trace," "radian," which have come into use or have a new meaning?—J. S. C.

[65627.]—**G. N. Single Bogie Express No. 776.** —Would "Lincoln" or "Engraver" kindly send a diagram and dimensions of above engine? Does it differ in any way from the 663 class?—METEOR.

[65628.]—**Raspberry Drinks.**—Will some reader furnish me with a recipe for making raspberry drinks same as sold in the Italian ice-cream shops?—A. C. WALKER.

[65629.]—**Testing Bleach.**—Would "Chemist" kindly inform me the simplest and most reliable method for testing bleach for the percentge chlorine it contains? I have an alkalimeter.—PAPER.

[65630.]—**Causticising**—How can I determine the quality of recovered ash from spent lye, recausticising re-recovered ash? The best method of testing the liquor when it is causticised.—PAPER.

[65631.]—**Blowing Fan.**—What size should the inlet and outlet be for a 16in. blast fan, and how many blades there should be to same, and what width the case should be for the diameter?—BLACKSMITH.

[65632.]—**Gelatine Bromide Processes.**—Will any reader give brief outline with formula for coating the plates of Dr. Eder's (or any other) gelatine bromide process?—A NEW SUBSCRIBER.

[65633.]—**Aquarium.**—I want to make an aqarium of small size. Would some kind reader assist? A diagram and dimensions would be very acceptable.—LIVERPOOL.

[65634.]—**S.E.R. Locomotives.**—Will some one tell me where to get a good picture of the old 7ft. singles, now nearly all replaced by those of which you gave two sketches last week?—PARSON.

[65635.]—**Gas-Lighters.**—Would some brother-reader kindly explain the construction of the dynamo electric gas-lighter?—T. J. O'C.

[65636.]—**Retouching Medium.**—Will some one say how to make the above, suitable for portrait work?—W. H.

To Identify Blood Stains.—Dr. Ferry (*Progress Medical*) advises that the fabric be teased out with a needle, and macerated in a solution 1:1000 of sodium chloride. The fluid will soon become tinged by the blood, and can be submitted to spectroscopic examination. To demonstrate the blood globules, add to some of the fluid a drop or two of a saturated solution of choral hydrate, which will throw down a rose-coloured precipitate. A drop of the precipitate is to be exposed on a thin plate over the flame of a spirit-lamp, and the clear fluid which separates is to be removed by blotting paper. The pellicle of coagulum which remains is to be coloured with fuchsin and washed with water. A drop of acetic acid will render the preparation transparent, and the globules will become visible in bright red.—*Pharm. Era.*

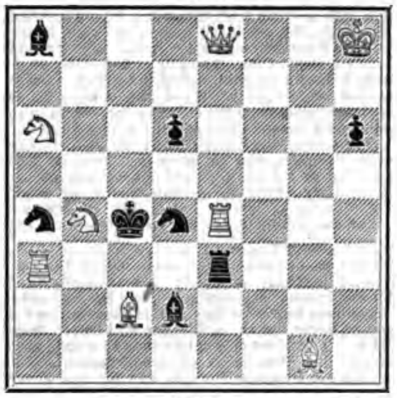
THE Canadian railways have doubled in length in ten years, being now over 12,300 miles. The number of passengers carried has increased by 66 per cent., and the number per inhabitant by 40 per cent.; the number of tons of freight carried increased by 107 per cent., the number per inhabitant by 97 per cent.; the receipts from freights increased by 87 per cent., and from passengers by 86 per cent., while the total receipts from all sources increased by nearly 90 per cent., and the expenses by nearly 72 per cent.; the tons of freight carried last year amounted to 16,368,000, and the number of passengers to 10,686,000.

CHESS.

ALL communications for this department must be addressed to J. PIERCE, Langley House, Dorking.

PROBLEM MCI.

Black.



White. [8 + 8

White to play and mate in three moves.

SOLUTION TO 1,099.

White.	*Black.*
1. B-R 6.	1. P-B 5.
2. B-B 8.	2. K-B 4.
3. R-K 5 mates.	

NOTICES TO CORRESPONDENTS.

CORRECT solutions to 1,099 by J. Bryden (neat, but rather easy and wanting in variety), J. Methuen, J. Palmer, H. Fellows, Hensing (pretty and neat), J. G. Hankin, A. Dean, W. Jay, Sorrel, T. H. Billington, G. W. Middleton, and E. W. Barnett; to 1,098 by Sorrel, W. Jay (2), A. Dean, J. G. Hankin, Link, E. W. Barnett, J. Palmer (2), and T. H. Billington; to 1,094 by J. Palmer, and to 1,097 by Sorrel.

J. PALMER.—Sorry for omissions.

IT has been found impossible to hold the coming Congress of the Scottish Chess Association in the building of the Glasgow Exhibition, as had been hoped by some of the promoters.

THE score in the International Correspondence Tourney now stands, England 25 won games; Ireland 24; Scotland 21.

ANSWERS TO CORRESPONDENTS.

⁂ *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

⁂ Attention is especially drawn to Hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, June 13, and unacknowledged elsewhere:—

MISS E. BROWN.—W. A. Ryan.—M. and Co.—Electro.—F. M. Rogers.—Elastic.—G. Mitchell.—J. W. Hillier.—A. B. G.—Fireman.—Lloyd.—C. Andrew.—M.I.C.E., Bath.—D. Truelove.—L. Brewer.—G. C. C.—H. H. E.—J. A.—G. L.—J. Newman.—Silent Force.—F. J. G.—J. Rogers.—S. Maddison.—W. G. Penny.—V. N.—R.—F. Caws.—S. Bottone.

ETHYL. (We do not remember the experiments of "Dr. Duprees." Does it matter?—for all sorts of statements are made. See "Scientific News" last week. If you must find it, we can only suggest a reference to the indices.)—A SUBSCRIBER FROM NO. 1. (Our "esteemed contributor" would not thank us for forwarding the paper and calling his attention to a letter of so ridiculous a character, the writer of which has had the impertinence to attribute to distinguished men views they never held, or could possibly hold, unless they had "gone wrong." No doubt the ENGLISH MECHANIC is, as you say, "read by everybody," and that you have been a "Subscriber from No. 1," but even those satisfactory announcements will not induce us to send the paper to our "esteemed contributor." If we know anything about him, he would not thank us for sending him such rubbish.)—A. A. MERRICK, Toronto. (We have forwarded it, and you will probably receive an answer in due course.)—COPPER. (There

is a simple method of coppering by mer
a solution of sulphate of copper, and a
processes—some of which have been rece
Have you looked in back numbers
(Why not look in the books on geomet
you will find something about it in b
T. H. P., No. 1. (Vulcanite is made of i
sulphur, and is "cured" by heat and
prepared mixture can be bought from th
dentists with their materials.)—MR.
string is attached to the tube, and whe
out it moves the index on the dial, c
coiled round a pulley on the axle of the
weight returns the index when the tub
—A WOULD-BE POULTERER. (See it
not mention the kind of apparatus you e
ing, or we might have been able to an
tion at once. Look in No. 1063, p. 504;
No. 935, p. 562.)—NICEL. (Full direct
given many times. See indices.)—H.
(We do not know any such work or
C. J. B. (We gave all the information a
thing more might be found in reports
—LOFTUS. (Questions incomprehensib
elementary manual of optics, and so
knowledge to put definite questions. Gl
magnify" by being ground to pre
BOTTLER. (Nothing: it is the natura
mentation, the same as in ginger-beer.
method has been explained over and o
you will probably find an answer in this
rate, you must describe your coil before a
to answer.)—T. BURGESS. (1. The bot
3. Ditto. Procure an elementary manua
—GWALIA. (Procure a list of books
Effingham Wilson, Royal Exchange.
(No. The ball bearings would be the
HERMES. (If you have not the use of
see such a work as "Ganot's Physics.")
(Galvanised iron may be used for stori
but slate is much better. Lead is prefer
zinc.)—JIMBO. (Nonsense! We a
things we should be sorry to waste spac
and we are not to be taunted into a gr
tisement of a quack.)—CRAFT IN D
nearly impossible to reply satisfactorily
legal questions. 1. The deeds themselve
primâ facie evidence of a good title, b
decide as to the goodness or badness of t
a lawyer after careful perusal. 2. No; a
ance is necessary. 3. A lawyer must dra
no "proper forms"—it must be properl
the stamp depends on the consideration
5. If your title is good, and your title
drawn according to the law of the pe
no new title deeds. Any *definite* legal q
be submitted to the legal Editor of the
and Echo. The legal column of that p
feature, and is ably edited by a well k
citor.)—YOUNG ANALYST. (Queries i
other is quite old.)

Every Man or Woman suffering
of nervous derangement, loss of power, debility,
order, should send at once for "Electropathy, or
to Health" (copiously illustrated). It will cost y
If, after perusal of the astounding facts it will bri
you should be persuaded to stop physicking and t
ment, you will assuredly be numbered among th
multitude who daily express their gratitude
benefits derived from mild, continuous curren
generated by wearing Harness's Electropathic Bel
a moment, but sit down at once, lest you forge
the treatise, which will be sent you free by p
C. B. Harness, Consulting Electrician, the Medical
Limited, 52, Oxford-street, London, W. (corner of

A "Bicycle" Railway.—An inve
Hampshire has built and equipped
railway on his patented system, and c
future for the same. The track has
and a surface rail, with grooved rail
the bottom of the first and the top
the cars being quite narrow, and the e
about 4ft. wide over all. The engin
built has two small wheels over the b
others over the tank, the engine and t
one frame; under the tank is a p
wheels—all these pairs of wheels
tandem or fore and aft—and under
one 8ft. diameter grooved driving
distance between the upper and low
16ft. The cars will be about 4ft.
engine will weigh about 20 tons in w
It is interesting to note that this in
some others in the same field, talks
speeds of 200 miles an hour, requiring
only for trains to South America. H
his system cheapness of construction an
safety, and speed. His patents are ta
nearly every country, and are very com
He certainly has the courage of his
Very elaborate detailed plans and worki
have been prepared, and the experim
three miles long, is to be in operati
According to report a company has bee
with a capital stock of 5,000,000 dols.
lines of various types have been inve
posed over and over again, but they
come into practical use. There may
small field for these as well as oth
but the inventors invariably have g
transcontinental lines and fabulous
Meigs elevated system is as yet th
practical system.—*The Engineer.*

THE consumption of lead pencils
States is placed at 250,000 a day. If
who uses a lead pencil were to sharpe
consumption, it is estimated, wou
about 250,000,000 a day.

nglish Mechanic
LD OF SCIENCE AND ART.
IDAY, JUNE 22, 1888.

AL ELECTRIC BELL-FITTING.—XIII.

munication with Lifts.

g of the lift-shaft having been ted, the next thing is to run the he pushes and bells on the re- s to the shaft, joining them into t have been stretched from top Fig. 77 shows the arrangement s apparatus, there being a bell and double contact push on each landing, which pushes were shown in detail in Fig. 13, p. 380 of last volume. When wiring, a wire is first run from the bottom contact of each push to the lift-shaft joining into the wire *c* that is connected to the positive pole of the battery. A wire is next run from the top contact of each push to one terminal of the bell on the same landing, being continued on from the other terminal to the shaft and joined into the wire *z*, which is in connection with the negative pole of the battery. A wire is also run from the spring of each push and joined into the shaft wire corresponding to the landing from which it comes.

As it is very seldom that a good fixing is to be obtained for the wires in the lift-shaft, it is well, when fixing the shaft wires as described in the last article, to select for this purpose the side of the shaft nearest to the pushes, so as to shorten, as much as possible, the distance through which the wires from the pushes must be run. If, however, space does not permit this, the wall must be "plugged" at such places as it is necessary to obtain a fixing, and the wires stapled to the wooden plugs. In joining the wires from the pushes and bells into the shaft wires, the connection must be made at the back of the shaft wires, so that the joints will not interfere with the contact springs as they move up and down with th Fig. 75, which is a side view, shows should be done. The end of the

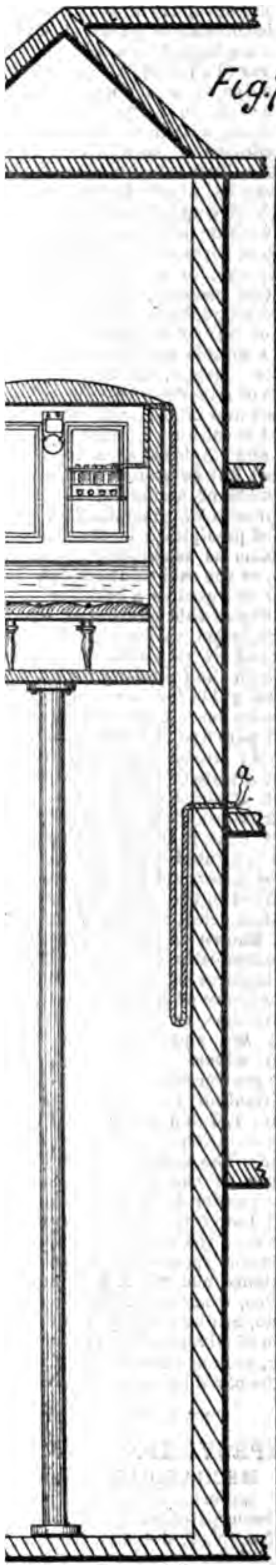


Fig. 76.

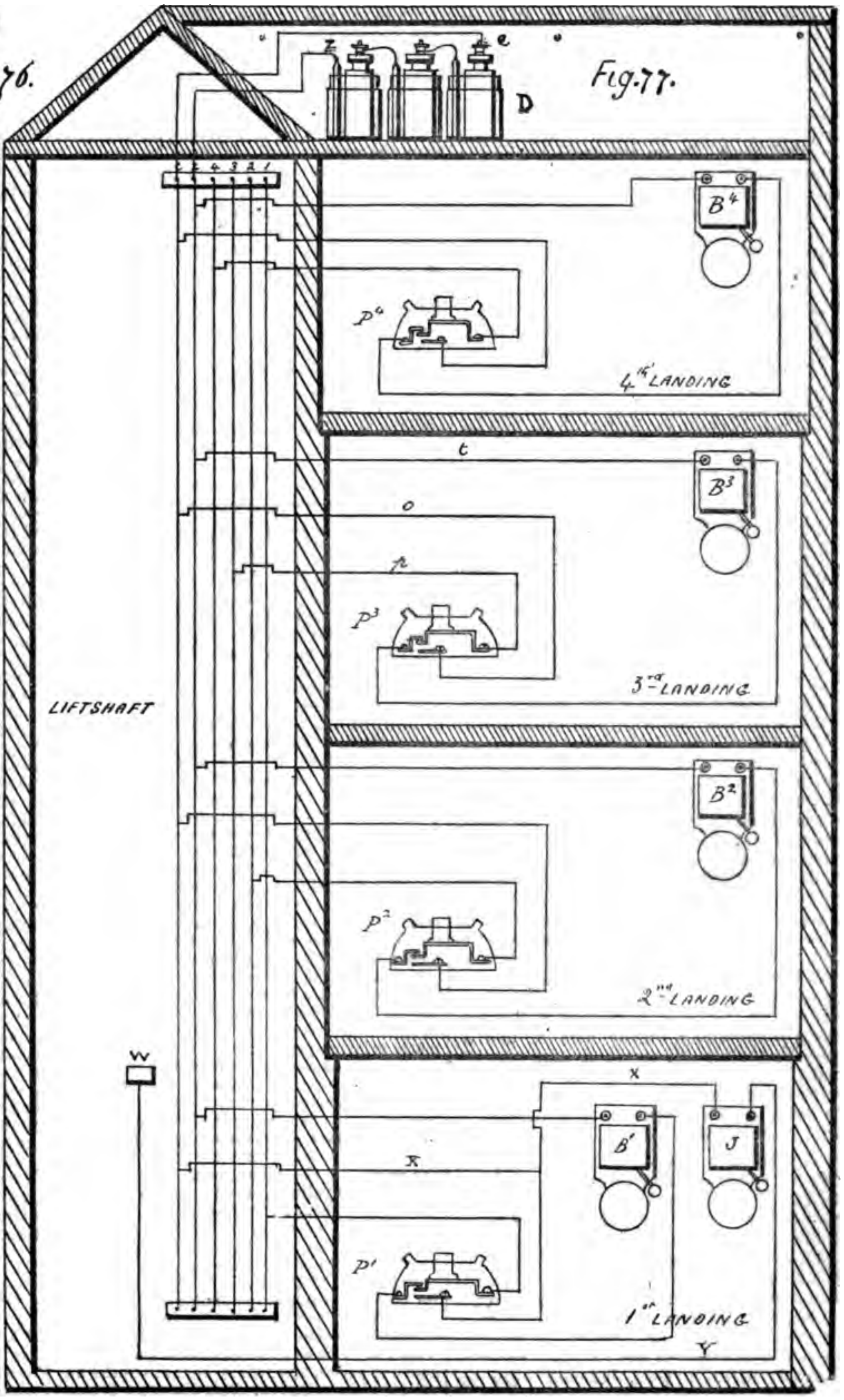


Fig. 77.

II.—No. 1213.

from the push is turned up and soldered on to the shaft wire A, which, if properly done, should leave no solder on the front of the wire, thus securing a smooth surface for the spring. The wire B must be fixed at the point where it leaves the wall to join the shaft wire, so as to prevent the joint coming to the front should the wire A have a tendency to twist at any future time.

In order to follow out the circuits, Figs. 72 must be imagined placed in the lift shaft of Fig. 77, the springs (1, 2, 3, 4, *c*, *z*) on the top of the lift-cab coming over their respective shaft wires, with which they would in actual practice maintain a rubbing contact. Pressing either of the pushes, P^1, P^2 P^3, or P^4 will ring the bell B in the lift-cab, and release the shutter of the indicator, corresponding to the floor from which the signal has been sent, while pressing the keys at the bottom of the indicator H will ring the bell fixed on different landings. Suppose, for instance, push P^3 on the third landing is pressed, the circuit closed by pressing in the button is from the pole C of the battery D, shaft wire C, wire O, bottom contact of push P^3, push-spring, wire *p*, shaft wire 3, spring 3 on top of lift-cab, wire C, key *d* at the bottom of indicator H, top contact, wire *e*, coils of indicator No. 3, framework of movement, wire *f*, spring Z on top of cab, shaft wire Z and zinc of the battery. This attracts the armature of movement No. 3 of the indicator H, throwing down the shutter, as shown in the figure. The shutter falls on to the copper rod *g*, causing the bell B to ring, the circuit closed being as follows: Pole C of the battery D, shaft wire *c*, spring *c*, wire *m*, bell B, wire *g*, rod *g*. shutter S, frame of movement 3, wire *f*, spring Z, to zinc of the battery. The bell continues to ring until the shutter is replaced by the attendant, which breaks the bell circuit. He then presses the key *a* at the bottom of the indicator H, which makes contact with the brass plate *n*, causing the bell B^3 on the third landing to ring; the current flowing from the pole C of the battery to the shaft wire *c*, spring *c*, wire *m*, brass plate *n*, key *d*, wire *c*, spring 3, shaft wire 3, wire *p*, push spring, top contact of push P^3, wire *r*, bell B^3, wire *t*, shaft wire Z, and zinc of the battery. The same action takes place if any of the other pushes are pressed, only with different movements of the indicator H; and different keys must, of course, be used for replying. When the lift cab is down at the bottom of the shaft, the spring *k* placed at the top of the cab makes contact with the brass plate W fixed in the shaft, and puts the bell J (which bell is fixed in the porter's lodge or any other place where the attendant is likely to be when not in the lift) in parallel with the bell B in the cab, so that if a signal is now sent from any of the landings both bells will ring, the circuit being as follows: Pole C of battery D, shaft wire *c*—here it has two paths to the wire *g*, one by wire X, bell J, wire Y, contact W, spring *k*, and wire R, and the other by spring *c*, wire *m*, bell B, there being a common return from both bells by wire *g*, rod *g*. shutter S, movement 3, wire *f*, spring Z, and zinc of the battery.

Fig. 74 is a side elevation showing the contact spring *s* fitted on to the cab *c* by means of the block *b*, and pressing against the shaft-wire *w*. The springs should be set well in towards the wires at the bottom, and must not be too long; otherwise a disagreeable chattering noise will be made as the lift moves up and down. Brass springs are much to be preferred to any description of rollers, as the [illegible] round and round and have no tendency [illegible] the wires bright; thus the contact, [illegible] time, becomes very indifferent. The wires scarcely wear at all, as most of the wear [illegible] on the springs, which can easily be renewed at a trifling cost. The *practice of hanging weights on the ends of the shaft wires, instead of fastening them off* with the metal pegs, is not advocated, as it has a great tendency to cause the wires to break.

The battery should never be placed at the bottom of the lift shaft, as no matter what construction the lift, there is almost always some leakage, which keeps the place constantly wet. The best position, perhaps, is at the top of the lift shaft, where a beam can generally be found on which to stand it; but if this is not obtainable, it may be placed in some room the wall of which adjoins the shaft, and a hole knocked through for the wires.

Fig. 76 shows a lift shaft and cab fitted with a bell and indicator, connection being made to the cab by means of a flexible cable. The connections of the pushes, bells, &c., for a lift worked on this system are the same as for the one just described, so the lift shaft shown in Fig. 76 can be substituted for the one in Fig. 77. When wiring for a lift on this system, all the wires from the various landings must be run to a point (*a*) about half-way up the lift shaft, and joined to one end of the cable. This cable must be composed of a number of small insulated wires, so as to be very flexible; and it is preferable to have each wire composed of a number of strands, as by this means the greatest flexibility is obtained. One end of the cable is suspended at the point *a*, and the other fixed to the top of the cab; being usually supported out a little way by means of a wooden arm. It will be seen, on comparison, that more insulated wire is used in this system, while there is the additional expense of a special cable, the lasting qualities of which are very doubtful.

F. C. A.

(*To be concluded.*)

DR. VOGEL'S ISOCHROMATIC PLATES.

THE specification of Dr. Vogel's patent for isochromatic plates having been recently published, it may interest our readers, in connection with Mr. Ives's researches, to compare. Dr. Vogel's invention is an "improved process for manufacturing isochromatic emulsion plates highly sensitive to light," and includes both the emulsion and the plates. So long ago as 1873 he made the discovery that chloride and bromide of silver, which are sensitive only to violet, indigo, and the blue light of the spectrum, can be made sensitive to green, yellow, and red rays by mixing the above mentioned salts with bodies which absorb the latter rays. If, for instance, chloride or bromide of silver is mixed with aniline red, which absorbs yellow rays, the chloride or bromide will become sensitive to yellow rays; or if the chloride or bromide of silver is mixed with aniline green, which absorbs red rays, the same will be made sensitive to red rays. He denominated these bodies which sensitise silver salt in the aforesaid manner, optical sensitisers. and I and others after him have discovered a large number of such optical sensitisers amongst the dyes, and in this manner the so-called isochromatic gelatine plates, coloured with an optical sensitiser such as cyanine, chinoline red, eosine, erythrosine, are now articles of commerce. All these isochromatic gelatine plates are generally less sensitive than ordinary plates, and require a yellow glass plate interposed between the lens and the sensitive plate for diminishing the power of the blue light. By this interposition of a yellow plate the time of exposure was lengthened, and if the surface of the plate was not quite even, the sharpness of the photograph was lost, so that these isochromatic plates are used on a small scale only for the reproduction of pictures or paintings, but not for portrait or landscape photography.

Dr. Vogel has now succeeded in making isochromatic gelatine plates, the sensitiveness of which is twice as great as that of the ordinary gelatine plates, and which do not require any yellow plate or screen. This discovery is based 1. On the application of the eosides of silver, that is, the chemical combinations of eosine dyes with silver. These eosine dyes or derivatives of fluoresceine are all acids, and combine with silver salts. 2. On the addition of silver salts to other optical sensitisers, for increasing their sensitising power. As early as 1884 he observed this favourable influence of the presence of silver salts, and proved, for instance, that eoside of silver will give ten times more sensitiveness for yellow light than ordinary eosine; but he had only now succeeded in making plates without fog or film and spots, so that he could introduce the process into practice, and he had proved that it is possible to produce in this manner landscapes and portraits far superior to those taken with ordinary plates.

Dr. Vogel has invented the following methods for making highly sensitive isochromatic plates or sensitising solutions, so that any photographer or amateur can prepare his own isochromatic plates. 1. Ordinary gelatine plates are bathed in a solution of a soluble salt of silver (1 : 1,000), then in a solution of an eosine dye, or a mixture of eosine dyes, or a mixture of an eosine dye with other optical sensitisers, with or without liquor of ammonia. The solution of the dye can also be used first, and the silver solution afterwards, or an emulsion can be mixed with a soluble salt of silver and the dye added to the mixture, or vice versâ, and with or without ammonia. 2. A silver eoside is formed by mixing a solution of an eosine dye, or a mixture of different eosine dyes (for instance, ordinary eosine, blue tinted eosine, chrysoline, aureosine, phloxine, Bengal rose, or any other derivative of fluorescine), with a soluble salt of silver, such as sulphate, nitrate, acetate, or fluoride of silver. This eoside of silver can be collected as a precipitate, washed and mixed with the emulsion, or dissolved in diluted ammonia, or diluted acetic acid, and employed as a bath for soaking dry plates; but he prefers to add liquid ammonia, carbonate of ammonia, or acetic acid, during the process of precipitation, so that the suspended precipitate is dissolved, and to employ the same as sensitising agent for fluid emulsions, or the said solution can be diluted with water and used as a bath for dry plates. The quantity of this solution of eoside of silver to be employed varies according to the quality and kind of emulsion treated with the same, although the following formula will serve as a general guide for those employing my sensitising solution:—50cc. of a solution of an eosine dye, 1 part dye to 1,000 parts water or diluted alcohol; 1cc. of a solution of nitrate of silver, 1 part nitrate of silver to 20 parts of water; 1 to 2cc. of liquor of ammonia. The solution is either mixed with the emulsion, that is, 5 to 10 per cent. is added to the emulsion, or the same is diluted with 200 to 500 cubic centimètres water, and the gelatine plates immersed or soaked in the same for about one minute, and then dried. 3. Dr. Vogel also uses other dyes, known as optical sensitisers, which do not chemically combine with silver, but the sensitiveness of which is much improved by the presence of a soluble salt of silver, such for instance, as cyanine, chinoline red, coruleine, &c., and mix them with any soluble salt of silver. He employs, for instance, 50 cubic centimetres chinoline red, or a mixture of chinoline red and cyanine (solution 1 : 1,000); 1, 5 to 3 cubic centimètres nitrate of silver (solution 1 : 20); 15 centimètres ammonia liquor. The solution is employed in the same manner as the eoside of silver solution described under 2. The solutions described under 2 and 3 are employed in varying proportion for improving the sensitiveness for any part of the chromatic spectrum. 4. In like manner, as mentioned under 1, 2, 3, the salts of lead which produce, when mixed with an eosine dye, eoside of lead, can be employed alone or mixed with eoside of silver; and also the insoluble salts of silver, such as the chlorides, tartrates, citrates, &c., dissolved in ammonia or acid.

IMPROVEMENTS IN DYNAMOS.

A MECHANICAL improvement of some importance in the winding of dynamos has been patented by H. W. Ravenshaw, of Halifax, W. T. Goolden, and A. P. Trotter, of Westminster — names which are sufficient guarantee that the invention is worth patenting. It has for its object the provision of means whereby the whole of the surface, or area, of the periphery of a drum armature may be utilised for the purpose of winding, while at the same time allowing of the coils being properly secured in place. In armatures of the drum type as heretofore constructed, the wires have either been laid in grooves or channels, formed along the periphery of the armature, or they have been retained in place by the aid of wooden or other suitable chock pieces, or other similar devices driven in, or otherwise secured at, intervals along the periphery of the armature. All these devices, however, tend to lessen the peripheral area of the armature available for winding. In winding an armature according to this invention, the whole, or any desired part, of the armature's periphery is covered by the winding, and the respective wires are retained in place by passing them between suitably formed projecting pieces, cast or otherwise formed upon, or attached to, the end pieces of the armature. These projecting pieces are so shaped and spaced apart radially and relatively to each other and to the axis of the armature as to insure their coinciding with the openings left by the intersections of the various coils. The pieces project a sufficient distance to prevent the coils slipping endwise over them, and if necessary, grooves, in which the wires would lie, may be cut in them. Fig. 1 shows a sectional elevation of part of the commutator end of a drum armature, Fig. 2 being a plan of the opposite, or pulley, end of the same armature, and Fig. 3 views, on an enlarged scale, of the projecting piece or pin, that the mounting and core of the armature are of the ordinary construction, A being the shaft, B one of the "spiders" or mountings, and C the core formed of the iron discs *d*, *d*. At each end of the armature, and outside the iron discs, is placed a disc of vulcanised fibre, or other suitable material D, pierced to receive the heads *a a* of the fibre pins or projecting pieces *b*, *b*, formed with a flattened shank as shown at *c*, *c* (Figs. 2 and 3). Outside each of the fibre discs is placed an outer ring E of cast iron or other suitable material, formed either in one piece or in sections and secured to the armature in any suitable manner. This ring is pierced, as shown by Fig. 2, with holes through which the shanks *c* of the fibre-pins project, and it may be made either solid in section so that its inner face comes flush with and bears upon the heads *a a* of the pins, or it may be formed hollow as shown, the space between it and the fibre disc being filled in with any suitable substance capable of retaining the pins in place. As shown (Fig. 1) the wires *e*, *e*, after traversing the periphery of the armature, in any desired manner of winding, have their ends *f f* brought past the pins 1, 2, to the commutator, where they are secured to their respective sections by any of the usual methods. At Fig. 2 a typical method of passing the wires round the pulley end of an armature is shown, the pins or projections *c*, *c*, serving, in this case, to retain two adjacent wires in place. It will be understood that in place of using one set of pins or projections only, as shown, two or more sets may be used, and that they may either be disposed in concentric rings on the same radii, or in concentric rings on alternate radii, or in such other order as the particular method of winding may necessitate.

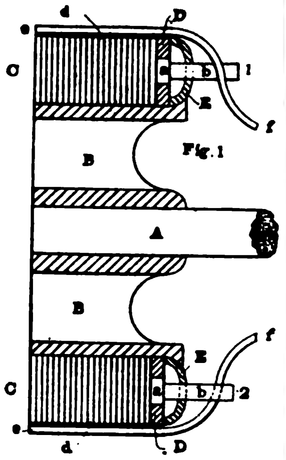
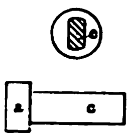


Fig. 1

Fig. 3.



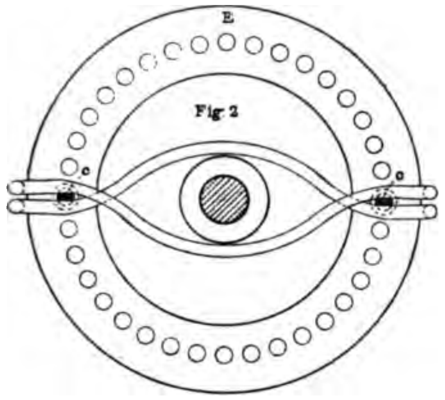
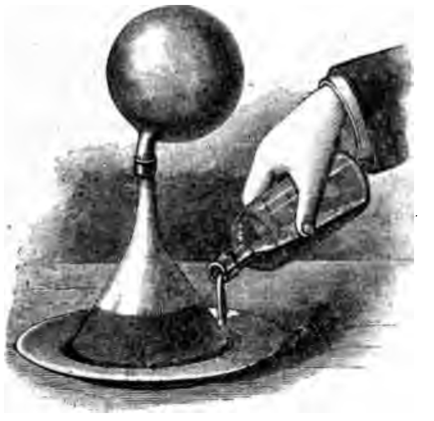


Fig 2

EXPERIMENT IN CAPILLARY ATTRACTION.*

FEW subjects are so fertile in simple experiments, requiring little or no special apparatus, as capillary attraction. Faraday, who was unrivaled as a popular lecturer, continually employed the simplest possible methods of illustrating the action of this subtle force. One of the most striking he performed thus: A pile of salt was placed upon a plate. The lecturer then poured into the plate a saturated solution of salt in water. The solution was coloured to make it easily visible. As it was poured about the base of the salt, it was drawn up through the pores existing between the grains. By the operation of capillary force the coloured solution gradually rose upward, colouring the salt as it ascended.

The clue to the success of this experiment is in the use of the salt solution instead of plain water. Were the latter used, it would rapidly disintegrate the pile of salt by dissolving it. With the saturated solution the solid salt is quite unaffected. In the illustration is shown a modification or development of this experiment. The apparatus required is a little more extensive, as, in addition to the plate, a glass funnel and an indiarubber balloon are needed.



The balloon should be inflated to its largest size, and kept so for some time, so as to stretch the rubber well. This is to enable it to fill at low pressure. The glass funnel should be as large as possible, as the demonstration is more satisfactory when executed on a large scale.

The funnel is filled with perfectly dry salt, well pulverised, which is pressed in as hard as possible. The funnel is completely filled with it when supported mouth upward. The filling may be carried a little above the rim. The plate is then placed over its mouth so as to bear against the salt, and the whole is inverted. The object is to so conduct the operation that the salt shall not settle down or change its position, but shall remain in close contact with the walls of the funnel. All these precautions are quite essential to success.

The mouth of the balloon, whence the air has been expelled, is now sprung over the open end of the funnel as shown in the cut. It is not necessary to tie it on. The balloon must, of course, be perfectly empty.

The plate, funnel, and balloon are now ready for the experiment. A saturated solution of salt should have been prepared. This is made by shaking in a bottle an excess of salt with water. As salt is more soluble in cold than in hot water, this operation must be done at ordinary temperatures. As colouring matter, a little ferric salt with sulphocyanide of ammonium may be added, or any ink that is soluble in water may be used.

The solution is now poured into the plate so as to rise above the edge of the funnel and keep it immersed. It at once rises through the salt, colouring it as it ascends. As fast as it rises, it, of course, leaves the plate. Hence the experimenter must make repeated additions of solution. As the fluid rises, it drives out the air before it. This would escape from the mouth of the funnel. But the balloon which has been placed there intercepts its escape. The air enters and rapidly inflates it. The pressure thus produced is slight. It cannot do more than just fill the balloon. It cannot distend it. But by having the balloon well stretched, its inflation can be made quite conspicuous. If, by settling, the salt has left any space between itself and the walls of the funnel, the possible pressure, slight at the best, will be greatly diminished. If the balloon exerts the least back pressure, air will bubble out of the weak spots around the rim of the funnel. By substituting a cone of porous clay for salt, a more permanent apparatus could be readily constructed.

FOUNDRY CUPOLAS.*

IN Fig. 1 is seen a sectional view of Greiner and Erpf's cupola. A is the bottom, and B the bottom line of the charging door. There is an air chamber C around the cupola for the lower tuyeres; above this there is a supplementary air chamber or pipe D connecting with the lower air chamber at E. There are valves F in these pipe connections to shut off the blast from the upper series of tuyeres, which are placed spirally around the cupola from G to H and I; each upper tuyere has a separate branch pipe J J. It will be noticed that the upper series of tuyeres are placed higher than any other cupola now in use.

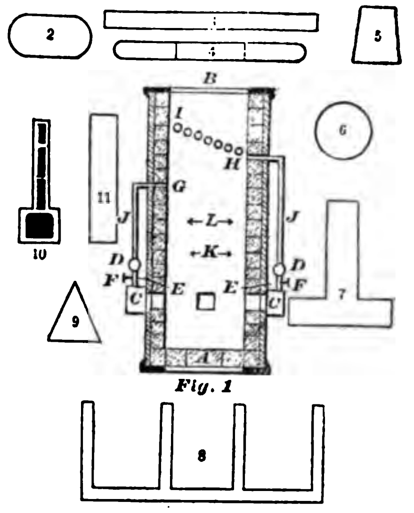


Fig. 1

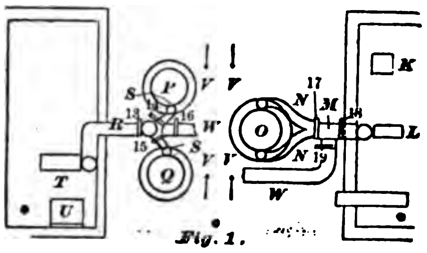


Fig. 1.

This cupola has, previous to this, been described, in substance, as follows: "Carbonic oxide in ordinary cupolas is formed about the line K, while in cupolas of two rows of tuyeres it takes place at L. Messrs. Greiner and Erpf, in their endeavours to solve the problem of the utilisation of the inevitable carbonic oxide, after careful study of the phenomena attending combustion in cupolas, perceived that to effect the required results the combustion of the carbonic oxide must be commenced at a point so far above the fusion zone that the descending coke has not attained the temperature necessary for ignition, while the ascending combustible gas is still hot enough to ignite on contact with air. Furthermore, the burning of the gas must not take place in one horizontal plane, but must be distributed through some depth of the charge; otherwise the concentration of the heat would cause ignition of the coke and consequ loss, by introducing the supplementary blast where the fuel has not quite attained the temperature necessary for ignition; the carbonic oxide is thus burnt to carbonic acid and the descending coke and metal receive the full benefit of the combustion temperature.

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* By T. O'CONNOR SLOANE, PH.D., in the *Scientific American*.

* By ROBERT E. MASTERS, in *American Machinist*

"Cupolas with two rows of tuyeres are undoubtedly much more economical than some of the older types, but experience has proved this to be due to improvements in shape and proportion of parts, rather than to the utilisation of carbonic oxide. Proof of the general non-efficiency of the double set of tuyeres is afforded by the fact that many cupolas originally constructed with two sets have their performance improved by the removal of the upper row."

This may seem a startling announcement to some, but it is my experience exactly. There are a number of points concerning the construction and operation of cupolas that are considered very modern by many, but which, if traced up, will be found to be rather ancient. I tested the double row of tuyeres when they were all the rage, but failed to discover the wonderful results claimed for them, and the experiments were not confined to one cupola one.

In heats of from 25,000 to 50,000lb. of iron, cupolas have been tried under the same conditions of blast pressure, fuel, &c., one heat with the upper tuyeres open, the next with them closed, or a trial of a week given to each plan without discovering the difference in the melting in favour of the upper row, but with the upper row of tuyeres open the brick between the two rows, and just above the upper row, burned and cut out a great deal faster than we thought was profitable, so the upper row was shut up entirely; yet the cupola gave better satisfaction than the old types. If there is any advantage in point of fuel with both rows in operation it is counterbalanced by cost of firebrick and labour of lining. There are, as stated above, a number of cupolas with double rows of tuyeres in operation to-day with the upper row entirely stopped up. I have in mind an account published by a foundry foreman of the grand results he obtained from this kind of cupola, when to my personal knowledge the upper tuyeres in that cupola have been kept closed nearly ever since it was erected.

From Nos. 2 to 11 are shown about all the shapes and styles of tuyeres that are in use. Fig. 10 is the Lawrence reducing tuyere; Fig. 9 is a tuyere introduced by Edward Kirk, of chemical compound flux fame: Fig. 8 is not very much used, and no doubt will be thought an unusual shape; but, in fact, there is not so much in the shape of tuyeres after all; the chief points are to get them properly placed, and in proportion and number to the size of the cupola.

A very prominent foundryman in St. Louis, who has melted in the neighbourhood of 200 tons of iron a day, called my attention to a cupola in which he was melting over 100 tons of iron daily. The tuyeres were 2½in. wide and 20in. long, on the plan of No. 11. When they wanted a deep bottom they bricked up 8in. of the lower part of the tuyere; when they did not require a deep bottom the bricks were taken out of the lower part and placed in the upper part of the tuyeres, so in any event, whether high or low, the tuyeres were 2½in. × 12in. This gentleman said in the various cupolas he had used, as far as melting was concerned, he found no real advantage from any particular shape of tuyere, if they were properly arranged and operated, and the most satisfactory results he had obtained, as far as economy goes, on all points, was in melting 7 to 8lb. of iron to one of fuel, even in large heats.

There is a new cupola now offered to the trade, called "The Water-Jacketed Cupola." It is claimed to be especially adapted for both iron and brass founders, and for the treatment of phosphor bronze, and by the addition of a small per cent. of aluminum, steel castings can be produced. In operating this cupola the expenses for repairs are considered a very small factor. It differs from the foundry cupolas now in use, from the fact that the bottom once made will answer for months without having to "drop it."

Often what would be a good heat receives a serious check, and is occasionally lost from a break in the belts, or fan, or engine, which brings things to a dead stand. This occurs now and then, even if all the appliances are carefully inspected (as they should be) before each heat every day, and the break always happens at the most unfortunate time.

Another bad feature to be found in some foundries is, the sheet-iron blast pipe is buried in the ground between the fan and cupolas. Right in the middle of a busy season something happens to the pipe, and even if the exact place can be located it stops the foundry two or three days to dig out and repair the pipe, if there is any left to repair. I remember one case where the pipe had rusted entirely away, and without knowing it we were conveying the wind through a hole or tunnel in the ground, but finally learned the condition of things when the *blast cut through, and* we had to shut down for several days to make and put in new pipe. There are only a few instances where there is any other excuse for burying blast pipes besides incompetent engineering. Even under the best conditions they are not as safe or handy as when placed overhead, where an application of paint now and then will keep them from rusting, and they are out of the way, and not getting banged all out of shape when dropping the bottom or getting the cinder out from under the cupola.

Fig. 12 shows an arrangement of blast pipes connecting the cupolas in the Marshall (Texas) Car Wheel and Foundry Co.'s works that can be advantageously employed in many foundries using two or more cupolas run by separate engines. K is a 30H.P. engine; L, No. 9 Sturtevant fan; M, 20in. main blast pipe; N N, 12in. branch pipes; O, 48in. Colliau cupola; P is a 38in. cupola having six tuyeres 2¾in. × 8in., shaped like No. 11. This cupola is 15in. from bottom plate to bottom of tuyeres, and 11ft. 4in. from bottom plate to bottom of charging door. Cupola Q is 38in. diameter, and has the same number and same style of tuyeres as cupola P, 2½in. × 12in. The bottom of these tuyeres is 18in. from the bottom plate, and the cupola is 10ft. 11in. to charging door. R is a 16in. main blast pipe, and the branch pipes S S are 8ft. × 18in. where they enter the air chamber. T is a No. 7 Sturtevant fan, and U a 12in. × 24in. upright engine.

PROTECTION OF THE HUMAN BODY FROM DANGEROUS CURRENTS.*

I ALLUDE to what are considered dangerous currents and their effect on the human body. That there is danger in handling conductors conveying high tension currents must be generally admitted. The question, therefore, is, Can fatal results from such currents be wholly or partially averted? All will agree that, with proper care on the part of the companies, and intelligent co-operation on the part of employés, but little would be heard of the danger of electric currents. But companies are economical, and employés are careless. Familiarity with danger breeds contempt for it. This is exemplified almost daily in every department of industry. A new man in a powder mill will exercise the greatest care, and observe all the rules of the establishment faithfully. In a few months the same man will smoke a pipe over an open powder keg.

Protection is necessary principally for those who through carelessness or ignorance fail to protect themselves. It has been claimed that there can be no such thing as an accident—that Nature has none, and that all so-called accidents are simply the results of miscalculation, bad judgment, or carelessness. But it must be remembered that the vigilance of the most alert will sometimes relax, and this to them is the moment of danger.

Realising that something should be done to protect dynamo men and wire handlers from injury from powerful currents, I a few years since invented a device for shunting the vital parts of the body. Partly on account of a pressure of business in other branches of electricity, but principally owing to a hesitancy in bringing out a device about the efficacy of which there seemed to be no doubt, its introduction to scientific criticism was delayed until a few weeks ago. As the references made to the question in the electrical papers have failed to elicit an expression of opinion satisfactory to any degree, it has been deemed advisable to bring the subject before this meeting.

The question to be determined is, to what extent a wire of practically no resistance, extending from one wrist to the other, and bound around the wrists in numerous convolutions so as to make good, but not uncomfortable, contact, will protect the vital parts of the body from fatal injury when it is placed in the path of a dangerous current through contact at the hands. It is claimed by some that the current having once entered the muscles, veins, and tissue at the hands, will not leave the arms at the wrists and follow the shorter path of the wire, but will confine its course to the arms and body alone. The other opinion is that the greater portion of the current received at the hands will leave the arms at the wrists and follow the wire. The problem seems a difficult one to solve. So much depends on the condition of the person at the time of receiving a shock, a large number of tests would be necessary to arrive at results which would afford a safe basis for calculation. A few years ago Dr. Stone, connected with one of the London hospitals, made a series of interesting experiments upon patients afflicted with various ailments, with a view of determining whether or not fluctuation in their physical condition affected the electrical conductivity or resistance of their bodies. The results proved, according to my recollection, that great changes took place in the electrical resistance of the patients experimented upon from day to day, and that there was a direct influence manifested by the rise and fall of different diseases upon the electrical conductivity of the body as a whole or in part. An account of Dr. Stone's experiments was published in *Nature* at the time. But while the experiments are most valuable for the purpose for which they were intended, they throw but little light on the subject of dangerous currents and protection from fatal injury.

Last September there was published in the *Electrical Review* of London a paper on "Shocks from Alternating Currents," by Mr. G. L. Addenbrooke, who for some time previous had charge of the Grosvenor Gallery installation, where a primary current of 2,500 volts was constantly employed. While no one had ever come in contact with both mains at once, the writer stated that even if such an accident had happened he was "by no means prepared to assert that the result would undoubtedly be fatal." "Indeed," says he, "I rather incline to the opinion that if the subject of the shock were healthy, and the circumstances under which he received it were favourable, the chances are he would survive."

I cannot make out what Mr. Addenbrooke means by receiving 2,500 volts under favourable circumstances. It seems to me, if they are received at all, the circumstance could not be other than unfavourable. Mr. Addenbrooke himself received a severe shock, and as he speaks from experience I quote his account of how it affected him: "The primary effect of the passage of the current through the body is, of course, to contract the muscles. The amount and persistence of this contraction depend on the quantity of the current flowing, or, as it is usually designated, the *intensity* of the shock, and varies from a simple twitching of the limbs to complete and intense contraction or rigour of apparently every muscle in the body. In this latter case the current completely supersedes the action of the mind over everything capable of contraction or movement. Consciousness, however, is apparently rarely, if ever, lost, though the subject may be entirely unable to make any motion, cry out, or do anything to help himself. If aid is not near, such a state may be maintained for some time. On release from such a position by extraneous or natural causes, the subject is usually dazed, but if at all unconscious, soon recovers completely, and experiences no further functional disturbance than the debility and nervousness naturally following such a severe strain on the system." While admitting that fatal shocks are possible, this gentleman gives it as his opinion that "if the shock is not sufficient to cause instantaneous collapse, apparently the body can bear the strain of the continued passage of the current for some time," and that death is caused by paralysis of the involuntary muscles controlling the heart and lungs, and that the preliminary stages of total collapse are analagous to what occurs when drowning." Referring to the local action of the current on the body where it enters and leaves, this writer also says: "If the contact is good—that is, if it consists of a good area, say of over a couple of square inches of a fairly moist skin pressed with moderate firmness against a metallic body or other good conductor, no visible injury may result. For instance, a man will often get burnt about the hands, but his feet, by which the current leaves, will be unaffected, or only slightly reddened or inflamed. Burning of the hands or other parts of the body will occur when there is imperfect contact of the body with the conductor, coming in contact with a bad or semi-conductor, such as a dirty or carbonised surface. The burning is caused by the absolute setting up of an arc."

It seems to me this gentleman's views, based, as we are led to believe, on actual experience, are somewhat paradoxical. And surely numerous cases of deaths from currents recently disprove many of Mr. Addenbrooke's deductions. True, nothing short of death is made public, so that there is but little information to go upon relating to the instances which must be of frequent occurrence where men are *almost* killed by electric shocks. In all cases that have come to light, whether simply injurious or cases of death, the parts of the body coming in contact with the current have been badly burned. The unfortunate "Trouble Hunter," who lost his life a few days since, was not only burned at the hands but at the knees. In cases where the shock is not instantly fatal, may it not be that the burning of the flesh at the points of contact is so great as to destroy to a considerable extent the conducting substance in contact with the wire, and thereby cause a fall in the current passing through the body? It is certainly owing to the fact of the body being a very poor conductor that harm is done. If it offered no resistance, there wo
no realisation that a current was passing t
it. An arc would be created at the point
tact, provided the contact was *imperfect*
body itself would be uninjured. It s
that the human body must be viewed a
semi-conductor, with the exception,
susceptibility to greater change und
tinued action of a current, owing t

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* By PATRICK B. DELANY. A paper read before the American Institute of Electrical Engineers.

which it contains. It is owing to its resistance that a carbon filament becomes incandescent. The carbon rod of an electric lamp is not consumed except at the point where the arc is formed by the resistance of attenuated particles under combustion. Any conducting substance placed in the path of more current than it is capable of conveying must be heated, consumed, or decomposed, according to its nature and in proportion to the discrepancy between the conducting capacity of the conductor and the sum of the current.

Now, if we liken the human body from hand to hand to a canvas hose or tube filled with water, and which allows a certain quantity of moisture to ooze through the surface, corresponding to the moisture of the skin, and if this be inserted in a circuit, connection being made at the extreme ends, corresponding to the hands, and a shunt wire of minimum resistance be wound around the tube 2 or 3in. from the ends, corresponding, say, to the wrists, we can, perhaps, more understandingly speculate on the action of a dangerous current on the human body, contact being made at the hands and the shunt wire encircling the wrists. It should be borne in mind that the contact between the shunt wire and wrists is much better than the contact at the hands, since the wrists are more tender than the hands. Now, referring to the tube and assuming that the contacts at the ends have improved by reason of the currents eating its way into the water, does it not follow that the current, instead of following the entire length of the tube of water, offering, say, thirty times the resistance of the 2 or 3in. of water from the end of the tube to the shunt wire, and several thousand times the resistance of the shunt wire itself, will, to a great extent, pass from the tube to the shunt wire, and in its passage *improve* the contact at that point as it did at the ends in entering the tube? I have often noticed that upon receiving a shock of 150 to 250 volts profuse perspiration instantly followed. This would greatly improve the contact at the wrists above the normal, so that it would seem impossible that the current should confine itself to the fluids and muscles of the body in preference to the wire when separated from the wire only by a thin tender skin filled with moisture.

In considering the danger point of currents it seems reasonable to recognise the same law, or rather recognise the absence of any law, governing other destructive agencies. Let it be concussion, strain, asphyxia, poison, or other enemy of endurance, there are hardly two cases alike. One man may emerge with but slight injury from a cause which to another man would be death. Why should it not be so in the matter of electric shock? Death, of course, must be the consequence of a certain degree of cause. If 2,000 volts are necessary to kill in any instance, one volt less would avert death, while shunting 100 or 500 volts would leave a proportionate margin of safety. Fatal results through the medium of electricity do not come by jumps any more than by any other force or element of destruction. There is in this subtle agency, as in all others, a last straw which breaks the camel's back—a last volt which does the final harm. Hence the importance of protecting, as far as possible, those exposed to this danger.

Regarding the immediate cause of death or the effect of currents on the substances of the body, we must look to the medical men for light. Probably all subjected to shock might not be similarly affected. In one case it might be the heart, in another the brain, and in others the lungs that might be injured. Why not have a thorough investigation of this subject, and then, perhaps, wire handlers may be subjected to an examination before they are allowed to engage in such work, just as men are examined for various other duties.

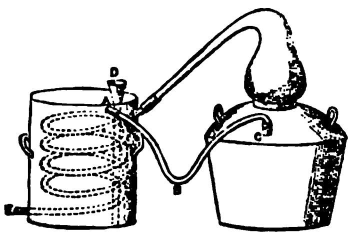
There seems to be so little known about these matters, I shall feel gratified if this paper serves as even a feeble incitement to discussion and investigation, as I can conceive of no subject offering a more humane incentive.

AN AUTOMATIC STILL.

THE arrangement here described is one that may readily be adapted to, and is specially suited for, the old-fashioned stills which are in frequent use among pharmacists for the purpose of distilling water. The idea is extremely simple, but I can testify to its thorough efficiency in actual practice. The still is of tinned copper, two gallons capacity, and the condenser is the usual worm surrounded with cold water.

The overflow of warm water from the condenser is not run into the waste pipe as in the ordinary course, but carried by means of a bent tube, A, B, C, to the supply pipe of the still. The bend at B acts as a trap, which prevents the escape of steam.

The advantages of this arrangement are obvious. It is perfectly simple, and can be adapted at no expense. It permits of a continuous supply of hot water to the still, so that the contents of the boiler may always be kept boiling rapidly, and, as a consequence, it condenses the maximum amount of water with the minimum of loss of heat. If the supply of water at D be carefully regulated, it will be found that a continuous current will be passing into the still at a temperature of about 180° F., or, if practice suggests the desirability of running in the water at intervals, this can be easily arranged. It is necessary that the level at A should be two inches or thereabout higher than the level of the bend at C, otherwise there may not be sufficient head to force a free current of water against the pressure of steam. It will also be found that the still should only contain water to the extent of about one-fourth of its capacity when distillation is commenced, as the water in the condenser becomes heated much more rapidly than the same volume is vaporised. By this expedient a still of two gallons capacity will yield about half a dozen gallons per day, a much greater quantity than could ever be obtained under the old system, which required the still to be recharged with cold water every time one and a half gallons had been taken off.



The objection to all such continuous or automatic arrangements is, of course, that the condensed water contains all the free ammonia that may have existed in the water originally, but it is only in cases where the water is exceptionally impure that this disadvantage will become really serious. The method here outlined has, no doubt, occurred to many, and may probably be in regular use, but not having seen any previous mention of the idea, I have thought that it might be useful to some pharmacists who prepare their own distilled water. —By T. MABEN, in the *Pharmaceutical Journal.*

USEFUL AND SCIENTIFIC NOTES.

The Zinc-Creasote Process of Preserving Railway Timber.—In a paper read before the Western Society of Engineers, Chicago, Mr. J. P. Card, after having summarily notice the processes of wood-preserving by kyanising, Boucherising, Burnettising, and creasoting, gives an account of what is called the zinc-creasote process. On this system, dead-oil and chloride of zinc are used in combination, for the preservation of railway sleepers and timber, as well as for protection against the attacks of the teredo in sea-water. For railway sleepers, bridge timbers, and the like, where the wood is not exposed to any considerable degree of moisture, after the timber is prepared in the usual way by steaming and vacuum, the dead-oil is run into the cylinder, and so much as may be desired is forced into the wood. For this purpose, Mr. Card recommends the proportion of half a gallon of oil per cubic foot of timber; though a smaller proportion may be found to answer. After the timber is treated with oil, the oil is withdrawn from the cylinder, which is then charged with chloride of zinc, which by pressure can be forced into the wood through and beyond the oil, impregating by diffusion that portion of the wood which is not penetrated by the oil, specially useful in the case of ill-seasoned or dense timber. By such combined operations, the wood, when it is in contact with the ground or other moist surface, receives the benefit of the dead-oil treatment, with an expenditure of one-half or even less than half the usual proportion of oil; whilst those portions unreached by the oil are impregnated with the zinc chloride. The chloride, surrounded by the oil, is protected for a lengthened period against moisture. By this process, the half measure of oil can be as widely diffused through the substance of the wood, as the whole measure by the ordinary creasoting treatment. Mr. Card concludes, from his observations and experiments, that the zinc creasote injection will give the best results for the money invested.

Poison of the Somalis, Extracted from the Wood of the Ouabaio.—The principle in question, ouabaine, forms rectangular plates, very slender, of a nacreous appearance. It is absolutely white, inodorous, and not appreciably bitter. It contains no nitrogen, and does not react with colouring matters. At a boiling heat, in presence of dilute acids, it is split up, yielding a reductive sugar. Its composition is $C_{30}H_{45}O_{12}$. It is poisonous if introduced into the circulation, but not if swallowed.—*M. Arnaud, in Comptes Rendus.*

SCIENTIFIC NEWS.

THE late Mr. Henry William Field, who died the other day at Brighton in his 86th year, was the last to hold the title of Queen's Assay Master, an office abolished in 1871. Mr. Field is said to have been a descendant of Oliver Cromwell; but he was best known in connection with his researches on photography in colours. He was appointed to a post in the Mint whilst still a youth, and in 1851 succeeded Mr. Henry Bingley as Queen's Assay Master, retiring in 1871. Sir John Herschel became Master of the Mint in 1850. Previously to that date the gold and silver coins of the country were manufactured and checked under the authority of and by comparison with trial or fiducial pieces or plates; but this practice had been found unsatisfactory, inasmuch as when the gold coins of this country were melted, the out-turn did not realise what was always looked upon as the standard of the country—namely, 11-12ths. Sir John Herschel authorised Mr. Field to bring the coin of the realm up to mathematical precision if possible. Mr. Field's first object was to make some chemically pure gold; this he did, and compared the result obtained with specimens from the assayers of India, America, and France, and with the most skilful assayers of our own country. He found, after carefully-conducted experiments, that the gold obtained in his laboratory at the Mint was unsurpassed in purity, and equalled only by a few of the specimens obtained from other assayers. From that time all meltings have been checked by comparison with the 2lb. bar (obtained as above stated), by which also other bars are to be made and severely tested.

Dr. T. Harrington Tuke, who died the other day, was an eminent authority on insanity and general diseases of the brain. Born in 1826, he took his M.D. degree at St. Andrew's in 1849, and afterwards became a Fellow of the Royal Colleges of Physicians of London and Edinburgh. He was hon. secretary of the Medical Psychological Association from 1864 to 1872, and was subsequently elected president; he was also a Fellow of the Royal Medical and Chirurgical Society, and an hon. member of the Medical and Psychological Society of Paris and the Imperial College of Physicians of Vienna. Dr. Tuke wrote an important series of papers on "General Paralysis of the Insane," and a second series on "Criminal Responsibility of the Insane."

Minor planet No. 272 has been named Antonia by its discoverer, M. Charlois, of Nice, who picked it up on Feb. 4th last.

According to an ephemeris of Encke's comet, prepared by MM. Backlund and Seraphimoff, of Pulkowa, the perihelion passage will be on the 28th instant, and the comet is not likely to be visible until after that time, and possibly not at all in these latitudes, as it is moving rapidly south. In the southern hemisphere the comet will be best seen in the month of August.

The Laboratory of the Marine Biological Association at Plymouth is approaching completion, the opening ceremony being fixed for the 30th inst. The salt-water reservoirs have been filled, and the water is circulating freely in the tanks. The fittings of the main laboratory are complete on the north side, and will give accommodation for seven naturalists, besides the Resident Director. In addition to this there are the physiological and chemical laboratories, all the fittings of which are in place. At the opening ceremony upwards of a hundred members and their friends are expected to be present. Prof. W. H. Flower will be the presiding zoologist, and with him will be many well-known men of science, including Profs. Ray Lankester, Milnes Marshall, McIntosh, C. Stewart, Dr. Günther, Mr. Adam Sedgwick, and many others. The hydrographer has stated his intention to be present, and the naval and military element will be fully represented by the commanding officers of both services at Plymouth. The Fishmongers' Company, which has been so munificent a patron of the Association, will be fully represented by its Prime Warden, Sir James Clarke Lawrence, and several members of the Court.

A plague of caterpillars seems to have invaded the country, for from all sides we hea that many trees—oaks especially—have been stripped of their foliage. They appear to be the larvæ of the *Yponomeuta Adela*, or Little Ermine moth.

At the ladies' conversazione of the Royal Society, which was attended by a large number of Fellows and guests, several of the displays made at the May soirée were repeated, and an ingot of gold from Mr. Morgan's mine in Wales, weighing over 2,000 ounces, was exhibited. Sir F. Bramwell showed his colour blender, and Mr. W. Caldwell illustrated his method of making microscopic sections.

The Trevithick Memorial, which at one time was expected to take the form of a scholarship for engineer students, was "inaugurated" the other day at Westminster Abbey, when the Dean stated that the consent of the Chapter had been given in deference to the services rendered by the great engineer, whom he characterised as one of the most fertile and practical of inventors. A memorial window is something, but it is scarcely what Trevithick himself would have liked. He has a definite claim as the inventor of the locomotive, and certainly was the first to use high-pressed steam, which nowadays is being used in a manner which would have almost frightened Watt. Every engineer knows now that high-pressure means economy, and yet Trevithick, at the beginning of the century, was considered a madman because he advocated its use, and practised it as far he could. "Captain Dick" had at least the "courage of his opinions," and was not afraid of a boiler exploding while it was under his care. He was unquestionably the pioneer in the real use of the steam-engine.

The four "vestibule" trains on the Atchison, Topeka, and Santa Fe's new Chicago line are said to be the finest and most luxurious yet seen in the West, embodying many improvements on the famous original vestibule train. An American paper says each train consists of one baggage car, a mail car, a second-class coach, two first-class coaches, composite or parlour smoking coach, one dining car, and two sleeping coaches, or nine vestibule coaches in each train. The sleeping cars, 60ft. long, are elaborately upholstered in peacock-blue silk glacé plush. The composite or parlour smoking car is in two apartments, the reading section containing a library, writing-desk, &c. The dining cars are finished in French antique oak, elaborately carved, and, in addition to the other conveniences, contain inclosed sections for private parties, very elaborate buffet, and a wine room. No wood is exposed in the kitchen. Each coach has gentlemen's toilet and ladies' toilet and dressing-rooms. The second-class coach is finished in native ash with Moorish-designed ceilings, rattaned sofa seats, and closet and toilet rooms. The trucks have 42in. steel-tired paper wheels. The entire length of each train will be about 600ft. The electric lighting system comprises a small Brotherhood engine and dynamo, which is placed in the baggage car, occupying a space of about 3ft. by 5ft., from which the wires are led through the train, thus charging the storage batteries that are carried under the cars. Each car is thus electrically independent of the others. The interior fittings are silver-plated.

A report of the performance of a secondary battery known as the "Tudor" has been issued apparently by the authority of Prof. Kohlrausch. As the cells tested have been in use for some time, the results obtained are notable, as will be seen from the following:—Total weight of plates, 29·3lb.; surfaces of four + plates, 1·29sq.ft.; volume of acid, 6 pints; specific gravity when charged, 1·147; normal charging current, 5 ampères; normal discharging current, 6·5 ampères; internal resistance charged, ·015 ampère; internal resistance discharged, ·02; capacity per pound, 1·6 ampère-hours. A series of six ordinary charges and discharges showed an efficiency of 94 per cent. for current and 82·4 per cent. for work. The cells were charged, and then left alone for various periods of time; the results at first obtained generally showed a loss of 7 ampère-hours, but after that there was practically no further loss in a week. When charged with a current of 8 ampères, and discharged with 10 ampères, an efficiency of 77 per cent. and 64·7 per cent. for ampères and watts respectively was obtained. When discharged through a constant resistance, with a current beginning with 50 ampères, they gave 23·5 ampère-hours and 40·5 watt-hours, the current having fallen off at the end of the test to 40 ampères, and E.M.F. from 1·8 to 1·3 volt. They were then recharged, and discharged with 90 ampères, giving 20·1 ampère hours and 32·7 watt-hours, the current falling to 62 ampères. After this enormous strain the cells, when recharged, gave their normal discharge, and they were run down for four days, starting at 1 ampère, until the E.M.F. had fallen to 0·2 volt, and the specific gravity of the acid to 1·1. The cells were then recharged until gas began to come off pretty freely, and on discharge they returned 46·8 ampère-hours, and an efficiency of 90 per cent. for current and 80 per cent. for work.

The decision of the United States Circuit Court in regard to the patent on the Edison electric light is of importance, for it is based on the interpretation of Section 4,887 of the United States Patent Laws. This is the well-known clause limiting the duration of an American patent to the term of the shortest foreign patent which may have been granted before it was granted in the United States. The ground of the defence was that a patent for the same invention had been taken out in the Austro-Hungarian Empire for one year, and by proper process was extended to two years, and expired on July 21st, 1883. This date was prior to the commencement of the suit. The American patent bore an intermediate date of granting, August 22nd, 1882. The decision covered the following points. The suit was brought subsequent to July 21st, 1883. The Court held that it could have no jurisdiction if the American patent expired on that day along with the Austro-Hungarian patent, because suit was brought nearly two years later. The defendants' plea as to lack of jurisdiction was therefore allowed. The complainants had claimed, as application for an American patent was made before the inventor applied abroad, that Section 4,887 should not apply. This Judge Wallace disallowed. It should be mentioned, perhaps, that these lawsuits have nothing to do with the inventors or patentees, but are simply the results of "speculating," and sometimes the real inventor finds that he is (in law) a copyist, although all the world knows he was the first to mention the subject.

Saccharin does not seem to be so valuable as was at one time asserted, although there can be no doubt that it is very useful. The Paris Academy of Medicine has been discussing the subject recently, and the French Société de Thérapeutique has taken up the matter, Dr. Dujardin-Beaumetz confirming the marked advantages of saccharin as a substitute for sugar, or any of its succedaneums, in the alimentation of diabetics. Although it does not appear to have any noxious action, it cannot be employed, like sugar, as an aliment, because it passes through the economy, and is eliminated by the urine without being assimilated or transformed. Dr. Constantin Paul thought that saccharin might with advantage replace the syrups of glucose employed in industry, which are often of an inferior quality. Dr. Delpech observed that saccharin does not possess the softness of the syrup of sugar, and leaves behind it a slight taste of tar. To correct this, and to prevent its affecting the stomach as it sometimes does, Dr. Constantin Paul recommends the addition to it of the bicarbonate of soda. The antiseptic properties of saccharin will, however, always commend it for certain purposes.

The Janney goods waggon coupler is being extensively adopted in the United States. It may be remembered that the laws of some of the States compel the use of automatic couplings.

THE average growth of the beard has been computed to be 6½in. each year. A man of 80 years of age, therefore, who has shaved regularly all his life may be said to have sacrificed to the razor about 35ft. of hair.

THE Hygiene and Life-Saving Apparatus Exhibition at Ostend will be opened on June 30. About 400 exhibitors have already sent in their names. An Industrial and Fine Arts Exhibition will be opened in connection with the one first named.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, *332, Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

⁂ *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects; For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

COMET SAWERTHAL.

[28869.]—HEREWITH is a continuation of my observations of this comet, which may interest your astronomical readers.

April 27th, 14h. 27m. Nucleus stellar, in centre of round head. Coma bright and large, outer edges rapidly diminish in brightness, tail slightly wispy, and brightest on outer edges. Strong moonlight.

May 1st, 13h. 30m. Just picked up with unaided eye. In telescope, nucleus is elongated, somewhat pear-shaped, with ill-defined edges, tail end of nucleus apparently detached from main. This detached portion proved to be a star, as I watched it until it was free from the comet, when it was a sharply-defined disc. During its occultation by the comet it presented the appearance of a blurred patch—circular and with ill-defined outline. The coma is elongated far into the tail. The tail is very long, broadening out but little towards its end.

May 4th, 14h. 10m. Very much the same as last observation. Tail is, perhaps, slightly broader towards its end, and fainter.

May 12th, 12h. 35m. The same, except fainter.

May 30th, 12h. 20m. Near the great nebula in Andromeda. On comparing the bright parts of the two objects, I make the comet to be brightest. The head is round, the nucleus difficult to see, but strongly suspected of being oval and not in centre of head. Tail is short and wispy and broader than on other observations, the outer edges of tail are brightest.

June 4th, 11h. 30m. Comet and the great nebula in the same low-power field. Bright portion of comet is about one-third the size of the bright circular portion of the nebula, comet not quite as bright as nebula. Cannot pick out nucleus. The head is pear-shaped. The tail just glimpsed for, perhaps, 20′ long. Twilight too strong for faint details. 12h. 20m. The same.

June 11th, 11h. 20m. Getting fainter. Head oval with slight condensation towards fore part. An occasional flickering of a stellar point in condensation, but it could not be held steadily.

June 14th, 11h. 30m. to 12h. 30m. Very faint, brightest portion is an elongated nebulous patch broadening out towards tail; very faint tail seen by averted vision, the whole length of comet does not exceed 10′ (estimated), occasional flickering up of a stellar point near extremity of head. Small star in the midst of tail about 5′ from head of comet, it had the appearance of being out of focus—could not make it otherwise by adjusting eye-piece.

Observations made with 3⅜in. refractor.

26, Servia Mount, Leeds. **David Booth.**

OCCULTATION OF A STAR BY JUPITER.

[28870.]—THE precision with which Mr. R. P. Lewis (letter 28843, p. 351) has recorded his observation of June 10 renders it, I think, abundantly clear that the object which he saw emerge from behind Jupiter was not a fixed star, but the first satellite which reappeared from eclipse after occultation at 9.40 and 1 p.m. I had prepared to observe the reappearance, and upon taking my station at the telescope a few minutes before the app time, I found what seemed at first sight to four moons in the field—a circu me to the *Nautical Almanack* ag have made a mistake. I prese satellite emerge, however, which of the other bodies was an interl from memory, I believe the star satellites 2 and 4, and that it was their plane in the inverted field; bu haps, worthy of remark that it was satellites in appearance that, although it closely, I could not, with the power (100), detect the difference between the

Fred. W

Birmingham, June 18.

THE CHEMIST NOT A CREATOR—BIBLE READERS — EVOLUTION — WHITEWASH—LEONA DARE.

[28871.]—IN answer to J. R. M. Thompson's letter (28861, page 354), may I ask whether he thinks that by making water from hydrogen and oxygen we can make ginger-beer? Yet Prof. Roscoe's remark, about making gall-nuts from gallic acid, is no more foolish. Making water and gallic acid synthetically is certainly one step towards the making of ginger-beer and of gall-nuts artificially; but then we have to make all the other components, and, after that, to mix them up properly. So again with protoplasm, we have to make all the components, then mix them up properly. Chemists probably possess all the components; but then they cannot mix them up properly. The mixing is the difficulty. One degree too hot or too cold spoils the whole thing; each compound must come in its proper order, and many other causes step in which make the probability of the manufacture of protoplasm very low indeed. But when we think of the thousands of laboratories, in every clime, mixing and compounding every conceivable substance made by nature or art, then, I think, the probability increases. But yet chemists have not as yet made protoplasm, and so I, for one, wait with expectation for that event, when all anti-evolutionists will be converted to the Darwinian faith.

The last sentence of the penultimate paragraph of my letter (28862, page 354) last week got mixed by the omission of a full-stop. The argument is: Bushmen, with the brains of men—that is, with brains improved with a little language, have been speaking for a long while in a language that does not express their thoughts well; Englishmen come and teach them a language which fully expresses all their ideas, and which, therefore, they quickly pick up. But with a parrot, though the speaking organs are highly perfected, yet there are no brains to express any thoughts, and so a parrot cannot become an intellectual being.

With all other animals, either brains or articulate voice, or both are wanting, so man remains the only reasoning animal.

"J. R. C." (letter 28863, page 354) asks "what becomes of the doctrine of original sin, on which the clergy base so much of their church religion?" What makes "J. R. C." think that we have an original sin? I believe nothing more than that fairy-like legend of Eve stealing the forbidden apples, resembling Jason's theft of the golden fleece by the help of Medea. I, for one, do not think that man has an original sin, any more than the poor rotifers, who are condemned to whirl their cilia round and round in atonement for it.

In reference to "Delta's" letter (28864, p. 354), I may add the question: "Did Noah take with him into the Ark all trees?" For a good number of the existing trees and flowers would not stand a submersion of forty days.

Can "Dens" (page 354, letter 28865) show me in one of those books he refers to the dimensions of the jaw bones, say, of a dozen different animals, or the formations of their tongues, or the number of blood-vessels passing through the necks of the same dozen animals? At least a dozen species must be recorded, for half of them, at least, do not vary. And the actual animals must be compared, for the outside covering, &c., which are not preserved in fossils, work great changes in the animals themselves. Surely "Dens" does not think that the fossils referred to in those books, or in any books whatever, are continuous—that is, that there is a fossil representing the life in every century. Far from it, many of our fossils of the same genus are separated by long ages, and although they can be classed in the same genus, yet variation has changed the later ones into new species. "Dens" says we cannot find any record of a hairy quadruped with a tail and pointed ears. We have no need of such records; the animals themselves are living to-day, in but a very slightly modified spect in the form of lemurs.

I quite understand that these sets of fifty years gin to count from 7,000 years ago, yet we get no rer to the meaning of that wonderfully meaningless sentence about men's business occupations. absolute extinction of the sea-cow and dodo room for other animals. I am not much ainted with the fauna of New Zealand; but I ure that after the extinction of the moa and auk, some species of plants and animals, before were poorly represented on those after became dominant species. These having lost their most powerful enemies, with them some of their natural defence; thus a new variety would be d and ultimately a new species. kind of "Dens" to tell evolutionists details which he cannot refute, and working from, which no man in ld accept. The first part of this basis" is very easily answered. thing in nature, so clearly and un ears the marks of being related to who can maintain that man has his own peculiar organism, when every bone, every muscle (except a few small nascent ones), every organ, has almost its exact copy in the body of an ape, of a bird, of a seal? We certainly have no proof—or at least, very little—that animals can go outside their order. But then, where did all the animals come from? Common sense acts against the miracle of creation, which Bible readers, by no proof whatever, use as an easy way of getting out of all difficulties. Rejecting such old wives' stories, we are forced to accept some theory such as evolution; and facts support this theory so strongly, that it is by a very large number considered as a solution to the question, "Where did all animals come from?"

No one disputed for an instant that the terms, "a high type of animals," or "a low one," were simply and purely relative. The very theory of evolution is based on the fact that every animal is most suited to the circumstances with which it is surrounded. Now, suppose these circumstances change, what is the animal to do? It has to change also. An aggregate of these circumstances collected during 500 years would work immense changes in an animal; 1,000 years, a new species. For I maintain that, if we could have an account of all the animals living throughout the world 500 years ago, the total number would be far less than now; and further, that half the new species constantly being discovered are either not unknown species, but the unaltered form of some of our own well-known modified animals or plants, or entirely new species formed by well-known productions.

The lower animals do not contain the higher ones in themselves, but the higher contains the lower in every case, without one exception; for a lower animal must have some addition to make it higher, just as one shilling must have another shilling to make it two shillings; but the two shillings contain the original shillings, so also the higher animals contain the original lower one.

I noticed some time ago that a correspondent dissuaded people from putting colour in their whitewash, saying that the size produced a sunny appearance. I tried whitewashing a room with only size and whitewash; the result was a dull, deathlike wall. I was very disgusted with its appearance, and immediately determined to re-whitewash the room. Having no blue or black, and an unlimited quantity of yellow, I tried the latter. The result was very satisfactory—in fact, the sunny appearance above mentioned was produced, so I do not think that colour is put into whitewash to neutralise the size, but to give a body to the whitewash. Care must be taken not to put too much yellow into the mixture, or else a distinct yellow tint is produced.

Most English correspondents, no doubt, have heard of Leona Dare's exploit at the Crystal Palace—namely, her going up hanging by her teeth from the car of a balloon. The thing she holds on by is simply a guttapercha ball, which fits into her mouth, and which is suspended from a trapeze. This shows the credulity of the masses; for it is impossible to sustain the weight of the entire body by merely the neck; the weight of the abdomen alone would dislocate it. It is a thing that has drawn thousands for the reason, I think, of seeing her fall.

Satine.

GENESIS AND ITS MEANING.

[28872.]—MAY I assure "J. R. C." (letter 28863) that the question of what the author of Genesis means us to understand is not the easy one he seems to think?

Nor do I consider it "common sense" to apply to the words of the translation of the Book of Genesis their "usual every-day meaning." The subject of the meaning of the early Scriptures is by no means an easy one. Has "J. R. C." ever studied it? and does he really know anything about what he calls "Church religion"? I think if he did, he could never have written as he has.

I have no particular hypothesis to maintain, clerical or otherwise; but though I do not agree with "E. L. G.," I see nothing in Genesis incompatible with his theory; nor do I see why a day with evening and morning should be only twenty-four hours long.

The King had his "day" with its "evening" and "morning." How long was it? Can we not write on scientific theory without bringing the Scriptures into the question?

Tresilian.

EVOLUTION: A DISCLAIMER—SODA CRYSTALS v. SODA ASH — BLAST FURNACES.

[28873.]—ON my return from abroad, I have found a series of back numbers of the "E.M." awaiting me, some of them containing matter which calls for further remark. The number in which my last letter was published has evidently been sent to my address in the East, and I have not yet had an opportunity of seeing it.

In reply to "Nun. Dor." (pp. 218 and 259). If he had taken the trouble to read the correspondence in back numbers, shared in by "F.R.A.S." to which, I think, I referred, and, having read it, was able to understand it, he could not, I feel sure, have equitably characterised my recent query, addressed, by the way, not to him, but to "F.R.A.S." as "unmitigated impertinence." The reply to which he refers on p. 218 as "a little bit of harmless stupidity, or want of understanding," was the only one I could get from "F.R.A.S." at that time. The imputations of motive, and the remarks with which "Nun. Dor." has accompanied them, are alike incorrect and unjustifiable, and, if I may say so, indicate the bent of his mind, rather than that of mine, in discussing the subject. The *odium theologicum*, which I was desirous of avoiding, seems to be as persistently introduced by writers on one side as by those on the other, else my query could not have suggested the construction put upon it by "Nun. Dor."

As "F.R.A.S.," however, assents to his misinterpretation, allow me to disclaim any intention on my part to insinuate any such inferences, or to treat with anything but courtesy a correspondent so justly respected. My sole aim was to know the whole truth, and I addressed the query to "F.R.A.S.," because I value his candid opinion.

He objected formerly to my description as creations of the first appearance of entirely new varieties, which natural selection cannot, and does not, pretend to account for, yet, without which, "it can do nothing," because, he said, that term predicated a creator.

Now, that I have for the first time observed him explicitly avow himself in your columns an evolutionist, I considered it a pertinent, and certainly not an impertinent, question to ask, whether, in ascribing these phenomena to evolution, the explanation is not likely to come to the same objection—that it predicates an "evolutioner"?

To my mind, it is so; and, if it be so, the fact is not to be slurred over in deference to preconceived ideas. Science demands not only the truth, but the whole truth; and it is a matter for congratulation that this fundamental difficulty in the Evolution hypothesis is being recognised and proclaimed by the highest authorities.

The quotation which, on page 335, "Nun. Dor." gives from Prof. St. George Mivart, expresses fully and adequately my contention: — "No wonder, then, if men devoted to physical science, but who are no philosophers, seek to explain evolution by causes within their own province, but which are hopelessly and necessarily inadequate, so that they may even come to accept as a scientific truth that most absurd of all absurd propositions, —namely, the proposition, that 'natural selection' *is the cause of* 'the origin of species.'"

"Nun. Dor." asks for a definition of "self-evolution," a phenomenon which he apparently agrees with me in considering impossible. Briefly, I might describe it as "spontaneous generation," and it is nothing else than this that "Satine," page 217, submits for criticism.

In a world hitherto destitute of organisms, surrounded by an atmosphere of "*poisonous* gases," and disturbed "by storms, accompanied by winds, displays of electricity, &c."—chlorophyl "*was produced*," and protoplasm "*was produced*." This may be a very simple way of accounting for the "origin of life," but I do not consider it a scientific one.

"Chemist," in his reply to query (65128), page 220, avowedly gives rough figures, and, in consequence, brings out an incorrect result, and one contrary to his anticipations. Soda ash of 56 per cent. contains not 94 per cent., but 95¾ per cent. of Na_2CO_3, so that at 1d. per unit, one ton of ash (equal to 19cwt. 0qr. 17lbs. Na_2CO_3), may be purchased for £4 16s. 0d., with soda crystals at £2 per ton, and this is generally sold gross weight. 2tons 8cwt. (equal to 18cwt. 1qr. 12lb. Na_2CO_3), may be purchased for the same money. If it be remembered that soda crystals are equal to soda ash of 21·67 per cent, the quantity which is equal to a given quantity of ash of a stated strength can be easily found by simple proportion. Similarly their respective costs. With 56 per cent. of ash, at £4 16s. per ton, soda crystals, if sold at the same price per unit, should cost only £1 17s. 2d.

For the reason given at the beginning of this letter, I am unable at present to reply to query 65520. I do not recollect the data assumed in the example I gave, but, as soon as I can procure a copy of the number containing my last letter, and have leisure, I will do what I can for "One in a Fix."

H. B. F.

[28874.]—YOUR correspondents who anticipate the production of protoplasm by the chemist are wiser than some prophets, for they do not assign any date for its accomplishment.

Sir Henry Roscoe ("E.M." No. 1171) at any rate says that at present no such problem lies within the province of the chemist. But suppose the prophecy to have become history, it does not follow that life originated spontaneously.

It is an assumption which stands very want of proof, that what man by select bination can accomplish Nature unaided can do. Is there any reason to believe that Nature could produce aniline dyes and saccharine from coal tar, though she had any number of ages to do it in? Again, many people seem to think that when a law of nature has been discovered, there is nothing more to be explained.

But this is a great mistake. Laws are not causes, they are only the rule by which the unknown cause acts. So far as efficient causes are concerned, we know just about as much, or as little, as they did centuries ago. The people who assigned a supernatural origin to life may have been very ignorant in some respects. But no discovery of any kind can ever prove their assumption to be wrong. For behind all physical causes there may very well be an efficient cause of a psychical kind.

Perhaps the theory of Evolution may yet be proved beyond the possibility of doubt; but I am well convinced that the haphazard theory of it will not survive. The term "natural selection," which passes so glibly from many lips as if it were the simplest of ideas, has been well described as an expression for "a congeries of many congeries of causes."

That this almost infinite number of physical causes could have been so disposed by chance as by their combined activities to produce a well adapted and orderly cosmos, is to me simply incredible. It is vain to talk of necessity in this respect. Professor Huxley says, "What is this necessity but an empty shadow of my own mind's throwing?" The only necessity which we know anything of is rational necessity; of ontolocical necessity we know nothing. **J. A.**

EVOLUTION.

[28875.]—The letters on the origin of the human race, from Bible readers and evolutionists, are highly interesting; but I certainly think that if properly understood the evolutionists have the best of the case. The Bible readers are arguing in the dark, while they depend, as they all appear to, on our Authorised Version, which is certainly lamentably misleading as to the truth, and is nothing but an allegory. For instance, there are two different accounts in the early chapters of Genesis as to the creation of man utterly at variance with one another. Again, we are told that the result of man's disobedience was death. This, from the Bible-reader's standpoint, ought not to refer to the animals however.

The Bible and evolution are, however, I consider, identical on the origin of man, "God formed man out of the dust," &c. The word "formed," or "created" in the original Hebrew, means simply formed with existing materials or evolved from the then existing matter. The whole story of the fall of man is an Eastern allegory of the relationship of the sexes for the purposes of propagating the species, and veiled thereby from the vulgar gaze by an artfully-designed fable. There being, therefore, nothing in the Bible, if the original is carefully examined, at variance with evolution, let us see what evolution has to say. Now, we have no evidence as to the period when life first evolved on this planet; we can only say it was ages ago. Neither can we with certainty say whether one or many different forms of life appeared at the beginning; but this we can and do know of a certainty, that in the long past and present both men as well as all creation was and is being metamorphosed by the variations of climate, race, and many varying conditions surrounding and bearing on our existence. Hence the disappearance of various types and species as time or evolution passes on, and their reappearance in other forms and species. Man is and can be no exception to this slow and well-ordered march of conditions towards some unknown goal, and structurally and mentally he is possessed of no other attributes other than is also possessed by all creation in its varying degrees.

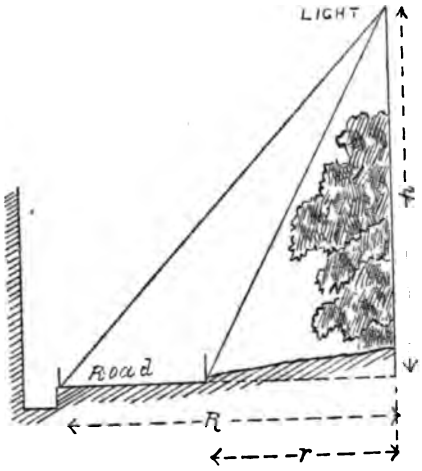
Some of your correspondents conclude very illogically that our position is wrong, by reason of errors appearing in some of the details of cases brought forward to support the theory. That we all are liable to drawing hasty conclusions from insufficient premises must be confessed. This necessarily arises from a finite mind hastily compressing his all too scanty knowledge of the works of the infinite. This applies more forcibly to the Bible readers, I think, than the evolutionists. I contend that the Bible and science or evolution, stripping both of the excrescences that their supporters burden them with, are identical and in harmony. A final word, however, on the evolution of man I crave. We had one example out of many in the Burmese hairy family recently in London. Being a relation of the gentleman who brought them over, I saw them and heard many details. It appeared that originally a female child was lost or deserted in the forests near Mandalay, and, like the fable founders of *Rome*, this child, however, fell into the power or society of the apes of that region, and in time a progeny was the result of this intercourse, with the various characteristics of the ape, the long hair and peculiar formation of the nose and lower jaw. The family was captured and held high honours in the king's palace for years before the English captured the town, when they fell into the hands of my friend, who brought them to England—the mother, son (both hairy), and a fat, jolly little Chinese wife, who was mated to the man. They all lived in the same room, and slept, I think, in the same bed, delighted in squatting on the floor, cracking nuts and eating almost anything, after a time, which could be got them; the peculiarity also was that the hairy and grosser characteristics appeared only in each alternate generation. Now this is a clear, indisputable fact of what we might term retrograde evolution. With these and multitudes of other examples before us, is it not perfectly reasonable to conclude that many ages ago some more highly gifted member of the ape species may have, through design if you will, or freak of nature, "thrown" our progenitor of the human race, and so evolved the new species called in after times "man." This is wisdom itself compared to the ridiculous theory of the Bible readers, who most unwarrantably, and without a particle of reliable evidence, contend that God made man perfection in His own Image, whereas, as "Satine" says, it would be more correct to say "that man made God in his own image." Finally, criticisers of this letter must remember that, as evolutionists, we speak not of time, but of vast cycles of evolutionary periods, without beginning or ending.

151, Fulham-road, S.W. **Thomas May.**

PROBLEM IN MAXIMA AND MINIMA.

[28876.]—The following original problem occurred to me when walking in the stately "Circus" of Bath, a relic of the past glories of the city. The sleepy old town has been talking about the electric light, and perhaps the Circus may have one in the centre of its circle; but there is a group of tall elm trees in a circular inclosed space concentric with the circles formed by the road and houses, and it might at first sight appear that there would be great loss of light if the light is placed high above the trees. It is only required to light up the roadway, and by an arrangement of horizontal reflectors, one above and the other below the light, the whole of the light might be utilised for the road alone.

For the purposes of this problem, however, the reflectors need not be considered at all. Now, it will be seen that if the light were low down, near the ground, the rays would fall upon the road at such an acute angle that they would have but little effect. Again, if the light were at a very great height above the ground, it would have but little effect; so there must be some height, *h*, where the effect of the light on the road is a maximum, and the object of the problem is to find this height in terms of R and *r*. The diagram is supposed to be a half-section of the Circus. This requires both the integral and differential calculus, and will put the correspondents of the "E. M." on their mettle if any like to try it. My result is—



$$h = \frac{(R\,r)^{\frac{2}{3}}}{\sqrt{R^{\frac{2}{3}} + r^{\frac{2}{3}}}}$$

Is this correct? **M.I.C.E.**, Bath.

MATHEMATICAL PARADOXES.

[28877.]—I am very glad to see some of the paradoxes of the Four Dimensionists assailed in your columns. They are, in my opinion, not merely as bad as, but much worse than, those of Mr. Hampden. The doctrines of the latter are founded on the perceptions of men in the present world, though most persons would add, of men who have the means of correcting these perceptions, and do not avail themselves of them. But the mathematicians in question appeal to unknown beings in an unknown world, and suppose that these have no means of correcting their original perceptions.

So far as the system, however, consists of misapplied mathematics rather than unsound metaphysics, its error appears to me to be this: The algebraical *x*, *y*, *z*, in their origin have a purely numerical meaning without any reference to extension at all. To connect them with extension, we begin by showing that the equation $a x + b y + c = o$, represents a right line. Why? First, because the sides of equi-angular triangles are proportional; secondly, because if you let fall perpendiculars from different points situated on one right line upon another right line which intersects it; the successive triangles thus formed are equiangular. Deny either of these propositions, and you have no ground for applying algebraic formulæ to geometry at all. Another fundamental assumption both in algebraic geometry and trigonometry is, that the sum of the squares of the sides of a right-angled triangle is equal to the square of the hypotenuse. Deny this, and there is an end to trigonometry and to every equation above the first degree in algebraic geometry. But in proving that the several triangles referred to are equi-angular—that the sides of equiangular triangles are proportional, and that the sum of the squares of the sides of a right-angled triangle is equal to the square of the base, it is absolutely necessary to assume that the sum of the three angles of a plane triangle is equal to two right angles. Without this assumption neither algebraic geometry or trigonometry are possible; yet this assumption is denied by the very persons who go on to deduce all kinds of geometric results from algebraical formulæ which they have commenced by divesting of all geometrical application. If this be not so, let them prove the applicability of algebra to the kind of space which they assume.

There is another class of mathematical paradoxes which pass current so often that it has tended to countenance those which I have been dealing with. I mean paradoxes relating to points, lines, &c., at infinity. Infinity, of course, is a relative term. It means at an infinite distance from some other point or locality; but the mathematician need not suppose himself to be at either point. If the distance between A and B is infinite, and I place myself at A, the point at infinity is B; but if I place myself at B, the point at infinity is A; and as there is no reason why I should identify myself with A rather than with B, or vice versâ, it follows that points, lines, &c., at infinity cannot differ in their properties from points, lines, &c., anywhere else. Who would dream of laying down as a qualification of the proposition that the sum of the squares of the sides of a right-angled triangle is equal to the square of the hypotenuse "provided that the right-angled triangle is not at an infinite distance"? The fact, however, is that we may suppose two lines to differ so slightly in their properties that the difference could not be detected without following them to an infinite distance, and that, therefore, for practical purposes and finite measurements we may treat one of these lines as if it was the other. Thus, we may suppose a pair of true parallels—lines everywhere equidistant—to meet at infinity, because at all finite distances from our origin we could detect no difference between them and two right lines which meet at an infinite or enormously great distance. And for the same reason we may suppose a number of true parallels to pass through the same point at infinity, or else to intersect at different points at infinity so as to form a polygon there; and we may suppose the points at infinity where they intersect to lie either in the same direction or in opposite directions, there being, in fact, half a dozen assumptions which will equally answer our purpose so long as we are dealing with finite distances only. So we may suppose a right line to be a circle with an infinite radius, or vice-versâ; or for a circle we may substitute many other kinds of curves with corresponding reference to infinity; but some paradoxes arise if we suppose the properties which are thus true at finite distances from the origin hold good at infinity also; for in the case of a circle, for instance, the point at infi
the greatest distance from the part
considering), is not in the direct
line, but at right angles to that c
overlooking this arise all such p
right line at infinity which is a
itself, &c., and the new class of par
more than try to bring these ph
home by inventing a space aro
they might occur instead of havin
in search of them; but there is, I
for believing that there exists a
around us or at infinity, a space

with a diminuendo in the tower, or vice-versâ; or that the reeds in west end should be echoed by those in the east?

In the service, at all events, the organ should be the humble servant of religion, and not be occupied in playing the mountebank, and so distracting the congregation, who, having paid for it, and knowing what it is capable of, are disappointed if it be not shown off. I once heard an organist accompanying the Nicene Creed. He played a bugle call on the tuba (inserted a week or two previously) at the words, "to judge the quick and the dead." With what blasphemous intention I leave your readers to judge.

Even as regards the voluntary, it appears to me that the organist need not be ashamed to play Bach's organ fugues, or Mendelssohn's sonatas, or Handel's choruses, and there is nothing in any of them that would not have ample justice done to it by a two-manual of twenty registers. Some modern composers certainly—e.g., Guilmant, Morandi, Widor—demand a solo manual in addition, but no writer of any worth would risk the due performance of his music by providing for all the sixty-four effects described by your correspondent, or half of them. This sort of thing will bring about a degraded taste on the part of the public (the same taste, in fact, which makes them go to see a woman shot from a cannon), and is very much like teaching a noble dog to perform little tricks. It degrades the instrument.

There is just one thing more. Your correspondent, C. C. Michell, says the organ is only projected.

Recollecting my futile search after the organ in Cologne Cathedral (not only projected, but nearly finished, according to your former correspondent), would it not be better to fill up the pages of the "E.M." only with organs that actually exist?

John T. Lawrence, M.A.

JOSEPH JEWSBURY'S DIFFERENTIAL BACK GEAR.

[28883.]—I SEE several correspondents are asking where the description of this may be found, thinking it would suit "J. L. D." There is a good description in Vol. XXV., page 586, and it is commended by a correspondent in Vol. XXVI., at page 413. There is also, in *Design and Work* of April 27, 1878, the description of an improvement by the inventor. I studied this gear when preparing the design of the "E. M." lathe. I have no doubt it works with perfect smoothness, and rather wonder it has not superseded the usual form of back-gear. It was not, after all, adopted in my design because the belt would give a speed of two treads to one turn of the mandrel, which should enable one to deal with cast iron up to 5in. diameter, all I considered the lathe suited for, and, besides, the lathe was already somewhat complicated.

I have just stumbled upon an advertisement of the inventor's in Vol. XXVI., offering castings of the two wheels for 2s. 6d. If "J. L. D." cares to write to me, I will send for his perusal two or three letters Mr. Jewsbury wrote me on the subject.

F. A. M.

4, Clarence-road, Tunbridge Wells.

SPAR-WORKING.

[28884.]—THIS is a very important and interesting subject, and one which I am glad to see raised in the "E. M." Hitherto, it has scarcely been touched in "our" columns. Wollaston and Brewster, who did such splendid work on this and other subjects, were in the habit of working out their own experiments, and there is no way in which this subject can be properly developed except by amateurs who take it up out of artistic love for it. Some trade-experts carefully keep their methods secret, and, indeed, often purposely mislead the amateur—a short-sighted course which prevents the full development of the business and limits the demand for their own productions. I have been picking up information on this subject for years with a view to write some notes upon it in the "E. M."; but I have not yet found time to personally work out all the points so as to feel prepared to deal adequately with it for the pages of the "E. M." Still it may be the best course for me now to offer a contribution to this discussion.

The working of Iceland spar is that part of the subject of crystal-working which is the simplest and the best to take up at first. Iceland spar in its crystalline structure is the least complex of all the crystals, while its substance is so soft that the labour of working it is comparatively easy. Next to Iceland spar comes quartz, in whose crystalline structure we have superadded the phenomena of circular double-refraction in the direction of the optic axis, and in which, while more easy to finally polish, we have much more difficulty in the slicing, grinding, and smoothing. After quartz we may take up an infinite number of biaxial and other more complex optical crystals which, when properly sliced, make such beautiful objects under convergent light in the polariscope; therefore in launching the subject in the "E. M.," we have before us one of considerable magnitude and complexity, and it behoves us to see our way to some such order and arrangement of our topics as will not call for space in the "E. M." which our Editor may think badly invested.

In all crystal-working we have to study four distinct processes.

1. We have to so understand the optical structure of our crystal as to plan the way in which our material can best be cut up. We need to get out not only the shape we require most economically, but we need also to get out that shape so as to contain the optic axis of the crystal in that direction with regard to its faces, which alone will answer our object. If we fail to combine the grain of our material with the shape of our object, we spoil our crystal. And we need also to consider what plan of cutting up our material will leave residual portions of the greatest value for other purposes. So puzzling and important is this question of *planning* that models of the available material should be made in wood or plaster, and actually cut up so as to produce a model of the object before an important piece of spar or other crystal be touched.

2. The method of slicing the crystal so as to cut it up with the minimum of waste. Now Iceland spar will always be shattered by any such method as the use of a fret-saw, and I do not wonder at "A Distressed Brother" having spoiled his material by attempting to cut spar up in this way. Iceland spar can be cut safely with a band of sheet copper, finished up truly, and tightly stretched in the frame of a fret-saw or band-saw. A piece of soft steel piano wire, tightly stretched in a bow frame, will also cut spar. Either must be tenderly handled, and must be used slowly, and with moderately fine emery-powder and water. The best way of all is to get a long piece of soft steel piano wire, so welded as to make its joint perfectly smooth and uniform in size with the rest of the wire, and then to rig this up over pulleys, and use it as an endless band-saw, while the spar, carefully chucked with the aid of some plastic material upon a slide-rest, or other travelling table, is so traversed as to slowly make the slicing which is required. The endless wire slicer must be fed with emery and water. Plaster of Paris must not be used for chucking the spar, as the heat generated at the moment when the plaster sets will break the spar. Even in balsaming spar on to a sheet of glass, dried balsam dissolved in chloroform had better be used, as if ordinary balsam be used, and the spar and glass then baked, the coefficient of expansion in spar and glass are so different, that in the cooling and setting the spar often breaks. A beautiful piece of spar which one of Mr. Hilger's people had prepared for me, and then baked upon a piece of plate-glass, split across in a plane of cleavage as it cooled, and was spoiled for my purpose. Mr. Ahrens has had serious accidents with spar from similar causes.

3. The grinding-down and smoothing of the surface of the spar is done in the way usual among opticians—that is to say, a post is set up, on to which face-plate-like iron chucks can be screwed, and upon these the surfaces are ground down by means of emery and water, the final processes of smoothing the ground surfaces being done by means of extremely fine elutriated emery. While thus working up the surfaces, the operator walks continuously round the post, so as to prevent unequal abrasion, and get a true flat.

4. The polishing. This is done upon true flat pitch surfaces by means of putty-powder and then of very fine rouge, perfectly uniform in fineness and free from any particles which would scratch the surface. It may also be done by means of putty-powder and water upon cloth. A piece of cloth cut out of the tail of an old dress-coat may be cemented on to a face plate and strained tightly by means of a hoop driven on over the periphery of the face-plate. The polishing chuck thus formed is kept in rotation by the lathe, and dressed uniformly with water and putty-powder. The smoothed surface of the spar is then held against it. In either of these ways a perfect polish can be obtained upon Iceland spar.

To make a true flat is a feat quite apart from the capacity to plan, slice out, grind, smooth, and polish an object in spar or other crystal. It is an accomplishment which — like playing the fiddle —requires to be worked at and practised, and which can only be acquired by a deft and finely-organised hand, gifted with a keen muscular sense. It is here that the trade-expert beats the casual amateur. But the making of a true optical flat is a personal accomplishment, in which the amateur may easily rival, and perhaps surpass, the trade-expert if only he have the requisite patience plus the necessary delicacy of touch. One eminent artist in crystal-working, who has kindly allowed me to see him at work when making things for me, polishes very successfully upon cloth. But another, who is one of the most eminent living artists in general optical work, always uses the pitch flats on which to polish his works in spar, ar me that it is not possible to finish a tr flat except upon pitch. I believe that t It is futile to attempt to polish any o face until it is traed-up perfectly on examining it with a watch the holes and scratches caused by are seen to have been smoothed ou tomed" perfectly. If cloth cemente hooped face-plate be used, the hoop mu ject beyond the face of the chuck, accidents may occur to the surfaces to l

If others will kindly contribute cri further data upon the methods of slic up, and polishing Iceland spar, we shal this part of our subject completed, an artists will favour us with help and am sure that scientific men who have n or skill to attempt to make their own will recognise such contributions to th of knowledge by visiting such artists in to others when they are in need of appa

Perhaps "A Distressed Brother," who so carefully through the "E.M." (65588 us references to, and abstracts of, the i which he has found on this subject.

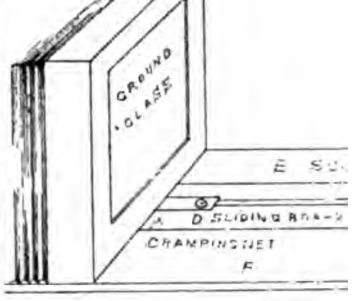
James Ec

Grafton-street, Bond-street.

FOCUSSING MOTION.

[28885.]—I INCLOSE sketch of a new motion, which you might kindly inse next for the benefit of your readers.

I am not aware there is anything existence, although I am thoroughly with photography since the old wet-plat idea is to do away with the tedious scr and pinion, and have a *quick* yet *accura*



instead. A, plate; B, cramping screw be hinged for folding tail-board); (cramping screw to trowel; D, sliding bo (tongued and grooved) in E and F. slacken B, draw camera out to approxi and make accurate with crank G, w screw H.

J.

OBJECT-GLASS WORKIN

[28886.]—"ORDERIC VITAL," thoug in the theory of this subject, as his va tributions to the "E. M." have shown siders successful optical workmans dependent on practical skill than on t this opinion he cannot be far wrong When one considers how uneducated goo workers often are, what simple means they possess, one is forced to attr success of their work to rule of thum of our perfect mathematical teachings how could this be otherwise? What m they to test the accuracy of mathematic What time, what precision, what expens ments that would require! From m conversations I have had with practical m become convinced, and that conviction has firmed both by what they said and lef that their art is dependent on empirical ru proceed very much like children when t to speak to grown-up persons, who go foreign country to pick up its language see, hear, try and imitate, without troublin selves much about grammar, and the resul they come to speak grammatically withou ing it. The practical workman grinds, p examines, touches here and touches the re-examines the image cast by a crown le certain focal length until he finds it clea couples it to a flint lens treated in the sam when the probability is that a colourless comp lens of good definition will result. If it does n is probably due to the non-homogeneousness o materials. That this is the way in which l lenses are made, I have another proof, der from the stock of lenses I had from an optician some 60 years' or more standing, who only re last year, and must consequently have been p the secrets and methods of his craft. s, varying from 1 to 5in. diameter, are d wrapped up in scores of packets, newhat in this way: "Crown concaves scope, flint concave for 5ft., plate con- ft. unedged, 5ft. concaves centred, or 30in. convexes for 11 × 19 concaves," rth, with occasional observations as "Veiny," "like Tulley's," "Marked by These lenses were evidently brought y the workmen ready to be coupled, or y the master in another room. Some r finishing touches, I understand, are cept from the common workers. They ore, not be very difficult to acquire, or it would be unnecessary.

these are methods of the professional hey ought not to deter the amateur, ample means and time at disposal, ting them. Many wrinkles he is de- can be found in books, or be picked up places, or invented by his own ingenuity. appear to be less deterred from tackling la than from the working of lenses. bably due to a want of the necessary Specula working has received more n the "E. M." than lens working. Can of obliging the thousands of readers of I." in various parts of the globe not e generous practitioner to supply the I cannot believe that his interests er through it. In educational matters, ou give the more you get. He would ber of amateur lapidaries' benches, whose r he would become. The implements and re simple and inexpensive. The acquisi- a tempting art as object-glass working is rth striving for. In the absence of any exciting mechanical pastime just now, surely meet with a warm reception at of amateurs, and as astronomical and ic work is making such rapid strides t would meet an increasing want. Many ve and could utilise their lathes for ses, and those who have not such have ugh of them to be able to contrive a dary lathe themselves. Old lathe heads, l benches, or tables, are met with for a gs almost everywhere. The head and t are set up vertically so as just to rise table, wheel and pulley remaining below on a cross bar passing along the middle ls of the desired curves replace the andle on the shaft of the treadle, and e is ready for work. Sewing machine e had at 10s. to 15s. can be made to same purpose.

Vital" quotes prices of glass discs; will be pleased to hear that 2, 3, and 4in. il's glass can now be had at much lower mely, 2, 5, and 15s. Emery in various ge, and putty powder are equally cheap, rticles nearly complete the worker's out- outsider, dependent upon others for my n, these observations may possibly be in- f so, I shall be glad to see them corrected. t the various problems the telescope, cope, the camera, and spectroscope of the destined to solve, it cannot be out of terest the readers in practical optics.

A. Caplatzi.

A LAUGHING PLANT.

—I CANNOT identify this leguminous ter 28866) by description. That very r contains many species, of which the luce cerebral irritation and violent in- followed by sleep, as do many other drugs. "Hasheesh," prepared from *Indica*, and *Atropa Belladonna*, our ightshade, act in a similar way. The or Indian extract of Cannabis, is so producing exaltation, laughter, and deas, that it never fails in bestowing on patients dying of hydrophobia or The excitement is rapidly subdued, and expires in painless insensibility.

Eos.

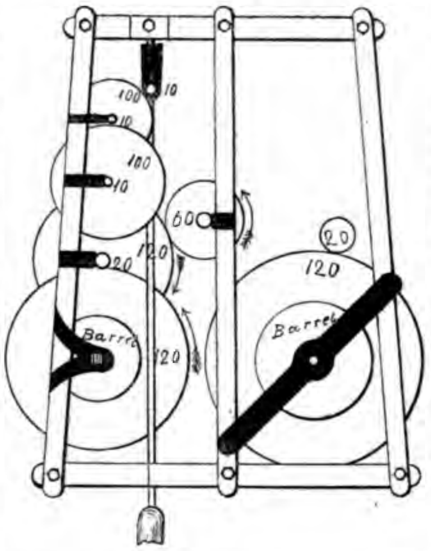
LITTLE-KNOWN PLANTS OF THE FLORA MEDICA.

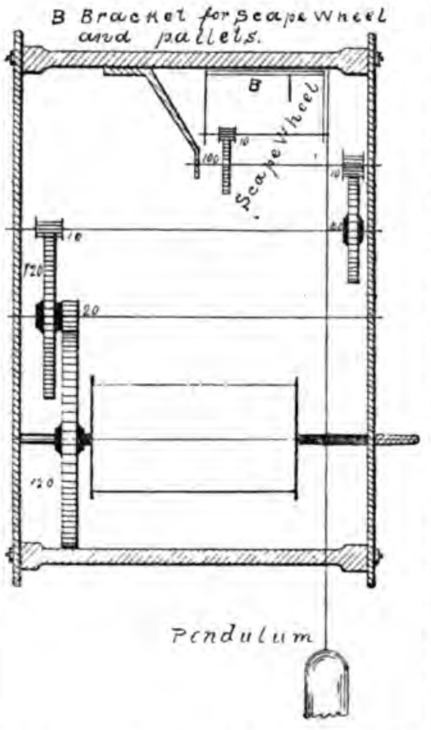
—STRYCHNEÆ. A small order contain- ost formidable vegetable poisons, with ion, *S. Potatorum*, the clearing nut-tree, in the native language meaning "re- irt"). The berry is shining black, con- e seed. By rubbing two or three of e inside of a water-pot, all impurities all to the bottom. This effect is so known that all classes of travellers ply. For many months of the year the rs, and reservoirs are rendered turbid by uous rainfall and overflow; but these s the valuable property of precipitating matters, and rendering the necessary uite transparent. These water vessels ugh village pottery, costing from a farthing to a halfpenny each, and are sold by the roadside in the most remote places. The nature of this action has never been explained, but it probably depends on the astringency of the fruit. The nuts are sold at a very cheap rate, being the produce of wild trees scattered over a wide extent in Southern and Western India, and they are not uncommon in Upper Burmah. Alum powder was much in use for the same purpose by Europeans, its constipating effects being very pernicious to health; but all who happen to know of the above harmless nuts clarify their water supply like the natives.

Eos.

TURRET-CLOCKS.

[28889.]—AS Mr. Carre wants to construct a turret-clock, I can help him in the matter. I have lately, in conjunction with Mr. Blythe, whitesmith and bicycle-maker, in this town, made and set up two church clocks, one striking the hour, the other the hours and quarters on two bells. They have both gravity escapements, and are made to go eight days. I inclose rough sketches of the going part, showing the numbers of teeth in wheels and pinions; also the way their bearings are attached to the frames. I do not give the striking part, except the great wheel and pinion. Further information can be afforded if needed.





The frame is made of flat bar 2½in. wide by ⅜in. thick, having round bars ⅝in. thick, with bosses at ends, turned to a shoulder and threaded. These keep the frames apart when screwed up at each corner, same as the pillars in a house clock. The clock frame is then very stiff and rigid.

Short flat pieces of iron, having a brass bush riveted in, are attached to the frame by bolt and nut. These carry the pivots of the spindles, and when the wheels are right as to depthing, holes for guide-pins are drilled, so that a wheel, if removed, can be returned to exactly the same place.

Then, as to wheels, I use the change wheels supplied by Mr. R. Lloyd, Steelhouse-lane, Birmingham. I can obtain all the numbers of teeth, and different strengths required, at a cost at least 10 times less than ordinary clock wheels would amount to, and practically they do just as well.

If the pendulum is to beat seconds, the 'scape wheel (double three-legged gravity) must turn 600 times in the hour. For convenience, we will suppose the second wheel in the train turns twice in the hour. Having 120 teeth it works one with 60 teeth, which, turning once in an hour, gives motion to the minute hand, and by means of dial wheels on the wall, also the hour hand. I have not drawn the dial wheels. The second wheel also drives a pinion with ten leaves, so that goes twelve times as quick. The pinion has on its spindle a wheel with 100 teeth, that works into a pinion with 10, which goes round 120 times in two hours. The pinion also has on its spindle a brass wheel with 100 teeth, driving a pinion of 10, whose spindle carries the 'scape wheel, and which consequently turns 1,200 times in two hours, or 600 in one hour. I do not give these numbers as the best; they are convenient according to my experience.

Cast-iron pinions with less than 15 teeth cannot be obtained according to Lloyd's list; but I find no difficulty in making lantern pinions, same as in the American clocks, having ten steel pins and thick brass ends. They work better than solid-cut wheels, as Denison mentions in his book.

I am about to start on another church clock, striking the hours only. When finished will photograph it, and perhaps the Editor will have it engraved. An amateur working on my system, if he wishes to put up a church clock in his parish, giving his labour, can do it for about £10. A really good timekeeper, striking the hours, is a boon to a village. I put up one in my native village nearly twenty years ago; it is as good as ever, and has given but little trouble.

I am sure Mr. Blythe would answer inquiries as to price, &c., if a stamped envelope were sent to his address, Foundry-street, Horncastle. I have given no description of the escapement: that can be reserved for another letter, as this is already too long, I fear.

Horncastle, June 11. **S. Maddison.**

HOW TO LIVE FOR EVER.

[28890.]—THE following extraordinary letter appeared in last Sunday's *Weekly Times and Echo*, and I should be glad if any capable reader—I should value "Sigma's," for instance, very much, would give his opinion. I have with some difficulty —for "W. A. W" is averse to publicity—obtained an interview with him, and, I must say, have been staggered by his appearance. His skin is as fair and plump as that of a child, with the exception of his hands and face, which he has not "finished yet." "Try it, sir," said he to me at parting, "and in another five hundred years you and I will congratulate each other!" I *have* tried it, and, whatever may be its effect as regards living for ever, there is no doubt about the cleansing and softening effects of diluted acetic acid on the skin. I cannot bring myself to believe that the acetic acid is the distilled gospel of immortality, but is it not possible that there may be *something* in "W. A. W's." ideas? I have long had a profound conviction of the possibility of some such discovery.

Kappa.

No More Death.

Sir,—I think I am entitled to complain of the tone of your remarks in "Powder and Shot" last week. The editor of a paper like the *Weekly Times and Echo*, which evidently holds the well-being of the people high, and strives to promote the prosperity of the nation, should at least take trouble to understand rightly what he writes about before he indulges in badinage.

It is perfectly true, as you announced last week, that I have discovered the great secret how to live for ever, but I said nothing about *mineral* deposits in the body, nor about the *blistering* effects of the medium I employ.

I was convinced, while yet a boy, that what we call old age was never designed by our Creator, and that it is not man's inevitable lot to die at any given period of time. I gradually began to look at the changes which take place in man's physical structure, and found that he changed from a fluid being to a solid being, and that life and all its enjoyments decreased as the solidity of the body increased. Years ago physiologists discovered that the body of an old man who dies from what is called death from old age, or a natural dec life, retains its functions up to death. Yet say that decay causes the body to become li The human body does not decay as long as in it. It only begins to decay after life be extinct. It is impossible for life to decay, because it is one continued stream of disembodied compounds; and when man becomes acquainted with God's laws and designs, and obeys them, his life's machine will not stop working, or show any signs of decay. I pondered much on these matters in my early years, and became a miserable man, doubting the soundness of my own mind, till 1852, when a thought was given me that acid would dissolve the waste compound deposits in the body without destroying the living flesh, if properly applied. All the mineral compounds taken into the body in what we eat or drink, and which cannot be converted into life, are sent out of the body, on all parts of its surface, through what may be called drain-pipes, through which the dross from the food is carried, in the form of a solution, and deposited on the top of the skin. When this is allowed to remain exposed to the action of the atmosphere it becomes solid, and sets like cement, blocking up the drain-pipes of the body, and stopping the waste matter from leaving the body. Hence the latter gradually accumulate, till the body becomes one solid mass of waste matter without life. This is what we call death from old age. Analysis shows that 95 per cent. of the dead matter which remains stationary in our bodies is organic matter, in combination with sulphur and 5 per cent. of mineral matter—sodium chloride, silica, calcium phosphate, carbonate, and traces of iron and lead. These apparently harmless, but deadly, compounds which accumulate in the human body, and dry up the natural fluids which give it life, would never have been discovered by scientific research because they become soluble, and cannot be distinguished from the flesh when analysed with the flesh. Neither would any man have persevered with the experiments as I have done, but the man who could see at the beginning the results that would be produced. These facts will be readily proved by those who attempt to follow my example. The material body is built up from these compounds; they are necessary for its existence. The great secret of life is to know how to clear away the surplus stock of these materials which gradually accumulate in the body. This material begins to destroy life the moment we begin to live—at least as soon as we begin to take food. Clear it out of the body as I can do, and in my own case have done, and there is nothing to hinder man from living for ever.

Glacial acetic acid (not the common acetic acid sold by ordinary chemists, but *glacial* acetic acid) is the medium by means of which I have extracted the matter out of my own body. The best parts to commence to experiment with are the feet and legs. One part of the acid to three of water is about the right strength for the hardened parts on the heel and thereabouts; for the tenderer portions of the body one part of acid to five of water will be strong enough. Apply with a sponge fastened to a square block of wood. Well wash the legs in the ordinary way, and then, having washed the sponge, wring the water out, soak it in the acid and water, and well rub the legs. Shampoo the legs with the hands, and you will at once begin to bring the waste matter away in quantities that will surprise you. As the skin cleans, the waste matter in the body will make its way to the surface, and will have to be removed in turn. Patience and perseverance are necessary. People who have led a healthy life, feeding properly, and pursuing cleanly occupations, may have less waste matter in them. Mechanics and others, leading more rough lives, with hard and grimy hands, will need more cleansing. It has taken me six years to cleanse my hands. It is not necessary for health that the hands should be made clean. When I began they were completely full of dead matter, and they are now full of pure blood, of a beautiful pink-like appearance, fresh and new as the hands of a child. All the other parts of the body can be restored in much less time; and when the body is once clean there is no difficulty afterwards in keeping it clean by the same method.

I am now seventy-two years of age. I carry a photograph of my baptismal register in my pocket, because few who do not know me will believe I am that age. I am as well and hearty as it is possible for a man to be. I have long since made a moderate competence at my business—so that it is no hope or desire of gain that leads me to seek to make my discovery known. I enjoy life's pleasures innocently and moderately—but as vividly as I did at twenty-five—and *I can afford to wait* while the world goes on with its dying in miserable ignorance of the glorious emancipation from death I strive to teach. I have not met with such an encouraging reception at the hands of scientific men and physiologists as encourages me to push the matter. I have not even published the book of which you, sir, had a copy. I will answer no idle or impertinent questions, but I will strive to satisfy any honest inquirer. Any man with a sound constitution can accomplish what I have accomplished at any age, if his mental faculties are good, and he will find that life's machine will work as freely as in youth, when he has cleaned the dirt out of it. Life's enjoyments soon disappear after man leaves off the natural pursuits of youth; he then becomes the stiff old man.

W. A. W.

THE BOEHM FLUTE.—III.

[28891.]—MR. CARTE'S 1867 flute is an improvement on the 1851 flute, and has the following differences from that instrument. The long F sharp key was removed, and a finger-piece to make F natural, was placed beside the one for F sharp for the first finger of the right hand, so that in the key of C, or in the flat keys the player could make F natural as on the Boehm flute, whereas in the sharp keys he had the advantage of being able to use the old F sharp, and could avoid the awkward cross-fingerings which the Boehm fingering necessitates in the sharp keys. The fork F natural fingering was done away with, and in its place, the Boehm F sharp, made by the third finger right hand was added, to be used for accidentals occurring in the flat keys or key of C natural. It will thus be seen that, as regards the perfect venting of the note, this flute carries out Boehm's system more perfectly than his own fingering did, for the ordinary F sharp used in all the sharp keys on this flute is not at all veiled, whereas even the best F sharp of the Boehm fingering is slightly veiled, though not, however, enough to be considered a fault. This instrument is now known as the "Carte and Boehm system combined, 1867 patent flute," although many improvements have been made in its structure since that date.

The difference between Carte's 1851 flute first described and the flute known as the Radcliffe model is that the latter has not got the open D, that it has the closed, instead of the open, G sharp, and that the first finger right hand closes the upper thumb key by means of a separate lever instead of its ordinary finger-piece. It is, therefore, considerably more like the old flute, and, in fact, in the two lower octaves presents no changes from it excepting the modern C natural, and B flat, the long F key (before described), and the fact that the upper C sharp, being properly vented, is fingered like the lower one, with all fingers off. It is hardly necessary to say much about the flute on the old system of fingering with the cylinder bore, the fingering being the same as the old eight-keyed flute, except that the upper E is fingered as on the modern flutes; that the upper A has a new fingering, and the upper C sharp is made usually with all fingers off, as it is done in the middle octave. Rockstro's model flute is nearly the same as a Boehm flute. His pamphlet and description would lead one to believe that all improvements on flutes were concentrated in this one. These improvements extend from 1852 to 1864, and are thirteen in all, and I will briefly enumerate them.

1. A contraction of the spacing of holes, so as to bring all nearer to the centre of the instrument.
2. A new F sharp lever for the third finger of the right hand.
3. A principle of tuning adapted to the cylinder flute similar to No. 1 improvement.
4. Larger holes than any heretofore.
5. Enlargement of bearing surface behind the keys, which control or act on one another.
6. Separate lever for the G sharp key.
7. Increase of length of the shanks of the keys.
8. Modification of the keys on foot-joint for slurring.
9. New lever for taking B natural with the first finger on left hand.
10. A new key connected to C and D shake keys for improving a number of shakes.
11. Lever to partly close C natural by second finger left hand.
12. A small hole at the upper C sharp.
13. The perforations in the five front keys.

These may all be classed under three heads.

Those that deserve consideration, viz., 2, 9, 10, 12.

Those that are doubtful at present, viz., 1, 3, 4, 11.

Those that are adopted by other flutes, viz., 5, 6, 7.

No. 13 deserves, however, more than a passing notice, as it is strongly recommended by the author. It consists briefly in putting rings, or keys, having a central hole, for stopping by the finger, on the five holes in front, viz., E, F, F, sharp A, A sharp, instead of the solid or closed keys now used on all cylinder flutes. Regarding them, he says, "Some amateurs have a strong objection to the perforations in the keys, thinking that there is a difficulty in covering them, and not being aware of the advantages obtained by closing the ring of the key, while leaving open the small holes in the middle of it. To such it should be explained that there is no difficulty in stopping these small holes, unless the fingers be absolutely deformed, but that if the feeling against them should be too strong to be overcome, it is indispensable that the key for the first finger of the right hand be perforated, otherwise one of the most useful of the extra fingerings will be lost. There are other objections which will occur to most players, not the least being the difficulty of padding such keys well; and the loss of freedom of hand consequent on the obligation to accurately finger these perforations.

Lastly, Messrs. Collard's double-hole flute is worthy of attention, although it has not yet been much taken up by professional players, partly on account of its complication and the difficulty of keeping it in order; also I am told that the touch, or ease in closing is not quite so light as some of the older systems, yet it is an attempt more or less successful to obtain fuller tones. The material employed for flute tubes seems to vary like the fashions. Many years ago German silver was the correct thing. Woods next took its place, commencing with boxwood: they ended at cocus; ebonite next came to the front, and now we are getting into the rage for pure silver. It is often stated by scientific investigators that the material of a sounding tube has no part in the quality of the sound produced, provided that it is air-tight, and non-elastic; yet we hear of church organ builders blaming the composition of the tubes of their rivals, by saying they have too little tin, or too much lead, &c., to produce the desired brightness or other quality. It is also easy to make organ-pipes of almost any chosen material, but few can imagine the dismay! of a flute maker if he was obliged to produce an instrument of pine wood, tin, cardboard, or similar materials. Ivory, glass, porcelain, tortoise-shell, horn, and other materials have all been tried and condemned for reasons too many to consider here. There are only three materials at all suitable for the body or sounding tube, viz., hard woods, ebonite, or metals. Boxwood is perhaps the oldest favourite, but the objections to its use are—that it expands too much when wet by the breath of the player, rendering the joints difficult to manage, so as to be tight without jamming. Also it is comparatively soft, and easily worn at the ridges of the holes, and thus liable to leak at the pads after two years' use. Rosewood and ebony have these faults, but in a less degree. The two best woods are African black wood and cocus, and the latter is by far the most satisfactory.

June 14.

Vulcanite.

FAN VENTILATION OF MINES.

[28892.]—WOULD "Hewer," or other valued correspondent, kindly say if, in calculating the water gauge and power requisite for circulating air through a mine (by exhaustion), it is sufficient to estimate alone for the friction of the air in the drifts or passages, or if, in addition to this, the water gauge (or power) requisite to produce velocity, as apart from friction, must be estimated for? I understand that the coefficient for friction is taken at ·0000150234in. of water gauge for each square foot of rubbing surface at a velocity of 1ft. per second. If the rubbing surface = 46,200sq.ft., velocity = 20·83sq.ft. per second, and area of shaft or gallery = 48sq.ft., the water gauge for friction is, I believe, found thus:

$$\frac{\cdot0000150234 \times 20\cdot83^2 \times 46{,}200}{48} = 6\cdot25\text{in.,}$$

and thus the power required: 20·83 × 60 × 48 = 60,000c.ft. of air passing per minute, and

$$\frac{60{,}000 \times 6\cdot25 \times 5\cdot2}{33{,}000} = 59\cdot1\text{H.P.}$$

Now, what I desire especially to know is if this covers also the power required to produce velocity, or if, in addition, an estimate for the latter, as apart from friction, must be made, and, if so, by what rule is this done?

There seems to me very great differences of opinion as to the coefficient for, or measure of, friction, some authorities stating it is about [illegible] of the above water gauge, and from estimates which have come under my personal observation I should think the figure (equivalent to a pressure of ·0000781217lb. per square feet, or ·000967716lb. of air column) too high, or, at all events, that it covers *all* resistances.

I have a case immediately under consideration as follows:—

Area of upcast shaft available for air passage = 35·5sq.ft.

Depth of shaft 1,322ft.

Required to pass 88,000c.ft. of air p[illegible] velocity equal therefore 41·2ft. per second.

Perimeter of shaft = 21ft.

Rubbing surface, 1322 × 21 = 27,762 [illegible]

By the above rule the friction w[illegible]

$$\frac{\cdot0000150234 \times 41\cdot2^2 \times 27762}{35\cdot5} = [illegible]\text{in.}$$

and the power

$$\frac{88{,}000 \times 20 \times 5\cdot2}{33{,}000} = [illegible]\text{H.P.}$$

which seems quite out of all rea[illegible]

At present, by furnace and [illegible] chimney, [illegible] is being passed per minute a[illegible] water 0·75in., and as the resistance [illegible] increases [illegible] square of velocity, it would [illegible] for the [illegible]

$5{\cdot}5^2 : 0{\cdot}75 :: 41{\cdot}2^2 = 4{\cdot}68$in. only, and the

$$\frac{88,000 \times 4{\cdot}68 \times 5{\cdot}2}{33,000} = 65\text{H.P.}$$

an one-quarter of the above—i.e., would ree with other authorities than Atkinson. must, therefore, necessarily be something out these calculations; for in a case in passing 100,000c.ft. per minute through a 70sq.ft. area, exhausting from a mine of ous area, the water gauge for all resistance 1. If estimated by the friction coefficient entioned, and by the rubbing surface, the the fan would unquestionably come out h higher.

is yet another point which I should much ve explained. When speaking of the rubace, am I to understand the side, bottom, urfaces of all the air passages in a mine, hose of the upcast shaft? There must be a line drawn somewhere, as it would t impossible to get at all the surfaces the passing air currents in a coal mine, manifold ramifications, and, if obtained, e factor, introduced into a calculation hat above referred to, would show such drawbacks as would be quite unmanage-

M.

THE STOAT.

]—THIS rapacious member of the blood-*Mustelidæ* (all of them the terror of ards and game preserves) lately astonished new fact, proving him to be an expert ier. Some months ago I was informed e old specimen was seen running along in of my water, and merely supposed he cooling his thirst. A few days ago I he broad gravel-bed of a sharp rapid with young salmon and shoals of trout. gaged in spinning a natural minnow as a the latter fish. My minnow having been by a "run," I took it off and threw it oceeding to replace the bait with a fresh aring a rattling of the pebbles near my feet, downwards, and there, to my surprise, ge stoat advancing quickly to seize the had dropped when baited. To save my houted. The bold animal merely walked swift stream, swimming over the rough e a feather, only his belly touching it, propelled himself actively with his four t. He went ten or twenty yards to a rock, running up the slope in a nimble ok himself, looked at me, then leaped off ite side of this rock and swam over to a od. Here are two remarkable circum-onnected with this adventure. Not one yards behind me, where the little animal d to seize my minnow, there is an over-abbit warren and pheasant cover where obtain as much blood as he chose to I stood up, mind, on the shore, and it is hat the scent of fish should have over-notice of my presence. My trusty terrier vermin killer—was basking in the sun-hundred yards from the water, or would ed the intruder before he could reach the bank—about fifty yards of swimming in urrent. I could not manage to pick up stones at the enemy, being encumbered ing tackle.

Eos.

IATURE OF MOLECULES.

]—I WAS very much struck with Mr. s theory as explained in the number for etter 28803. I have just read something ne order of ideas which may interest him book called "Un Voyage à Sirius," by de. If Mr. Schwarz would like to have the in question, I would have much pleasure g them to him if he will advertise his

Liege.

]—I REALLY cannot remember whether any discussion on the matter when I first the subject, now, I dare say, 16 or 17 years not, however, see that there is much base ssion. Mr. Schwarz is, however, mistaken ing "that I have let the cat out of the giving the name of a book I have pu-That "Sigma" is the nom de plume of rague in these columns has been well or many years, and the series of articles in r, which were the origin of the book, bore nes. In fact, I wrote anonymously as ' for several years; but when I took to what was meant to take a permanent form k, it was necessary to use my own name. etain my old signature in these letter from habit, and because it is a shade more in discussions with some of those who e to our information and amusement. Of I have not written much for the last two years, new readers might naturally sup-a nom de plume involves disguise.

Sigma.

WATER-WHEELS AND TURBINES.

[28896.]—HAVING read the letter of "V. I. A.," and also that of "Engineer, Govan," I am sorry to say I cannot agree with the remarks of the latter; with regard to the former's practical letter, I think some of it is very unpractical.

"V. I. A." says the largest water-wheel he knows of is, he believes, 150ft. in diameter. Will "Millwright" please state the probable cost of such a wheel, &c., &c., and the necessary gearing to obtain 629 revolutions per minute (now, in my particular case, there was only the exhaust fan that wanted to run more than 130 revs. per min., and that was easily managed)? As to the cost, I must refer him to my reply in No. 1,198—for I cannot go into that question further than what I then stated.

As I had never heard of such a monstrous thing as a wheel 150ft. diam., I have taken the trouble to ascertain from good authority its true size, when I find it to be 60ft. diam., 2ft. 6in. wide, and takes the water at a height of 50ft. No one in his senses, I should think, would ever put in a wheel 150ft. diam. I should say that would be the place for a turbine.

"V. I. A." then goes on to say he could name three firms at least who would guarantee 20H.P., if not more, with the quantity of water I am using. Now, as there is but 13·25 in the first instance, and 17·25 in the latter, theoretical H.P. in the quantity of water, I fail to see how they will do it. I have always been taught that the effect could never be greater than the cause.

With regard to his seventh statement, I have to observe that it is evidently copied from a testimonial published by a firm of turbine makers in the North. It is almost word for word as the original stands, with the exception that it was a breast-wheel, replaced by a turbine, and not an overshot. How could an overshot 18ft. diam. be worked with 8ft. fall?

Lastly, he says some men hate any kind of mechanism above a sewing machine; and when they look for the first time on a set of triple expansions, moving a big steamer, are lost, as a rule. Now, as I was employed for a number of years in one of the largest and most eminent marine firms in the country, I don't think the sight would frighten me. And is not "V. I. A." aware that even at the present day the paddle steamer holds its own for speed in smooth water; and that the fastest boats that ever crossed the Channel are paddles; so that they have still their place, as well as a water-wheel and turbine have theirs?

To sum up the matter, I am aware there is a limit as to the diam. of a water-wheel; but, say, for a 30 or 40ft. fall, and you do not require an excessive speed and moderate power, I for one would use an overshot wheel in preference to a turbine, for I believe it would be more efficient; but if you have a very high fall, or require to run machinery at a great speed, or want hundreds of horse-power, then use a turbine.

To "Engineer, Govan." In answer to the latter part of your letter, I should think it much the best under the circumstances to use a turbine.

I beg to say that, as far as I am concerned, this ends the discussion, as I do not think it can serve any useful purpose.

Millwright.

INDUCTION COILS.

[28897.]—I trust Messrs. Allsop and Striffler will pardon my delay in answering their kind letters of 11th ult.; it was due to pressure of work.

As Mr. Allsop points out, the terms suggested by me are perhaps not so happy in their selection as they might be; still, it is very certain that distinctive and definite names are required for the various types or transformers of intermittent-alternate, alternate-alternate, and alternate-intermittent, &c., conversion.

The Committee of the Soc. Telegraph Engineers and Electricians, whose labours in the revision of electrical nomenclature seem very protracted, will doubtless see to all this.

I am unable to refer to articles quoted by Mr. Striffler in Vol. XLIII. Of course I am perfectly aware that the idea of closed mag. circuits in not a modern one, seeing that Faraday (statue at Royal Institution) holds in his hand the typical semblance of a closed magnetic ring.

W. Perren-Maycock, A.S.T.E.

THUNDERSTORMS AND LIGHTNING ACCIDENTS.

[28898.]—AS the season of thunderstorms and lightning accidents is now approaching, I hope you will kindly allow me to make known, through your columns, the fact that in the interest of science, the Institute of Medical Electricity is very desirous of obtaining authentic information concerning lightning accidents, whether fatal or otherwise. I should therefore esteem it a favour if some of the many friends of humanity, among your readers, will assist us to investigate these phenomena by sending me such particulars of accidents of this nature as they may have personal or reliable knowledge of as soon after they occur as possible.

Of course electrical and physiological details are what we most require; but reliable general information is often very valuable, and will be gratefully received.

H. Newman Lawrence, A.S.T.E. & E.

Electrician to the Institute of Medical Electricity
24, Regent-street.
London, S.W.

PROPULSION OF STEAMSHIPS.

[28899.]—WITH reference to letter 28818, page 329, what I proposed was to attach a ram to the piston, so that when the inner stroke is complete, the end of the ram is flush with the nozzles of the cylinders, the object being to prevent the backward tendency of the vessel, which the piston, when making the inner stroke, being inclosed in a cylinder, performs the duty of a repeller (or a stick in the mud), rather than a propeller; but really I have so little hope in ever seeing the piston supersede the screw, that I think we might as well let the subject drop until something more promising occurs.

If the object of "T.M." is to confine the whole of his apparatus within the lines of the hull, he might as well stow away his hands and feet, and try to swim without them.

John. W. Hillier.

Upper Holloway, June 12th.

OCCULTATION OF A STAR BY JUPITER.

[28900.]—YOUR correspondent R. T. Lewis (letter 28843, p. 351) is mistaken in supposing that the object he saw emerging from behind Jupiter on June 10th was a fixed star. It was, in fact, the first satellite, which was due to reappear from the shadow at 9h. 40m. 31s.

The star he saw was 47 Libræ, magnitude about 6·5, and on the evening of the 10th it was considerably east of the planet, between the second and fourth satellites. Conjunction took place about 11 a.m. on June 10th, when the star was about 13" from the centre of Jupiter, so that an occultation seems to have taken place, but it was, of course, not visible in England.

A. C. Crommelin.

SAFETY REAR-DRIVERS.

[28901.]—SEEING that the rear-driving type of safety bicycle has now become so popular, there is no doubt that many readers of this paper (myself included) would welcome a series of articles on the construction of a machine of this class. Starting with a complete set of fittings and stampings, as supplied by many firms, explicit instructions for fitting them up, with hints as to chucking, turning, boring the hubs, &c., would be very useful, not only to those wishing to build a machine, but also to possessors of machines, as it would enable them to repair their own mounts.

An explanation, with rough sketch, if possible, of the driving action of the American Star Safety Bicycle, would greatly oblige.

F. J. G.

Mars.—ERRATA.—En vous remerciant du bienveillant accueil fait à ma communication sur Mars (p. 351) je me permets de vous signaler les fautes d'impression suivantes qui s'y sont glissées: Herculis pous, au lieu de pons; Tithonicus, au lieu de Tithonius; Achillis pous, au lieu de pons. Le Trivium Charontis et Elysium se trouvent . . . au lieu de se trouvant. Neigente, au lieu de neigeuse. De pâleur de Mare Tyrrhenum, au lieu de, la pâleur . . . ou haut du disque, au lieu de au haut.—DR. F. TERBY.

Electric-Light Fires.—The frequency of conflagration caused by electric-light wires induced the Electric Club of Philadelphia to inquire into the means of preventing them. At a recent meeting, the report of a committee of four months' standing, under the chairmanship of Mr. H. B. Cutter, was presented. The various automatic cut-outs proposed by different inventors were considered, some utilising the heating of a wire, some the action of a spring pulling against an armature of a magnet. The old arrangement of a fusible alloy cut-off was pronounced objectionable on account of the interruption produced when it melted, but this was obviated by an arrangement for throwing other fusible pieces into the circuit one after the other. Thus a momentary increase of current would only cause a momentary stoppage. It was evident that there is a good field for inventors here, in devising an efficient safeguard against too strong currents that may accidentally be thrown upon a wire unable to carry them without heating.—*Scientific American.*

REPLIES TO QUERIES.

⁂ In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.

[65056.]—**Box Tunnel.**—I send you a copy of a paragraph I happened to see while looking for something else in an old volume of the *Family Herald* of May 4th, 1850, as some sort of answer to this query. "Box Tunnel, which is 3,192 yards in length, was an object of some interest on Tuesday, the 9th of April, as on that morning, at twenty-five minutes past five, the sun shone through it; the only other periods that such an event occurs are on the 3rd and 4th of September."—S. REYNOLDS.

[65159.]—**Compounds on G.W.R.**—There are two compound engines on the G.W.R. No. 7, a N.G. 4-coupled, outside frames, 7ft. wheels, h.p. cylinders 15in. by 21in., l.p. cylinders 23in. by 21in.; built at Swindon, Feb., 1886. No. 8 a B.G. 4-coupled, inside frames, 7ft. wheels, h.p. cylinders 14in. by 21in., l.p. cylinders 22in. by 21in.; built at Swindon, May, 1886.—IXION.

[65199.]—**Golf Balls.**—The paint is white, without blue tinge; dense and opaque, to minimise quantity used; elastic and adhesive enough to prevent cracking or peeling off the guttapercha balls. DORMI.

[65274.]—**Cost of Engines.**—Beam-engine costs more to run, as there is the friction of the beam and the weight of it and other parts.—J. T.

[65288.]—**Self-Testing Sums.**—How comes it that an "Assist. Inspector" has to ask how to arrive at a good system of self-testing sums? Surely he ought to know.—ARITHMOS.

[65300.]—**Stereo Metal.**—Of course, the alloy is rotten. Zinc and lead will not mix well, but a little lead can be added to zinc—say 10 parts lead, 90 zinc—with advantage for some purposes. The mixture of stereo metal, zinc, and compo. cannot be good. For casting purposes zinc should be extracted, and hardness be sought by the addition of antimony or tin.—NUN. DOR.

[65302.]—**Common Perfumes.**—Gather the blooms when most odorous, and immerse them in purified fat. Then extract the perfume from the fat.—GOILES.

[65308.]—**Boiler.**—Doubtful if you would get six miles an hour out of such a launch with such an engine. In so small an affair you would need about 10lb. of coal per actual H.P. per hour.—T. M.

[65317.]—**Air-Pump.**—Nothing better than best olive oil. Of course it is possible to prevent leakage, if the parts are properly put together.—SELIM.

[65318.]—**Chloride of Gold.**—If my correspondent "Chemist" finds any pleasure in setting up any number of men of straw, fathering on to me, and then proceeding to demolish them, I am sure I for one will not deprive him of so innocent an enjoyment. His variously compounded waters have certainly the charm of novelty. So also has the deduction that in order to neutralise an acid solution it is necessary to present the calcic carbonate in the form of solution in water charged with an excess of carbon dioxide. I wonder how many photographers have used this last "elegant preparation" instead of a pinch of chalk? Perhaps "Chemist" is not aware that neither the chlorine nor the hypochlorous acid as such are the real bleaching agents in chloride of lime; but simply the nascent oxygen set free by their action.—S. BOTTONE.

[65321.]—**Model Locomotive.**—"Athenian" says he wishes to make a working model locomotive. I do not think there is anything to prevent him, and instructions have often been given. Let him take the main dimensions of some locomotive, reduce to scale, and, instead of a large number of tubes, use only a few of best brass.—T. M. P.

[65323.]—**Case-Hardening Cast Iron.**—Why does "L. E. H." want to case-harden cast iron? Won't chilling do?—DOUBTER.

[65330.]—**Plating Dynamo.**—May I venture to criticise the designs of so old and valued a contributor as Mr. Bottone? On page 311 he shows sketches for plating dynamos which, as regards provision for the magnetic circuit, seem hardly consistent with modern practice. The F.M. cores in each case are thick enough; but the lines of force have a path provided which practically requires them to turn round sharp at right angles twice before they enter the pole-piece—which, it is needless to say, they will not do.—W. PERREN-MAYCOCK.

[65330.]—**Plating Dynamo.**—Mr. Beaumont is quite correct; and any dynamo may have, within the limits of critical speed and resistance to enable it to give current at all (if shunt-wound), quite an indefinite number of amperages. But in practice the limits are not large. We are tied pretty closely to a certain angular velocity in the armature, beyond which we cannot very well go, for mechanical reasons, and below which it is not economical to work. These limits are found to lie between 1,200ft. per minute for very large machines of low E.M.F. and 2,200ft. per minute in smaller machines; and although it is perfectly possible to increase the E.M.F. of a dynamo by driving faster, yet, apart from mechanical reasons, it is not advisable so to do, as the wire, &c., on the armature will always have been calculated at a gauge to carry a given number of ampères without injurious heating. Therefore, if by any means we increase the ampèrage of the dynamo beyond what the wire was originally calculated to carry, we risk to break down the insulation. The usual length of copper conductor cutting the lines of force in our average modern dynamos is about one yard per volt, at an average angular velocity of 1,700ft. per minute. In replying to "Mc," I had, of course, in view the fixed conditions of speed, size, and capacity of vats mentioned by the querist. If H. C. Beaumont desires to go more deeply into this interesting subject, he will find full details in Dr. Frölich's article in the "Monatshefte" of the Berlin Academy of Science for Nov. 30, 1880; also in W. B. Esson's "Magneto and Dynamo Electric Machines" (Whittaker and Co.), pp. 140 to 181; and last, but not least, in Prof. Silvanus P. Thompson's "Dynamo-Electric Machinery," second edition, page 241, et seq.—S. BOTTONE.

[65354.]—**Steam.**—I thank both "T. C., Bristol," and "Marienberg" for their answers; but they will, I think, acknowledge that no explanation has been given to my question—"Why and where is this discrepancy, and how explained?" I, of course, accept the figures as correct; but as I am going to try for better results, I was expecting that there was some reason, unknown to me, which made engineers contented in accepting the result of $\frac{1}{13}$th of theory as an "Ultima Thule," beyond which it was useless waste of time and study to strive for improvement. However, I will just name the points in which the present engines appear defective, and trust later on to test the truth of my investigations by putting the results before the readers of the "E.M." "T. C., Bristol," hits one spot, when he says "heat is abstracted by the condensing water." Granted, it is; but should there be so much or any heat thus lost? Ought not expansion to be continued until all heat has been converted into work—all latent heat, I mean—and the condensed steam returned to the boiler without sacrificing any portion of it in the condenser, every degree such steam carries to the condenser being evidently lost. I presume his 16lb. steam-pressure refers to a condensing engine. Now, allowing 30lb. of feed per H.P., this for 500H.P. = 15,000lb. only, whilst I find 13 tons of water in one case maintained to supply steam to an engine of that power (I.H.P.)—i.e., 29,120lb. of which per minute only $\frac{15000}{60}$ = 250lb. is used! I take it that keeping the weight of 28,870lb. water in a state of vibration sufficiently rapid to generate the temperature of 335° and 105lb. pressure must be a source of great waste—that is, if the kinetic theory be true. I fancy, also, that the proportion between cylinders should be such that length of stroke should govern it—say for three cylinders, each with 3ft. stroke, as 1, 3, and 9ft. piston areas—so that with cut-off = one-third we should have 27 vols.—1 = 28 expansions, which will convert all the latent heat into work; in such arrangement the cubic contents of H.P. cylinder will pass into second, and just fill without expansion one-third of it, expanding two-thirds, and when filling the second cylinder having 9ft. vol. (this again being one-third of the third cylinder capacity, and expanding two-thirds, the cranks being equi-distant). I shall be glad to know what is thought by both "T. C., Bristol," and "Marienberg," and others on these matters, and will then advance one or two more; but will not trespass too greatly now on the Editor's space. I intend to work with 105lb. + 15 = 120lb. pressure. What will friction amount to in pressure per inch of largest piston—I mean, allowing for a back-pressure of 3lb.? What will friction increase the resistance to? Does "T. C., Bristol," mean that it will only amount to additions of 1lb. or 2lb. to the b.p.—PUZZLED ONE.

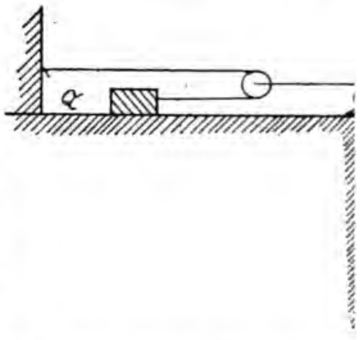
[65402.] — **Electricity.** — Gordon-Wiga[illegible] "Electrician's Pocket-Book" possesses ma[illegible] merits: of arrangement, perspicuity, type, and illustrations. Munro and Jamieson's "Pock[illegible] of Electrical Rules and Tables" (Griffin [illegible] though deficient in the above respects, is [illegible] commended on account of the greater [illegible] subject and newness of information.—W. P[illegible] MAYCOCK.

[65428.]—**Throttle-Valve Grinding.**—"T. C., Bristol."—I have done as you req[illegible] and found all working parts in good order, [illegible] that the throttle valve lets a deal of steam [illegible] when it is supposed to be shut off there; the[illegible] the engine runs very quick at times. Now [illegible] want to know is, how to grind the valve [illegible] steam-tight if possible. Valve is 20in. fr valve with slow motion governor.—FIREM

[65447.]—**Finishing Billiard Ball** directions for making and finishing thes found in Holtzapffel's fourth volume, following pages.—G. C. C.

[65467.]—**Gloomy London.**—This most noticeable when the wind is at all The fogs and mists rising from the marsh border the whole east of London are blo the metropolis, unite with the smoke, an in suspension.—W. PERREN-MAYCOCK.

[65472.]—**Problem.**—The suggestion query as to starting a train by the forc powder is absurd; but if a little more allowed in which to get up speed, the pro comes an interesting though somewhat dif in dynamics. I should be glad if any mathematical correspondents would read see if my argument is correct. Suppose an ment of weights and pulleys as in the



moving without friction, Q representing P a weight which by its descent moves zontally; it is evident that Q moves twice P, and by introducing more pulleys it n arranged that Q moves n times as fast object of the pulleys being to avoid an u able depth for P to descend. Now what w is a formula which will give us the weig we are given n (as above), and also g weight of the train, or Q, and the velocity it to acquire in a given number of sec only difficulty is to find the accelerating velocity required in 1 second of P, usuall by f; and for this purpose we must use th formula for transferring energy to w energy is $\frac{Wv^2}{2g}$, which is equal to Wh foo h being height to which the velocity will weight when suddenly arrested. If f is v one second of P, nf will be that of Q energy will be $\frac{Qn^2f^2}{2g}$, which also repres pounds of work the motion of the tra perform if suddenly arrested. Now, in get an equation, we must find what wo done during the time, and equate the two of work; from the general formula S = $t = 1$ sec., $S = \frac{1}{2}f$, and the work done therefore be $\frac{Pf}{2}$; but at the end of one is moving with velocity f, which $\frac{Pf^2}{2g}$ foot-pounds. We, therefore, get th tion—

$$\frac{Pf}{2} = \frac{Qn^2f^2}{2g} + \frac{Pf^2}{2g},$$

from which—

$$f = \frac{gP}{P + n^2Q}.$$

Now, in the general formula, velocity = stitute the value of f just found, and $\frac{v}{n}$ is the velocity of P, that of Q being v), fo hand of the equation, and we get—

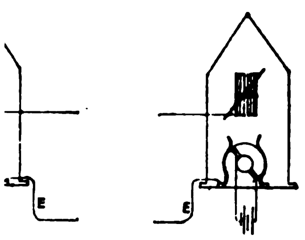
$$\frac{gPt}{P + n^2Q} = \frac{v}{n};$$

[illegible]ce, finally—

$$P = \frac{n^2vQ}{ngt - v}.$$

[illegible]ple.—Suppose $n = 2$, $Q = 100$ ton [illegible]o get up a velocity of 30 miles an [illegible]n a second) in 15 seconds, P will be [illegible]21 tons, f will be 1·47, and heigh [illegible] 65ft. If n were made 4, the ot [illegible] the same, P will be found 37·5 [illegible] 82ft. The train is supposed to [illegible] with the rope at the time t, and th [illegible]t that time, or $\frac{Pf^2t^2}{2g}$ might be s [illegible]essing air in a cylinder for futu [illegible]E., Bath.

.W. Telegraph.—TO MR. BOTTONE.
d sketch will give a general idea as

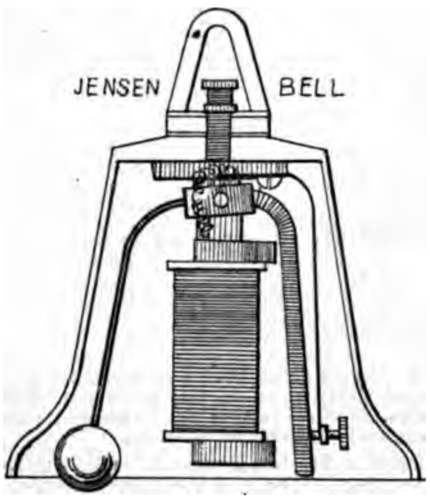


of connecting up two single-needle
with their respective batteries, keys,
h a short distance it would hardly be
o employ an earth plate, and ordinary
d wire, if not too fine, would answer
for go and return, provided no leakage
take place from one to the other. A
clanchés at each end would be ample.
ch, the return wire E E, may be re-
earth plates.—S. BOTTONE.

Survival.—Thanks to "Nun. Dor.";
ot answered my question—viz., For
whom the fittest? If he does not
ecortication," will "F.R.A.S." kindly
ifficulty? All I can make out is that
must be supposed to be the fittest to
species, or the fittest to improve—or,
up to the mark—their own breed.
carnivorous animals do not, as a rule,
asses of animals they devour, for they
terminate them; and it is equally
e finest and strongest specimens are
survivors (unless by the finest are
hose who are too sickly to live), for
prey will seize a fine specimen sooner
ll a lesser one; and millions of young
devoured by them before it can be
h will turn out prize animals and
hen a pike, e.g., rushes open-mouthed
f small fry (even of his own species),
regard to the rule of Darwinism?
can discern, the expression, "the
e fittest" must mean either nothing,
survive who do not die a violent or
eath from sickness early in life—a
hardly needed for its existence the
a Westminster Abbey to be honoured
Further, among creatures that pair,
tively weak obtain partners and pro-
s the strongest do; and, according to
human beings the weak and ill-fed are
ve the largest families. "Nun. Dor."
he slippery weaklings" of our race
but would not have done so when men
sed, and all had to rough it more than
present; so that the more the race
a rational animal, the more the
fittest survive—a fine conclusion for
to arrive at! "Sigma" prudently
ntroduction of man into the question,
at when man appears on a scene the
order of things comes to an end! So
ture has done its best stroke of work
e highest animal, it at once begins to
eding work, and to subvert its former
action. Australia, e.g., eliminated by
ion, all but pouched animals, and then
retched creature man, and introduces
rows, and what-not, and then begins
e extirpation of these, and he, as the
re, does this! "Nature's a rum 'un!"
ers, and she indeed is, if all this is an
her sense of fitness. It won't do to
ut of the account. In my question,
eant to do so, in order to render a reply
y expression, "slippery weaklings,"
d to refer to such creatures as rabbits,
allies" to lions, eagles, and other
eings of the like classes, those who have
nce of survival (at least in countries
xtent) being the creatures that are
or the other, such as deer, sheep, &c.
eep, the short-legged sheep of Canada
leap a wall are the offspring of a
nature through natural selection
. Without man's intervention, such
nals would have been the first to fall
lves, &c. Is man, therefore, to be re-
Nature's nature-created opponent?
law of natural selection, if it ever
be still in operation. Will man then
ning immortal and (so to speak)
he will not, natural selection is a
e will, and (as that would imply) we
n, as schoolboys say, "It's a great
natural selection didn't begin a few
es earlier so that we might have come
in the chain.—B.

.W. Engines.—The engines I mean
guished from those by Mr. Beattie of
1863, because those of the latter have funnel safety valves, and Mr. Gouch's have none; their wheels 5·6, cylinders 15 by 22.—G. L.

[65501.]—**Electric Bell.**—I send sketch of church bell about 10in. dia. by 8in. high, Jenson pattern. The illustration shows the mode of making bell. The bell itself forms one contact, the terminal screw projecting through the top of the bell, and properly insulated from it, forming the other contact. Make the core and pole pieces of best soft iron, and insulate same from bell with a piece of ebonite or boxwood.



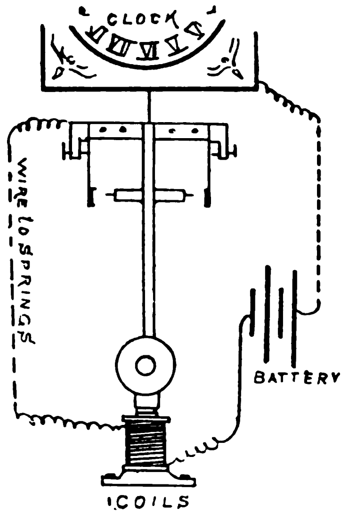
¼ FULL SIZE

Size of bobbin, 3½in. long, 2in. wide, and 1in. core. Wind with 1lb. of No. 22 silk-covered wire. You will require about six No. 2 Leclanché cells to ring the above if the circuit is short. If the bell be hung on a bracket, connect one of the battery wires to the latter, and the other wire to the terminal referred to, taking care not to let the bared part of such wire touch the gong. Any other information required will be supplied by—H. H. E., Electrician, Torquay.

[65504.]—**Electrical Tools.**—The tools I use for batteries are cutting pliers, screwdriver, and battery knife. I have used a "Jolin" pocket galvanometer for over a year, and have found it all that could be wished.—H. H. E., Electrician, Torquay.

[65506.]—**Melted Steel.**—The following is extracted from Greenwood's "Steel and Iron," 2nd edit. (Cassell and Co.'s Manuals of Technology):—The average melting-point of steel is considered to be about 1,800° C.; but this varies widely with the content of carbon and the presence of other elements in the metal.—W. H. COPE, Birmingham.

[65509.]—**Pendulum for Electric Clock.**—I send sketch, which explains itself. Of course you must adjust contact springs till you get the proper swing of pendulum.—H. H. E., Electrician, Torquay.



[65514.]—**Theory of Leclanche.**—The equation given by "Sm." on p. 358 is impossible, for it contains one atom of manganese and two of oxygen on one side, while there are two of manganese and four of oxygen on the other. I fancy it has been copied from Guthrie. "Sm." is not the first who has sent us the equation without noticing its inaccuracy, and probably he will not be the last.—WM. JOHN GREY, F.C.S., Analytical Chemist, Newcastle-on-Tyne.

[65517.]—**Fire Prevention.**—Nothing is better than a jet of steam for the prompt suppression of an outbreak of fire. The building should be constructed with sliding doors, and a 4in. steam pipe furnished with cock, fitted in about 2ft. above door; if practicable, the 4in. pipe should be lagged externally, and connected up to a boiler of ample size, volume being of greater moment than pressure of steam.—F. M. ROGERS, F.C.S.

[65518.]—**Focussing Screen.**—Expose a dry plate (I used a Wratten and Wainwright rapid) by placing it in a frame with a piece of black velvet in front of it, and then removing this rapidly either in dull daylight or in front of a gas flame—say 2sec. in the former case or 5sec. in the latter. Develop with ferrous oxalate solution, and the plate will be found to present an even, slightly granular surface, with a depth of tint depending on the time of exposure. Mount without varnishing, with a glass in front to protect from injury. I have found this an excellent screen in celestial photography where a very sharp focus is necessary; but for ordinary purposes a sufficiently fine ground glass is best, as light does not pass through so readily.—J. R. C.

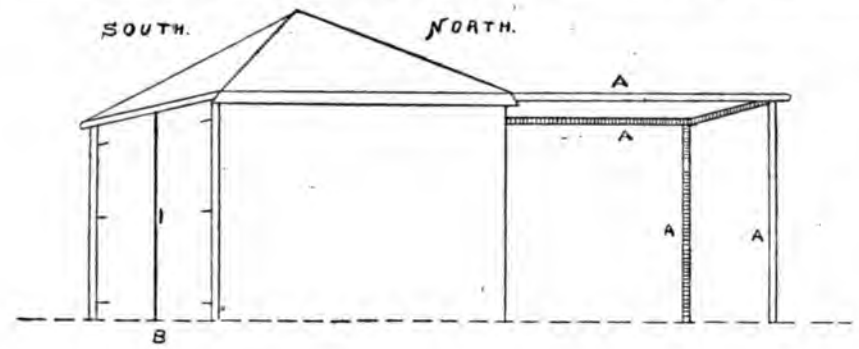
[65519.]—**Entomology.**—If my memory serves me, this is the Troglodyte (or "Cave Bee") not uncommon in dry places.—EOS.

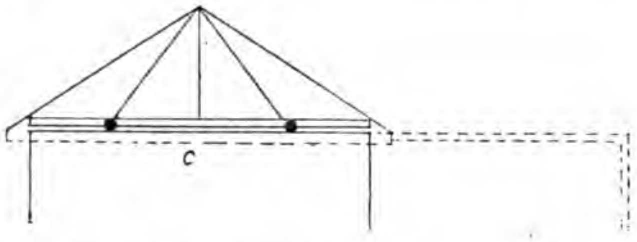
[65519.]—**Entomology.**—The little insect "J. B. P." inquires about is the mining bee (*Andrena*). It is one of the solitary bees, of which there are several kinds. Its habits are exactly as "J. B. P." describes. It makes a hole in the ground in banks, mostly of a southern aspect, wherein it deposits its eggs and rears its young. The female is an industrious little creature: it excavates the hole or gallery itself, and also provides food for its offspring without any help from the male, which, like the drone in the hive, and eke like some of the male sex of our own species, does no work, but spends its life in idleness.—W. B. G., Bedford.

[65527.]—**Water Power for Lathe.**—I should certainly advise you to ascertain the pressure, as on it depends the power you can get with your size of pipe. I made an engine to work from the town pressure, of the reciprocating type like a steam-engine; but, of course, with no eccentric, a tappet rod being used instead. But you had better apply to Bailey, Manchester, for a list of water motors.—C. ANDREW, Leamington.

[65537.]—**Ringworm.**—This is a vegetable parasitic disease which attacks the follicles of the hair, and is essentially a disease of childhood, rarely attacking adults. It is extremely contagious, but especially so when it first appears. Should R. appear in a family it may be prevented from spreading by well rubbing over the scalp (or parts affected: it most frequently attacks the scalp) every morning, carbolised glycerine ("Brit. Pharmacopœia"). The smell of this is rather unpleasant, but it is a capital remedy. Other precautions should be taken, however. It is most desirable to keep separate combs, brushes, &c., besides, all the clothes of those suffering should be washed separately, with a little carbolic acid in the water, but complete isolation is the best. Woollen clothes should be disinfected by baking in a hot chamber, or by subjecting them to the fumes of burning sulphur; this is most desirable with caps or bonnets. R. is very often spread in public schools by children placing the head-coverings of others on their heads. Treatment: For very young children a little tincture of iodine painted on once a day, to be followed by precipitate ointment. For older children, if on the scalp cut the hair short all round the place and apply Coster's paste (with a brush)—acetum cantharidis, or iodine liniment. Pure carbolic acid is an excellent thing, being very effective, but its application gives pain. I suppose "V. J. B." knows that there are persons who can go with impunity amongst persons who are suffering from some of the most fearfully contagious diseases without being attacked, but this does not prevent such persons conveying the germs of disease to other persons whose systems are more liable to contamination. There are persons who are pre-disposed to certain diseases, and who would be stricken down by the merest contact with a person suffering from disease, whilst there are others who seem impregnable to all diseases. I have answered this query in a full manner, hoping that the few simple remedies put forward may be of use to other readers of the "E. M." besides "V. J. B."—W. H. COPE, Birmingham.

[65524.]—**Observatory.**—If "No Sig." has sufficient space, he cannot do better than construct his observatory of galvanised corrugated iron, with a light peaked roof arranged to roll off entirely on to supports fixed to the north. Some time ago I had a simple observatory built after this fashion

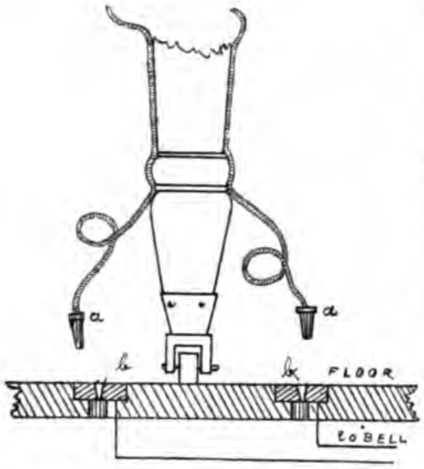




and find it exceedingly convenient and satisfactory in all respects. Description as follows:—Floor of concrete; dimensions of building, 10ft. by 10ft.; walls 6ft. high; roof a light wood skeleton frame covered with Willesden paper and supported by four grooved iron rollers running on light rails sunk in wall plate; door at south side, opening full width of observatory. I inclose rough sketch. A A A A are supports for roof when rolled off; B, door facing south; C, section showing rollers to run roof on to supports.—V. N.

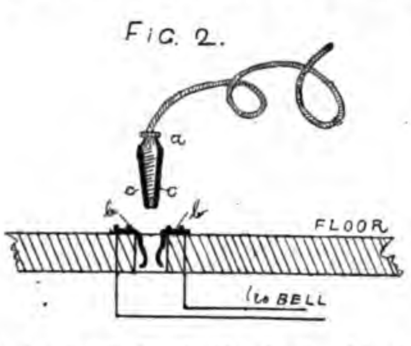
[65532.]—**Electric Bells.**—I send herewith a sketch showing two ways in which you can connect the wires on the table-legs with those on the floor. In Fig. 1 the wires down the leg terminate

FIG. 1



in two brass plugs (*a a*). Two brass plates (*b b*) are also let into the floor at the place where the leg generally stands. When it is desired to connect up the push on the table, the plugs (*a a*) are inserted in (*b b*), but when the table is to be moved, or connection is not desired, the plugs are withdrawn, and can be placed in two holes drilled in the table-leg. In Fig. 2 a twin wire is used down

FIG. 2.



the leg, terminating in the ebonite plate (*a*), which has a strip of brass (*c c'*) fastened each side. A hole is drilled in the floor, and two brass springs (*b b'*) fastened inside. The wires are connected up by placing peg (*a*) in the hole in the floor, which causes the plates (*c' c*) to make contact with the springs.—F. C. ALLSOPP, Brighton.

[65530.]—**Electric Bells.**—Fuller information is necessary as to mode of connection and requirements.—W. PERREN-MAYCOCK.

[65530.]—**Electric Bells.**—It is not possible to say definitely what is the matter with these bells from the information furnished. The connections are evidently crossed somewhere. If "Amateur" will look at Fig. 67 in "Practical Electric Bell Fitting," he will see how his bells should be arranged. If he is not able to put his bells right then, and will send rough sketch of his connections, I shall be pleased to point out the mistake.—F. C. ALLSOPP.

[65532.]—**Electric Bells.**—Flexible wires are in general a nuisance. Having wires already fixed to the table legs, you could not possibly do better than provide metal castors, the wires in the floor terminating in neat brass plates screwed down over carpet, say 2in. square, or, better, circular. The weight of the table will insure continual and effective contact.—W. PERREN-MAYCOCK.

[65546.]—**Field-Magnet Winding.**—No. For dynamo field-magnets the total diameter of the wound coil should not exceed twice the diameter of iron core.—H. H. E., Electrician, Torquay.

[65547.]—**Poles of Dynamos.**—Yes, there must be an open space between the two poles of a dynamo.—H. H. E., Electrician, Torquay.

[65548.]—**The Mint.**—The principle (not theory) of this machine is, that the balance does no work. The work is done by a revolving shaft, on which are suitable cams or cranks. The coin or other article to be weighed is placed on pan of balance while fixed at rest, the balance being then released by the mechanism remains, if weight be correct, level, but rises or falls if weight light or heavy. In the latter cases a pendant or arm of the balance gets in the way of the higher or lower one of two triggers; that one being then pulled by action of cam on shaft causes the delivery shoot to shunt to right or left, thus sending light or heavy accordingly. Correct weight is not shunted, since neither trigger is pulled. I have myself constructed a machine on this principle to check the work of boys weighing up large quantities of goods in ¼oz. packets.—F. G. LL.

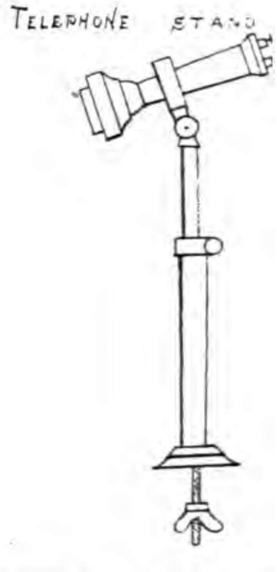
[65553.]—**Parrots Affected with the Gapes.**—Garlic is an excellent remedy for gapes in chickens, so probably in all other birds. I give it chopped up in soft food; but probably a parrot would eat the green leaves.—ROLYAN.

[65560.]—**Drying Stove.**—I should say about 300lb. of coal per twelve hours, if steam be taken from a boiler of the size mentioned.—MARIENBERG.

[65561.]—**Shocking Coil.**—The separate contact breaker should be wound with the same size as the primary. As you have it now, there is a great resistance placed in the circuit, which prevents a large amount of the current from passing. The primary wire need not be insulated from itself, but must be from the secondary. Wind the 5in. by ⅝in. core with two layers of No. 16 for primary, and about 6oz. of No. 36 silk-covered wire for secondary, and with a two-cell chromic battery you would get about a ¾in. spark if you have a good large condenser.—H. H. E., Electrician, Torquay.

[65562.]—**Working Printing**
Friction clutches are no use, but cone
Why not have pulleys on the shaft an
belt? Cone pulleys are risky in prin
there is a guide to prevent the belt tra
PRACTICAL PRINTER.

[65563.]—**Telephone Appliance**
sketch of telephone stand as used in
rooms of the principal telephone comp
telephone is held by swivel joint, which



to brass tube which slides in larger bra
base screw and fly nut, being held at
by suitable fastening. If you requi
send sketch drawn to size.—H. H. E.,
W.C. and S.W. Telephone Company,

[65564.]—**Dynamo.**—The size ar
state would not light more than four 5-
at the most. State how many lamps
to light, and I will send sketch of
dimensions that would suit you.—H.
trician, Torquay.

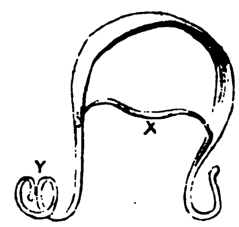
[65565.]—**Water Power.**—The wei
being 62·5lb. per cubic foot, and th
foot-pounds in a horse-power being 3
have to do is to divide 62·5 by 33,000
constant ·001892, as given by Mol
others.—T. C., Bristol.

[65565]—**Water Power.**—In full t
is $\frac{62{\cdot}4 \times Q h}{33000}$. But you will always
over 33,000 in any case you are
G. L. Molesworth simply divides 62
and multiplies it by the cubic feet per
the head, 62·4 being weight of 1lb. of
ought as well to reduce from the
efficient of inefficiency to get the
motor.—C. ANDREW, Leamington.

[65567.]—**Ice Cream.**—Freezers
zinc and pewter. Machines have a stu
on. A simple plan of making freezi
is the following:—Obtain a tin or
which must be perfectly water-tight.
in a pail or small tub sufficiently large
a space of 2½in. all round the tin for
Pack the latter in closely, and ro
quickly. In the course of fifteen
cream will thicken and freeze at the
should be scraped off and the tin again
the course of about half an hour the
be fairly hard; but much depend
weather and the amount of salt used
salt used the quicker it freezes. A
salt to four parts ice is a quick-free
See advertisement column for pa
making cream, &c.—L. BREWER, 3,
Manor-park, E.

[65571.]—**Shocks from a Basin**
Place a metal bowl or basin on
mahogany pedestal, or a dry, well-po
not metallic. Connect one terminal o
the under part of the basin, by means
wire. Lay a sheet of zinc, iron, or co
of the pedestal or table, where the
stand who attempts to take the coin.
join the other terminal of the coil to
plate. When a person standing o
attempts to take the coin from the
complete the circuit, and unless his bo
be remarkably dry and non-conduct
receive a smart shock.—S. BOTTONE.

[65563.]—**Telephone Appliance.**
sketch of head gear invented by M
Errington and myself, and patented



ears ago. It consists of a light steel
plated) which holds the receiver by
Y, and a light band of elastic, X,
head, carrying most of the weight,
ing holds the receiver to the ear. It
and comfortable, both for ladies and
They are very inexpensive, and can
from Messrs. Emley and Sons, New-
ie. We have also a similar holder for
ell tubes, officially tested and approved
.—FRANK CAWS, Sunderland.

Oxygen—Bodies Greedy of.—This
one too clearly worded. Were I called
ulate a list of chemicals which have
xygen, I should have to specify several
dies, both simple and compound, be-
the metals of the alkalies—potas-
, rubidium, cæsium, lithium, &c.—and
the less active reducing agents, such
and hydrokinone. Were liquids only
definite chemical composition, we
with cacodyl, which is spontaneously
; but if mixtures are to be specified,
oportions, I am doubtful whether the
olumes of the "E. M." would contain
. BOTTONE.

Blue Bricks.—There are several
making blue bricks—by using the
billy " left after calcining ironstone;
g the bricks in the kiln; and, the best
y burning them blue by nearly melting
lphur them blue, when the bricks in
ve been burnt till slightly vitreous,
burn clear, then fill up the fireholes
e slack. This method will soon make
lue—and your neighbours black.—

Staining Bookshelves.—A very
ny stain can be made by dissolving
ismarck brown in a pint of water; or
solved in French polish. If it is not
h, add a little more of the Bismarck
n lay on very even with a camel's-hair
of Bismarck about 8d., of any chemist
POLISHER.

Staining Bookshelves.—A good
ain is made by dissolving 2oz. shellac
of naphtha, and adding about an ounce
na ground to a fine powder, the quan-
egulated by the depth of colour re-
er applying, let dry, and then give one
of size; let this dry thoroughly; rub
ass-paper, to get a smooth surface, and
h a coat or two of good oak varnish—
as "church oak" is very suitable.—
J. RICKCORD.

Chloride of Silver.—Reduce to metal
g a plate of zinc and slightly acidu-
sulphuric acid. Well wash the result-
ssolve it in diluted nitric acid, filter,
pitate as chloride with common salt.
e ppt. chloride, and reduce to metal
The metallic silver must now be
vashed with dilute sulphuric acid to
es of zinc, afterwards with water.
ow be fused in a carbon crucible, and
ld of plaster of Paris. If carefully
thod will yield silver of 99 per cent.

Chloride of Silver.—Place a large
cible on a good fire (with a blower)
be raised to a white heat. Mix your
le with twice its weight of saltpetre
veight of wood charcoal. Powder up
r, so as to insure perfect mixture.
rucible is red-hot, throw in it, a tea-
time, the mixture. It will deflagrate
s, producing intense heat each time.
addition rapidly after each deflagra-
the powder has been projected into the
e heat may then be pushed to white-
silver be required in the form of a
ot, the crucible may be allowed to get
spongy silver washed to free it from
S. BOTTONE.

[65580.]—**Gas-Engine.**—If "Somerset Lad" would only put his query in a more definite manner, one could answer it straight off; as it is, I can't tell what type of engine he is inquiring about, whether compression or non-compression. To obtain the quantity of gas (if the former), calculate the cubic capacity of the cylinder, with the piston at the end of out-stroke, and divide by nine or ten, as that is the proportion of the charge (see reply 65503 last week), multiply by the number of explosions per minute, speed about 160 revolutions per minute, power, theoretically, ·9728H.P. If a non-compression engine, take the capacity of cylinder at ⅓rd or ⅜ths of the stroke, as that is the usual point of ignition; but why adopt such a short stroke? It is unreasonable in a non-compression engine, being quite opposed to the principle of the gas-engine, which is, that the more rapidly the heat of the exploding gases is converted into the work, the more economically will that work be done; in the non-compressed engine this end is obtained by the long stroke increasing the speed of piston during the expansion of the gases, and in the compression engine by compressing the gases before exploding. Don't run away with the idea that a very heavy fly-wheel is any advantage; of course, it is necessary to have the wheel heavy enough to store up the energy developed by the explosion, and to distribute the same evenly and steadily; but it is possible to have the flywheel heavy enough to absorb all the power of engine in overcoming the inertia of flywheel. Power of non-compressed engine of size named should be about ⅜ths man-power at 120 revolutions per minute, but it would depend on the arrangement on fitting of engine.—ENGINEER, St. Mary Ch., Torquay.

[65583.]—**Accumulator.**—Suppose you run your 10 lamps in parallel, the resistance will fall to 8·2 ohms, or, allowing for leading and loss, say 10 ohms. Each lamp will absorb about one ampère, and as you want to run the lamps for three hours, your accumulators must be capable of giving at least 30 ampère-hours. Now every square foot of "positive" surface in a well-made accumulator is equal to a little over six ampère-hours. Hence five cells, each containing leaden plates, the positives of which present 5sq.ft. of surface, will do the required work, if coupled in series. If home-made, the cells need not cost more than 10s. each. See my book, "Electrical Instrument Making for Amateurs," for further details on accumulator making.—S. BOTTONE.

[65584.]—**Gas-Engines.**—The ignition by slide would not make any noise at all; one certainly cannot say that of the flap-ignition arrangement. I know of small, non-compression gas-engines which work silently; but I am not at liberty to say more at present—probably you may hear of them "a little later on." One patent of the "Otto," if I mistake not, expires this year.—ENGINEER, St. Mary Ch., Torquay.

[65586.]—**Damaged Picture.**—If "Auld Reekie" will take canvas off stretcher, then cut a piece of canvas, say, 2in. larger each way; then, with some hot glue, not too thick, and well cooked, take a brush and go over the picture with it; unite the two as quickly as possible, and rub well down, commencing from the middle and working out to the edges. Have a warm smoothing iron ready, and go over the back on a flat surface, and you should make a good job of it. Any other way would be a botch, of course. The picture will require touching-up by an artist.—B. G.

[65586.]—**Damaged Picture.**—Lay the picture face downwards on a clean marble or glass slab. Cut a strip of stout, unbleached calico, a little longer than the rent, and about 2in. wide. Dip this in thin, hot glue. Bring the edges of the tear as closely together as you can from the back, and lay the prepared strip over the rent, inch by inch, keeping the edges together with the fingers as you go on until the tear is entirely covered. Press down firmly with the fingers with a rubbing motion. Rear up and allow to dry. If you are an artist you can paint in any portions that are missing; if not, get some one to do this for you, and the rent will be unnoticeable. I speak from personal experience.—S. BOTTONE.

[65587.]—**Flute.**—I consider Carte's 1867 patent the best flute in existence, and should recommend ebonite with thin head. The ordinary price is 28 guineas; but I believe the thin head is an extra. —SM.

[65587.]—**Flute.**—Please read my description of Boehm flutes now appearing in these pages, and you will then be able to form an opinion; but for the general purposes of an amateur Carte's 1867 model, or the Boehm as now made, will be satisfactory. With a good embouchure silver is the best material; but how few players have this!—VULCANITE.

[65591.]—**Enamelled Iron Signboards.**—The plant required for making the above consists of a muffle or box-kiln, with bats or shelves in it, and fitted with a hinged door or doors, colour-grinding mill, and utensils to hold the colours. A muffle, or small kiln, or quarries to build a kiln, may be had from almost any makers of firebricks. The mills for grinding colours are made by Messrs. Boulton, engineers, Burslem, Staffordshire; Hartley and Arnoux Bros., California Works, Stoke-on-Trent, Staffordshire. There are several methods of applying the enamels. You may mix the enamels as paint, with fat linseed oil or Venice turpentine, thinning with spirits of turpentine, and applying as paint (not boiled linseed-oil and dryers, please); or making the enamels into a thick slip with water, and floating the signs with it, allowing the enamel that forms the ground to dry before putting on the letters or pattern; stencils may be used for the latter purpose. Another method is by using what are called bodies and glazes by the powder process; but, as I have never seen any lasting, substantial work turned out with it, I prefer not to give this process. Before applying the enamel, see that your iron is perfectly clean and free from dust. The burning on of the enamel will require a little practice. I can give you instructions, but cannot give what you want to be a good enameller—experience.—POTTER.

[65592.]—**To Mr. Bottone.**—To work out these examinations in full would occupy a good column of the ENGLISH MECHANIC. You can get the replies to these on application to the secretary of the Science and Art Department, S.W. I will, however, put you on the right tack to answer them yourself. A unit magnetic field is set up by a unit current when one centimètre from the centre of the field. The intensity of the magnetic field increases with the ampère turns. The effects are inversely as the squares of the distances. You will fine this matter fully explained at pp. 208 and 209, also 282 to 285, of Thompson's "Elementary Lessons in Electricity and Magnetism," 1887 edition.—S. BOTTONE.

[65595.]—**Bow Legs.**—If you are a man of any means, consult at once a good medical man, who will provide the child with properly fitting and jointed irons, and give her lime-water and other foods capable of supplying the want of lime in the bones. If your means will not allow of this, go to one of the London orthopœdic hospital—say the City—or the National Orthopœdic. Get advice there, with the necessary instruments. Follow the advice given, and let the child wear the irons, and you will have no reason for regret.—S. BOTTONE.

[65598.]—**Tension on Belts.**—5H.P. = 165,000ft.-lb. ∴ H.P. pull = 165,000 ÷ 350. The ratio between tension on slack side and tight side may be expressed by formula—

$$R = 2{\cdot}7184^{\underline{c \times 2\pi \times a}}$$

where c = coefficient of friction, and a = percentage of arc of contact of belt with pulley. Tension on tight side $= 472 \times \left(\frac{2}{2 - 1}\right) = 944$lb. You can easily see this last formula. Tension on driving side = initial tension on band + H.P. pull. Tension on slack side = initial tension, the ratio R between these two = R, as found above. To take an example: H.P. pull = 72lb. angle of contact $= 80° \therefore a \frac{80}{360} = {\cdot}222$, $C = {\cdot}3$; then $R = 2{\cdot}7182^{\cdot 3 \times \cdot 222 \times 2\pi} = 2{\cdot}7182^{\cdot 42} = 1{\cdot}522$ = ratio between tight and slack sides. In this formula 1 represents initial tension and 1·522 represents total ∴ 1·522 − 1 represents H.P.P., and $\frac{1 + \cdot 522}{1\cdot 522 - 1}$ = ratio between sum of the two and H.P.P., so total pull on tight side $= \frac{1\cdot 522}{\cdot 522} \times 72 = 210$lb. The initial tension of course = 210 − 72 = 138lb., but belt must, of course, be strong enough to stand the two together.—ENGINEER, Govan.

[65596.]—**Magnitudes of Fixed Stars.**—Since the stars present no determinate discs, but are merely points of light to our eyes, it is obvious that their magnitudes cannot be measured. The more perfect the telescope, the smaller is the image of any given star. I should imagine that "Capella" has never seen a star through a telescope, or he would never have written his query.—SM.

[65599.]—**Water Tank.**—You cannot find better advice than Anderson's. Stick to it.—F. CAWS.

[65601.]—**Preserving Malt Liquor.**—Impossible under the conditions named, unless dosed with an antiseptic.—SM.

[65603.]—**Galvanometers.**—Such an instrument is useless for directly indicating voltages; though with additional external resistance, and deflections not exceeding, say, 5 degrees of arc, you could compare one or more voltages with a standard of E.M.F. But being limited to such small deflections, the method is to all purposes impracticable.—W. PERREN-MAYCOCK.

[65603.]—**Galvanometers and Volts.**—In these instruments the fine wire coil, or "intensity," has a resistance of about 800 ohms. Hence, it may be used for measuring the voltage of batteries up to about six volts without much error. To grade it for such a purpose you will need six good Daniell cells. Couple up one with the "intensity" terminal—say you get a deflection of 10°. Since the E.M.F. of the Daniell is a little over one volt (1·079), you may mark 10° as one volt. Now couple up two Daniells in series on to the same terminals. Note this deflection, and call it two volts. Proceed in like manner until you have added on all six cells. Your readings will be volts, correct to within 8 per cent.—S. BOTTONE.

[65604.]—**Electric Circuit.**—You might employ very advantageously a small transformer, wound with very coarse wire.—S. BOTTONE.

[65604.]—**Electric Circuit.**—If, as I infer, your lamps are in parallel, what is to hinder your joining up bell circuit to + and – leads, inserting required resistance? Besides, you must remember that transformers in ordinary transform alternate currents into alternate currents of higher or lower potential; so that even if your dynamo is alternate, the bell will not ring. Certainly there are transformers converting alternate into direct intermittent, but they are complicated in construction and action.—W. PERREN-MAYCOCK, A.S.T.E.

[65606.]—**Motion in Wire Helix.**—TO MR. BOTTONE.—The contraction of the helix during the passage of the current was in all probability caused by the attraction of the parallel currents. This property is well known, and made use of in one form of contact-breaker under the name of "Roget's vibrating spiral."—S. BOTTONE.

[65608.]—**Battery.**—There is none that will give you so little trouble or so little expense. You might use the Fuller, but where you now require 10 cells you would need 20, and still the zincs will consume rapidly if left in. Or you might use the Daniell, but you would need at least 24 gallon cells; so that I cannot advise a change.—S. BOTTONE.

[65610.]—**Dynamo.**—TO MR. BOTTONE.—It is almost impossible to advise, without knowing more about the machine. But I may point out that if this is connected as a series machine the resistance of the wire on the field-magnets is much too great, since 7lb. No. 18 = 4·83 ohms, while the armature resistance is only 1·815 ohm. Now, 7lb. No. 14 would have given far better results. Try whether you get better results by coupling the wires on both limbs of the P.M. in parallel. This will reduce the R. to quarter what it is now. Be careful so to couple up as to get N. and S. poles. Remember you must drive in the reverse direction to what the machine runs, when coupled up to battery as a motor. This machine should give 50c.p.—S. BOTTONE.

[65612.]—**Batteries for Electro-plating.**—To S. BOTTONE.—You cannot do better, if you are going to use batteries, than to get half a dozen quart-size Smees. You will not need them all coupled together except perhaps in "starting" the nickel castings.—S. BOTTONE.

[65618.]—**Magneto-Electric Machine.**—To MR. BOTTONE.—In all probability the defect is in the little spring that presses on the movable spindle. It should only just clear it when the flattened portions of the spindle are under it; but should press lightly on it at the other times. See that no oil lies on the spring on spindle. The bobbins should just clear the poles of the magnets. The current is set up by the inductive effect of the magnets upon the bobbins. You will find full explanation as to this machine in "Electrical Instrument Making for Amateurs," for which see Sale Column, under the name—S. BOTTONE.

[65614.]—**Electric Lighting.**—TO MR. BOTTONE.—Your battery will have an E.M.F. of about 24 volts. Hence, as a good lamp requires about ·75 of an ampère to light it well, you can select among the following arrangements and *candle-powers of lamps?* Either one 10c.p. of about 80 ohms resistance; or three 5c.p. lamps of about ten ohms resistance, arranged in series, or six 2½c.p. lamps of about four ohms resistance, also arranged in series. Although it would be possible to run lamps in parallel, yet the battery would run down much more quickly. No. 16 wire would do very well.—S. BOTTONE.

[65615.]—**Polarisation.**—The rotatory power of liquids is determined by the aid of a special instrument termed a saccharimeter, or polariscope; for a description of which see chemical manuals—e.g., Roscoe and Schorlemmer, or a chemical apparatus.—SM.

[65615.]—**Polarisation.**—"Young Analyst" had better study the description of the Biot polariscope given in Ganot. It would take too much space to describe the instrument properly, and a diagram would be indispensable. If he has any difficulty in understanding Ganot, I will be glad to help him.—WM. JOHN GREY, F.C.S., Analytical Chemist, Newcastle-on-Tyne.

[65618.]—**Entomological.**—Certainly; there are hundreds of such books. A very excellent one, costing only one penny, is "Orders of Insects," by W. F. Kirby, published by Swan Sonnenschien and Co., London. For the Lepidoptera, both Diurnæ and Nocturnæ, I believe we have no work to beat Stainton's "Manual of British Butterflies and Moths."—S. BOTTONE.

[65618.]—**Entomological.**—There is no book on British Entomology, I think, equal to that of "Curtis," published 50 years ago. Probably a second-hand copy may be obtained cheap. "The Naturalist's Library," a series of volumes with coloured illustrations, each volume devoted to a genus—as Coleoptera, Lepidoptera, &c., &c.—and sold separately, published about the same period, and which aided me greatly when collecting specimens in England while working with a naturalist who was corresponding with "Curtis."—EOS.

[65621.]—**Incandescent Wire.**—It requires at least 20 ampères of current to incandesce 6in. of platinum wire No. 22 gauge. Hence, suppose you can command a current of 20 to 25 ampères, you might make a coil of about 12in. of platinum wire (No. 22), over which the beaker should stand, not touching, but in close proximity. But you will find that "le jeu ne vaut pas le chandelle.—S. BOTTONE.

[65621.]—**Incandescent Wire.**—I cannot exactly see any means of heating liquid effectually except by actually inserting wire in liquid, and that may be an objection. Certainly it is most effective in action. Experimenting with some arc lamps, I wished to insert some considerable resistance in circuit, about 20w., and for this purpose wound a helix of cotton-covered German silver wire about No. 20. This, in air, would immediately have fused up (E.M.F. about 90 v.); inserted in an ordinary-sized pail of water it actually caused it to boil in about half-an-hour's time. G.S. wire would be best, and E.M.F. depending on gauge and length, and these on size of vessel.—W. PERREN-MAYCOCK.

[65622.]—**Dr. Gasner's Dry Battery.**—To MR. S. BOTTONE.—I have no practical acquaintance with this battery. Applegarth's Leclanché presents less internal resistance than the ordinary power, so that for some purposes it may be preferable, where a large current of short continuance is desired.—S. BOTTONE.

[65623.]—**Photography.**—Cannot understand your getting blisters if you use good paper and chemicals; never had such an experience myself. Try the addition of a little alcohol to a portion of your toning bath as an experiment, and see that the toning and fixing baths are not too hot. The addition of salt or ammonia are just the things to cause the trouble, I should think.—WALTER POTTER.

[65623.]—**Photography.**—"Liverpool" has exhausted almost all the known means of avoiding blisters on his prints—viz., salt in the washing water and ammonia in the hypo.—and also changed often his make of paper. As it is almost always the double albumenised paper which blisters, I would recommend him to try the single; also to fume the paper in an ammonia box, as many professionals do. If that does not do he should give up albumenised paper altogether, and take to "matt surface," which is the fashion, at any rate. There must be something in the water or atmosphere prejudicial.—B.SC., Plymouth.

[65628.]—**Blisters on Albumenised Paper.**—The causes of these are various. First, paper made with inferior albumen; second, water containing much air in suspension; third, hard water, containing much carbonate of lime held in solution by carbon dioxide. If the paper is at all acid, carbonic-acid gas is given off in the texture of the paper, especially in hot weather. Preventives: Avoid the use of stinking papers; use water which has been boiled and cooled to begin the washing; let the washing water be as cold as possible.
Remedy: Prick the bubbles from th
the paper side, so as to let out the
drying off.—S. BOTTONE.

[65626.]—**Geometry.**—Any work
solid geometry gives the definitions
of lines and planes. One of the best
but I don't remember its publisher
I am writing this in a regimental cam
my books, and so cannot refer to the
is a small work by Payne (price, I t
which is very concise. "J. S. C." see
fusing the pure, or Euclidean, geomet
tical geometry. Euclid's methods we
as examples of reasoning, but were no
for practice. If "J. S. C." is incli
this, let him try to do the third pro
book, adhering strictly to Euclid, an
full construction.—WM. JOHN G
Analytical Chemist, Newcastle-on-Ty

[65629.]—**Testing Bleach.**—The
ENGLISH MECHANIC literally teem
for estimating the amount of availab
bleaching powder, &c., embodied in
practical men such as Geo. E. Davis, a
Allen. Perhaps the most exhaustiv
which appears at p. 135, No. 344, fo
1871. This is, however, too long for
in its entirety; but the following e
with a mention of other methods,
interest to "Paper." In the first
necessary to make up a standard soluti
hyposulphite of such strength that
centimètre shall be equal to 0·00
chlorine. This may be done as foll
some pure resublimed iodine, weigh
and dissolve them in 250 cubic ce
water along with 18gr. of potassic io
thoroughly dissolved, make up to 1
addition of water. Now dissolve 2
hyposulphite in 1 litre of water. To
degree of purity of this salt, 10 cubi
of the above described iodine solution
a measure glass, and some of the
solution added gradually until the c
the iodine is nearly gone. A few d
starch paste may now be added, whic
an intense blue along with any fre
present. More hyposulphite solution
cautiously added, until the blue colo
discharged. Notice the number of
mètres required to produce this result.
standard solution of hyposulphite, th
cubic centimètres must be made up
addition of water. Suppose, for e
9·85 cubic centimètres had been use
cubic centimètres of water would
make this up to 10 cubic centimetres
985 cubic centimètres of our hypo
tion, along with 15 cubic centimet
would give us 1,000 cubic centi
standard hyposulphite solution, each
mètre of which is equal to 0 00355
chlorine. To use this, 1 gramme of t
powder to be tested (previously well m
obtain uniformity) is carefully an
weighed out. It is then rubbed up
with about ⅓ of a litre of water, along
8 grammes of potassic iodide. It is
ferred to a beaker, and rendered acid
tion of about 40 cubic centimètres of
acid. A little thin starch paste added
dish fluid will give an intense blue
Drop by drop from a buretta the stand
of hyposulphite of soda is added, unt
is completely decolourised. There
remains to note carefully the exact
cubic centimètres of standard hyposu
tion employed to produce this effect. T
multiplied by 0·0355, will give the amo
able chlorine per cent. Another metho
be employed in conjunction with the
tube, is as follows: Take 50 grains of
to be tested, rub up in a mortar with
water, let it settle, and pour the clear
the alkalimeter; add more water to
grounds, and proceed in the same man
alkalimeter is full to the graduation
the operation is properly conducted, all
of the sample will then be in solution
ferred to the graduated tube. Next, ta
of ferrous sulphate reduced to fine
dried between blotting paper, and disso
2oz. of warm water acidulated with a d
vitriol. Then add the chlorine solut
drops at a time, to the iron solution, a
time, until this latter ceases to produ
blue when brought in contact wit
of strong solution of red prussiate
the most convenient plan is to drop t
siate solution on a white porcelain p
glass stirrer before commencing, say,
places. When the blue colour is no
duced, read off the number of degre
bleaching solution used, and divide 2,0
number; add 1 for loss, and you have
Thus, e.g., if you have used 66 hundre
solution in the alkalimeter, you will get
$= 30\frac{1}{3} + 1 = 81\frac{1}{3}$, which is the stren

percentage of chlorine, it contains. A ery generally used method is as follows: five grams of the bleach, grind it well water in a mortar; transfer it to a up to 250 cubic centimètres with cold l a burette with the solution, and run ubic centimètres of arsenious acid solu- ed with indigo sulphate, until the blue eplaced by a yellowish brown. The cubic centimètres used to effect this, 500, gives the percentage of available The arsenious acid solution is made by 13·59 grammes of pure arsenious acid centimètres of glycerine, and making e litre with water. For accuracy of hyposulphite method will be found the other modes.—S. BOTTONE.

- **Blowing Fan.** — Cannot "Black- the particulars he requires from the in No. 1203, p. 152, of April 13th? = in his case 8in., from which he can er dimensions.—MARIENBERG.

— **Gelatino-Bromide Processes.**— e following:—A. Nitrate of silver, illed water, 2oz. B. Bromide of potas- ; Nelson's No. 1 gelatine, 20gr.; dis- r, 1½oz.; one per cent. mixture of c acid and water, 50 minims. C. Iodide n, 8gr.; distilled water, ½oz. D. Hard 0gr.; water, several ounces. Begin by n its water. When it has swollen and roughout, drain off all the water, heat parately to about 120° Fahr.; then in om add B to A in a fine stream with itation; then add D, stirring continu- dissolved. Set aside in perfect darkness Shred up fine, and wash in plenty of nove soluble salts. Add ¾oz. alcohol as ive. To coat the plates this must be a stoneware bottle, and poured on the e dark room. The plates are then put .—S. BOTTONE.

—**Gelatino-Bromide Processes.**— are now generally coated by machinery, them far better than the old method, ortly, as follows: The glass must lie on level table in the dark room, the emul- ad on with a glass rod, and left to set. dry quickly, if possible, by dried air The formulæ for emulsions are legion. e: (A) Nitrate of silver, 100 grains; ater, 2oz. (B) Bromide potassium, 85 lson's No. 1 gelatine, 20 grains; dis- , 1½oz.; 1 per cent. mixture of hydro- l and water, 50 minims. (C) Iodide 8 grains; distilled water, ½oz. (D) ne, 120 grains; water, several ounces. tine is well soaked, let all possible ured off D. A and B are now heated °, after which B is gradually added to stant agitation; C is then added. Heat ath for half-an-hour, and stir in D. shing, add ¾oz. alcohol. — B.SC.,

— **Retouching Medium.** — The ement is a resin, usually Venice turpen- used in two forms. (1) Dissolved in or (2) dissolved in spirit. In the first rk can be done directly the varnish is he second case a little of the "medium" n that part which requires retouching. ms sell retouching medium in one ttles, sufficient in quantity to last an r years. For my own professional use I which is sold by the Autotype Company, et. It "goes on" evenly, and gives a ng "tooth."—RETOUCHER.

—**Retouching Medium.**—The follow- itz Luchardt's formula: Alcohol 300, , camphor 5, castor-oil 10, Venetian tur- I much prefer, however, the simpler "rosining" those parts of the plate o be retouched, such as the face and ou take a lump of rosin in the left hand gently with the middle finger of the a fine flour of rosin has been collected then rub gently and evenly on the film, king with a circular motion, then dust erfluous rosin with a camel-hair brush. ind now that the pencil will "bite" SC., Plymouth.

er to the question why the duration of be 100 years in man, and something else imals, a law has been enunciated by ourens, and others, that "the duration ve times the duration of growth." Thus wth is complete about 20, in the horse at ox at four, in the dog at two. This e duration of life in man 100 years, in 5, the ox 20, the dog 10.

UNBURY has presented to the Univer- bridge the botanical collections of the Bunbury.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

64999. S.E.R. Engines, p. 155.
65003. Rag Water, 155.
65023. Dew Point, 155.
65028. Microscopic Lithology, 156.
65035. Rifling and Rifle, 156.
65039. Recovering Tin and Zinc, 156.
65041. Persian Mystic Jewels, 156.
65047. Armature Velocity, 156.
65049. Dry Battery, 156.
65050. Violin Bow, 156.
65062. Great Western Railway, 156.
65067. Electro-Deposition of Carbon, 156.
65068. Electric Bell, 156.

65267. Gas Engine, p. 244.
65275. Model, 244.
65281. Slide Rule, 244.
65291. Bee-walk Clock, 245.
65293. Stamping Metal, 245.
65294. Great Lick Refractor, 245.
65301. Ammoniameter, 245.
65304. Welsh Harp, 245.
65307. Practical Biology, 245.
65314. Gizzards for Micro. Objects, 245.

QUERIES.

[65637.]—**Model Engine.**—I have a pair of brass cylinders 6in. long by 2⅜in. bore. I want to make a pair of horizontal engines. Would you kindly give me length of connecting rod and size of flywheel? I want flywheel to stand in centre. A sketch of engine put together would oblige.—A POOR CHILD.

[65638.]—**The Board of Works and Movable Buildings.** — Can any of your experienced correspondents inform me how to meet the refusal of the Metropolitan Board of Works to permit the erection of a small galvanised iron tool shed? I can place it 30ft. from a building, but not from the ground of an adjoining owner. I am told that if placed on wheels it is exempt; but that is not my reading of the Act of 1882. I was surprised that the district surveyor interfered.—ALTO PETIT.

[65639.]—**Extracting Gold from Quartz.**—I have several samples of quartz which contain some amount of silver, lead, copper, &c., and I am told that there must be a quantity of gold in same. Will any of your correspondents inform me which is the best method to find it, and extract same, as I have no crucible to smelt same? I would like to know of a method to extract and separate it from other metals myself.—ARVON.

[65640.]—**Washing Composition.**—How is the American washing composition made? Two of the ingredients are liquid ammonia and turpentine. Also the proportions to make the same.—D. TRUELOVE.

[65641.]—**Bunsen Cell.**—To MR. BOTTONE.—I wish to let off a small cannon by electricity. Would a pint Bunsen cell in good condition make about 1½in. of fine iron wire sufficiently hot to explode the gunpowder?—BEGINNER.

[65642.]—**Ship Ventilators.**—Will any friend tell me the best way to cut pattern for the above?—TINSMITH.

[65643.]—**Cutlery.**—What hardening material is used to fasten the blades of knives in ivory or bone handles?—QUERIST.

[65644.]—**Paraffin from Cloth.**—What will remove paraffin from a pair of tweed trousers?—C.

[65645.]—**Herschel.**—What children did Sir John leave?—ESNE CARALITA.

[65646.]—**Vacuum.**—Suppose a column of water 32ft. high balanced by the atmosphere, as in the case of a pump, and three gauges inserted, one at surface of water, one at 16ft., and one at 32ft., what vacuum would each show? ENGINEMAN.

[65647.]—**Conics.**—The directrix of any parabola is distant from the vertex one-fourth of the latus rectum. Is there any similar proportion between distance at which directrix of an ellipse is placed from extremity of axis major, and length of the latus rectum or either axis?—ESNE CARALITA.

[65648.]—**Cooling Oven.**—A friend of mine has an oven. He has to have it very hot to do his work, and before he can do another lot he must let it get cold. This takes a long time, and waste, as it does the work sharp if hot and cold quickly. The oven is about 2ft. 6in. long, and about 15in. square. If near red-hot how long would it take, and how large an air-pump would cool it for him, if it had a chamber round it, and how cold would it be?—BOTHERED MACHANIC.

[65649.]—**Eccentric Turning.**—Can any of "ours" tell me a good and sure way of turning or scraping some steel pieces? They are forged like door keys, and I want to turn each end of the spindle, and the tool to jump out and back to scrape the block. It would not matter if the block was flat one side and a little bevel the other, but it would have to do each lot exact alike. It wants a tool that will jump in and out about 1½in. in about ⅛ rev. of spring. No spring or dummy behind the lathe will do. It must be certain and true to the first one.—BOTHERED MECHANIC.

[65650.] — **Determination of Copper by Electricity.**—Will any reader inform me as to best method for determining copper in ores, &c., by this method? I should like to have a detailed description of the apparatus required, with an idea of cost of one set for regular work.—ELECTRO.

[65651.]—**Water-Motor.**—What power could I get from a spring 60ft. from motor, with 1½ bore, pipe 30ft., fall from 4gal. to 5gal. per minute? Would there be enough for one lathe for general wood turning? What kind of motor is best?—SILENT FORCE.

[65652.]—**Medical Coil.**—To "PRINCIPIA."—Many thanks for your able answer to my query, but I should like to know how I am to regulate the primary current of above coil, as it has only the usual brass tube regulator?—J. NEWMAN.

[65653.]—**Dipping.**—How can I get a deep yellow colour on sheet brass stampings (cornice pole decorations)? I cleaned off old lacquer with potash, polished them, then dipped in aquafortis, but only got a very light yellow result, nothing like the original colour. Also what lacquer should be used?—SAM KOK.

[65654.]—**Oil for Gas-Engines.**—What oil should be used for a gas-engine cylinder, which is not jacketed, and which consequently becomes very hot while running? Any hard grease would be objectionable, as the engine when cold could scarcely be started?—CALCULUS.

[65655.]—**Electric Gas-Lighter.**—I have one of Clarke's electric gas-lighters given me to repair. I can get it to spark all right, but when it is laid to one side for a few hours I cannot get it to spark without a vigorous rubbing? Will any reader tell me how to remedy this?—ELECTRO.

[65656.]—**Brazing.**—Will any kind friend give me a few hints on the best method of brazing small work, and also the best and most reliable material to use? I have used soft brass binding wire and ordinary borax, but this appears to leave the work rather brittle, which is fatal to my success. Does the quality of the wire and borax interfere with the successful issue of the work?—ELASTIC.

[65657.]—**Improved Primary Battery.** — Will Mr. Bottone kindly give his opinion as to the merits of the battery described under the above heading on p. 250 of the current vol.? Also which form of the three described he thinks the best.—G. MITCHELL.

[65658.]—**Lead Poisoning.** — Have lately been making some dandelion wine, letting it stand to ferment in a red glazed earthenware pan. Fearing that it may have taken up a large amount of lead from the glaze, would some friend tell me a simple test to show freedom from lead?—LLOYD.

[65659.]—**Welded Boilers or Tanks.** — Would "T. C., Bristol," or "W. M. J., Dublin," kindly give me any information on the following? How is the welding of boilers or tanks done, so as to leave them seamless? The only opening that I saw was a small hand hole, the edges of the tanks being very square and sharply brought up.—ANTRIM.

[65660.]—**Water-Motor.**—Being desirous of constructing a small ⅛H.P. water-motor, working under a 50ft. fall, a brother amateur who has a set of plans or other information which would aid in the carrying out this work, would greatly oblige the writer, and doubtless many others, by communicating them through these columns to—TURBINE.

[65661.]—**Overhead Wires.**—At what height does it become necessary to fit lightning protectors to outside lines? I have one rising to a first-floor window; but it has trees only about 12yds. distant, and barely rising over their tops. Does the wire attract lightning in any way more than anything else? I suppose if a wire runs the whole way through a plantation of trees it is quite safe?—FEN.

[65662.]—**Bubbles.**—I read with much interest, in your number of last week, the account of Mr. Chapman's paper on soap bubble solutions, &c. Most of these solutions are difficult to prepare, and therefore do not always come out right. Some time ago, therefore, I tried a simple mixture of oleate of soda and pure glycerine, which I see also in your article as likely to give good results. I am sorry to say, however, that my efforts were not very successful, which I must ascribe either to impure glycerine or the proportions of the mixture. If one of your correspondents knows the proportions of glycerine and oleate of soda, I should feel much obliged if he would publish it in your columns. Is there any other term for oleate of soda, and has this to be very pure? It seems that chemists do not know this term.—A. K.

[65663.]—**Waterproofing Paper.**—I am informed that silicate of soda is used for waterproofing paper, &c. I wish to use an ingredient with the ordinary paint to render it more waterproof. My chemist recommended me to use the silicate, but I find that it will not dry, or, rather, after once drying it became wet again in the damp. Should it be mixed with the paint before using, and in what proportions? Should the silicate be used in its present jammy state or mixed with any other ingredient? What ingredient and in what proportions? Should the silicate be heated?—E. G. H. CRANFIELD.

[65664.]—**Bells.**—Can any friend explain the following? I have fixed two continuous ringing bells in the same circuit, one in lodge and one in house, 60yds. or 70yds. away, with a local battery, earth return, both to ring at once from lodge pull, or lodge only, by means of switch. Now when the house bell starts ringing they cannot stop it till they have been down to the lodge and stopped that first. This is very awkward, and I should like to know where I am wrong. A sketch would greatly oblige.—PUZZLED JACK.

[65665.]—**Gas-Engine.**—I should be glad of the opinion of some one acquainted with the working of above as to the most reliable and economical engine to be used for pumping water from a well 45ft. deep into a cistern 35ft. above ground, making total height to raise water 80ft. I have at present a 2 man-power engine, which, after working about six years, has now failed, and maker tells me it is not strong enough to do the work. The pump is a 3in. ordinary lift pump, and could be worked by one man with ordinary lever handle with ease.—X.

[Write the British Gas Engine Co., whose advt. you will find every other week in these pages. They will probably serve you as well as anyone.—ED.]

[65666.]—**The External World's Reality.**—In Herschel's admirable "Outlines," Edition 1883, chapter 8, p. 290, line 15, occur these words:—" . . . the existence of an external world—the vindication of whose reality has (strange to say) been regarded as an achievement of no common merit in the annals of this branch of philosophy." Will some student of metaphysics kindly inform me who it was that first vindicated the external world's reality; in what book I can find the proof; what manner of people doubted its reality, and give me the benefit of his ideas on this (to me) very curiosity-exciting sentence?—ESNE CARALITA.

[65667.]—**Transit.**—To "F.R.A.S."—Sometime since I was observing the sun with reflector, and inadvertently left the cap of my finder 2in. o.g. off, which was focussed on the sun, and the wires, which were made of fibre, were immediately burnt. I am now using a transit 1¾in. o.g., of which the construction is just the same—viz, slide in eyepiece to focus wires, and rackwork to focus object. Is it safe to use it as it is on the sun, and, if not, how large should be the opening of stop? Would a pinhole do?—OBSERVER.

[65668.]—**The Island of Sumatra.**—1. Is tobacco extensively grown here? If so, where distributed for manufacture and sale? 2. What are the other chief crops grown? 3. What are the special characteristics of the prevailing soil and sub-soil of the island? 4. What labour is employed? 5. What is the value of the land per acre in purchase money? 6. Where is Deli, and is it a suitable place for a young man to go to gain experience in the growth of tobacco, or in the management of an estate in Sumatra generally?—RIP.

[65669.] — **Oscillating Slide - Valve Steam Engine.**—Would any of "ours" kindly give me dimensions of a pair of oscillating slide-valve steam engines, about one man-power, as I intend to make a pair, and also sketch of same? I have never seen them in the Midland Counties.—A BLACK-COUNTRY LAD.

[65670.]—**Joining Lead Pipe.**—There is now being used a kind of composition for making joints in lead and compo. pipes. It is apparently made of lead (chiefly) reduced by some process into a paste. It is applied cold and soon sets as hard and has exactly the same appearance as the old kind of joint. Can you tell me how it is made or if it is a patented article?—C. M.

[65671.]—**Organ Voicing.**—Will Mr. Robinson or some other gentleman kindly inform me as follows? One writer says there should be about 12 voicing nicks to the inch on the languid of a 4ft. tenor C open diapason, and about 20 nicks to the inch on the 8½in. G in the same stop. Thus the 8½in. pipe, having about half the number of nicks, will be much coarser in the voicing. Will this be right? Should not the same number of nicks that is on the 4ft. pipe be carried throughout the stop as far as possible to secure equality of tone? Will some of "ours" please tell me of a cheap, white, hard varnish that will not crack or draw up when thoroughly dry for varnishing paper organ pipes?—DAN D. WINDFIELD, Newport, Mon.

[65672.]—**Problem for the Seaside.**—A steamer passes the windows of my room at a certain hour every day. I have ascertained that her speed is very regular, and that she holds exactly the same course daily, making a bee line between two points, which line is parallel to the row of houses where I am. Wishing to ascertain her actual speed, I make a mark on each of the two windows facing the sea, these marks being 12ft. apart. Then facing a point midway between the two marks, I place myself so that, closing one eye, the other eye is exactly 6ft. from the plane of the windows. I then note the time that the steamer takes, as it appears, to move from one mark to the other. This I find to be 6 minutes 40 seconds. Next day I repeat the observation, but this time I retreat 20ft. back, or 26ft. from the plane of the windows, and I find the time taken between the same marks is 1 minute and 33 seconds. Required to find the speed of the steamer and the distance when nearest to me.—M. I. C. E., Bath.

[65673.]—**Optical.**—Should feel grateful for some of our numerous correspondents to help me on with the following. I have an object, 10in. by 8in., placed 3ft. 6in. in front of lenses, and I wish the object to appear 18in. the other side of lenses on to ground glass the same size, 10in. by 8in. I am told that all I require is photographic lenses of the proper focus. How am I to test them, as I am in humble circumstances? I cannot afford to buy the lenses on speculation. Should like the lenses of small diam., say 2¼in. or 2½in., if possible.—TWO YEARS' SUBSCRIBER.

[65674.] — **Manchester Dynamo.** — TO MR. BOTTONE.—I am going to make a dynamo, Manchester pattern, Gramme, and should like to know if the following are good proportions:—Armature, thin sheet iron rings ½in. broad, 5in. diam, 4in. long; field-magnets, cast-iron (soft) 12in. long, 1in. thick, 4in. broad; round wrought cores for wire 1½ diam. Would you say what space there should be between pole-pieces? Also how many coils you recommend on armature, with size and weight of wire. I want to make it compound. What size and weight of wire for series and shunt, and how many incandescent lamps it should light and speed it should run?—W. H. M.

[65675.]—**Scene-Painting.**—Will anyone skilled in the above please tell me what are the colours used? I do not mean oil colours. I am given to understand that water colours are used when the scene is not required for any length of time, and would be much cheaper. Is this true, and what are the different colours named, so that I can order them at an oilshop if they are not kept?—DAN.

[65676.]—**Crushing Strain on Arches.**—What is the greatest crushing strain exerted on the material of an arch of 50ft. span and 25ft. rise, and having a thickness of 2ft. 6in. all round? The arch is one of a series of twelve forming a viaduct carrying a double line of railway. Would good cement concrete blocks form a suitable material for building the arch with, the piers being of stone?—PUNCH.

[65677.]—**Cheap Freezing—Refrigerator.**—Will H. M. Ward or others kindly give the best plan, with particulars of construction and so on, of freezing machines and refrigerator, or whichever may be considered the best for the purpose of keeping from day to day a perishable article? To me it seems as if an adaptation of the ammonium nitrate would be less costly than ice even, it costing me from 1s. 6d. to 2s. 6d. per day for the latter.—J. P.

[65678.]—**Insulation Test.**—Would "Sigma" or others please say whether I am right in assuming that if three Daniell cells show a deflection of 45 on a tangent galvanometer through 1 000 ohms resistance, that the three cells would be sufficient to take an insulation test of a wire 100 miles in length? If not, why?—TELEGRAPHIST.

[65679.]—**Reflecting Telescope.**—I am in possession of an 8½in. glass speculum and flat, and would like to mount them as altazimuth. Would any of the practical astronomers, who favour the "E. M.," kindly give me their experience or a few hints how to proceed with fixing plane speculum, &c.?—ASTR' N.

[65680.]—**L.B. and S.C. Engine. No. 205.**—With regard to the sketch of the above (letter 28830), "Reymond" calls it "Craven's Improved." "C. F. G. M.," in his query, 65142, calls it "Stroudley's Improved." I have heard it called the latter and also "Westminster" class. Can anyone say which is the right name?—G. L.

[65681.]—**Manchester Dynamo.**—Will Mr. Bottone kindly give measurements of dynamo illustrated on p. 311, No. 1,210, to make it suitable for lighting, say, four 10c.p. lamps? Also size and quantities of wires and how connected, and say if an engine giving ¼H.P. would work such a dynamo if carefully made.—MANCHESTER.

[65682.]—**Acid Stains.**—How can nitric-acid stains be removed from paper? A simple recipe will oblige.—ENQUIRER.

[65683.]—**Boiler.**—Will some one kindly tell me what sized boiler I should want to drive one 2½in. bore and 3in. stroke cylinder at 300 or 400 revs. per minute—vertical boiler—and what thickness of copper to stand 50lb. or 60lb. pressure?—A NOVICE.

[65684.]—**Smocking Machine.**—Can any fellow-reader kindly furnish full particulars of the new smocking and honeycomb machine, lately introduced for garments? Practical drawings would, I think, oblige more than—W. CARTER.

[65685.]—**Coil.**—Will anyone kindly give me the following information for a bobbin 9in. long? Thickness of cylinder, whether single or double covered, and a little information concerning connections to obtain a steady current.—F. W. W.

[65686.]—**Battery.**—Will some reader kindly answer the following? Calculate the electro-motive force of a battery whose resistance is 7·3, and which is able to drive a current of 10 through a conductor whose resistance is 12·7?—YOUNG SCIENTIST.

[65687.]—**Cremona Varnish.**—It is wished to verify identification of a modern varnish with the verniss of the Amatis. Will fellow-readers kindly suggest how, where, and when it can be done in London? An independent testimony required. Instruments only submitted.—T. WOOD.

[65688.]—**Arithmetical.**—How many square yards of paper will be required for a room 17ft. long, 12ft. 7in. wide, and 8ft. 5in. high?—STUDENT.

[65689.]—**Algebraical.**—Should feel greatly obliged if some reader would kindly show how this problem is worked. The answer is supposed to be $2a - b$. The problem is as follows:—$3a - [b + (2a - b) - (a - b)]$.—A. B. G.

[65690.]—**Lemon-Juice.**—As I am using lemon-juice as a corrector of bile, I am anxious to know how to store the same for keeping any reasonable length of time.—LEMONS.

[65691.]—**Composition Gilt Frames.**—I have several ornamental casts in composition gilt frames and large looking-glass frame which I have sponged very lightly with a little warm water to clean, but I find some of the gold come off. I thought if I was to varnish them over I should be able to wash them without the gold coming off. Would any kind reader inform me whether they would be injured if I varnished them?—BLARNEY.

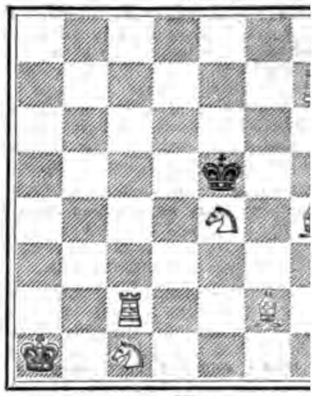
The Spectra of Oxygen.—The author has observed a fact which furnished a remarkable demonstration of the law of the production of the dark bands which he has detected in the spectrum of oxygen. The phenomena of elective absorption in oxygen gas are manifested in two mutually distinct spectral systems. A first system, formed of fine rays, follows the law of the product of the gaseous system traversed by its density. The second system is formed of bands much less easily resolved, is governed by the law of the product of the thickness by the square of the density. This second law being quite novel in spectral analysis, the author has instituted experiments necessary to prove that this system of obscure bands really belong to oxygen. These experiments range from pressures of 100 atmospheres down to those of a few units, and with lengths of tubes from 0·42 mètre to 60 mètres. At the same time prolonged observations have been made upon the atmosphere brought into connection with the experiments in the tubes. These observations, and especially those made during autumn last on the Pic du Midi, prove that all the bands of the spectrum of oxygen are found in the spectrum of the solar light if it is allowed to traverse a sufficient thickness of the atmospheric medium. Further, on comparing, by the aid of photography, the intensities of the bands of the atmospheric spectrum with those given in the tubes, the author has found that the intensities of these atmospheric bands fulfil the law of the square. It appears from *Wiedemann's Annalen* that M. Olszewski, when liquefying oxygen, examined its spectrum and ascertained the existence of the bands in question with a stratum of 7mm. of liquid oxygen.—*J. Jansen.*

CHESS.

ALL communications for this departu
addressed to J. PIERCE, Langley House, Do

PROBLEM MCIL.

Black.



White.

White to play and mate in two m

SOLUTION TO 1,100.

White.	*Blac*
1. Kt-K B 5.	1. Anythin
2. Q mates.	

NOTICES TO CORRESPONDEN

CORRECT solutions to 1,100 by W. Jay, J. M
Pawn, Hensing, G. W. Middleton, Anon (St. I
H. Fellows, A. Fellows, R. G. Briscoe, J. Klib
field, A. Dean, A. Wheeler, and J. Bryden
H. A. Lindfield, R. G. Briscoe, and A. Wheel

A. WHEELER.—We congratulate you. It
difference.

A. NEWLAND.—K cannot move to K 4, a
there would be no (ch).

THE first solution in the *Shoreditch Citizen*
cluded, the prize winners being Messrs. W.
Kistruck, Rev. R. G. Hunt, G. T. Stringfell
Symons in the order named.

A MOST successful Solution Tourney has
cluded in *Yenowine News*, the first prize,
having been won by Mr. H. C. Thomson,
who scored 110 points out of a possible 111.
ful English competitors are G. J. Slater,
T. H Billington, and J. J. Spence, fifth and
J. G. Chancellor, B. Bridgewater, J. A. Mil
Brown, James Rayner and Hensing.

IN the Christmas competition of the *Tri-W*
the first prize has been secured by Mr. B. G
second by Mr. J. Keeble, and the third and fo
Herr H. F. L. Meyer and Messrs. H. and E.

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with colds, coughs, bronchitis, and other chest comp

e English Mechanic
WORLD OF SCIENCE AND ART.
FRIDAY, JUNE 29, 1888.

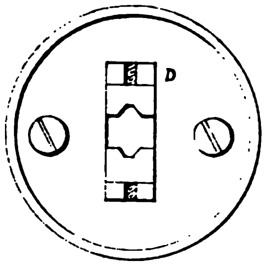
ACTS FROM BERGERON.—VIII.

EN a piece of work is held in a split
chuck it is seldom that a greater
than about an inch is necessary to be
hold of, as the pressure of the ring
it necessary that the bore should be
contracted towards its entrance; the
art may be of slightly larger diameter,
cidedly when a piece of any given
is gripped for a distance of an inch,
ardly fail to be held in the lathe with
ely security. There is also an ad-
in the fact that the hole is larger at
tom than at the extremity—namely,
the piece does not revolve with truth
uracy, which is a proof that it is not
in alignment with the axis of the
l and chuck, we can with a light blow
mmer set it over to one side or the
as may be required. But if the
rity is barely perceptible it suffices
a light tap to the ring upon the
itself. We shall return to these
when describing the method of turn-
article in a chuck of this kind.

ed not be thought necessary to have
number of rings of each size: it will
o have three or four of the different
rs. Thus there may be had four of
ar of 3in., four of 4in., four of 5in.,
ar of 6in. They must be slightly
so as to be capable of being driven
e wood should dry and shrink. So
or standard sizes. Cases will occur
chucks of very large size, as 12in.,
r even 16in.; as, for instance, when
ge frames are to be turned. In such
bit of plank-wood is to be used of
ut of 15 or 16 lines in thickness.
to be mounted on the mandrel nose,
n this, after it has been rounded and
in the lathe, the plank out of which
ne is to be made. If it is desired to
of such size that the radius exceeds
the height of centres, there can be
er the poppet lifting pieces of wood
ly planed of convenient thickness;
e required size is excessive, it will be
y to have a lathe of higher centres.*
y in wood does need arise to turn in
lathe, but frequently in metal, espe-
some branch of mechanics is taken
a hobby. There are many cases
h the nature and shape of the
to be turned in some of its
vill not allow it to be easily
the lathe. In such case, chucks
een contrived in which the work
between two jaws which advance
e as required in a groove between
t is secured by a pressure screw
in the margin). With this chuck a
a piece can be held which would be
ible to be worked between centres.
e is made to enter the hole drilled
the axis of the mandrel, and only
t is allowed to project for the work re-
Chucks have even been made on which
nted a pair of vice jaws, which, by
f two nut screws, one right and the
eft-handed, can be moved without
to be equidistant from the centre
in margin). These jaws are very
o as to be capable of holding a large
iron, steel, or brass, so as to turn it
g to need.

is another kind of chuck with four
jaws called a "universal" chuck (F
argin.) This, which we have brought
tion, and of which the structure is both simple and very ingenious, is now in use in nearly all workshops. It specially assists amateur or professional in the work they may wish to undertake, inasmuch as it affords means for centring rapidly any flat piece they may wish to turn. It has the further advantage of laying hold of it internally or externally. Suppose that it is desired to retouch the surface of a ring already made, and that such surface is the outside one; the piece would be held by placing the jaws of the chuck inside. Then there is nothing to obstruct the tool in finishing it. It is evident that in the opposite case the piece must be held by the outside.

Fig. D



There is, moreover, a power in certain cases of holding work excentrically by advancing two of the jaws from left to right to a certain distance from a given point. For this, as for the previous operations, the piece must be centred with very great care. In a brass plate, which is mounted on the mandrel nose, are four slots or grooves, made with great exactness, and occupying from six lines from the edge to a similar distance from the centre. Into these grooves enter with a sliding fit four jaws with file teeth, whose grooves (cut in their two sides) grasp the thickness of the plate. These jaws are drilled between their grooves with a hole tapped with a double screw-thread, often left-handed. Into this hole enters a screw, one end of which has an enlargement, in which is made a square hole, which serves as a means of rotating it with a key. These screws are kept in place at the back of the plate by an external band, in which are worked four conical holes for the passage of their heads, whose form is identical. The other end of the screws is fixed at the centre of the plate by a steel plug which prevents them from advancing or receding; so that when they are caused to turn they compel the jaws to traverse the length of the slot. At the centre of the plug is a movable screw-point which can be advanced at pleasure. This serves to receive the centre, which should have been made by the help of the compasses, and prevents the necessity of a number of experimental trials.*

Fig E

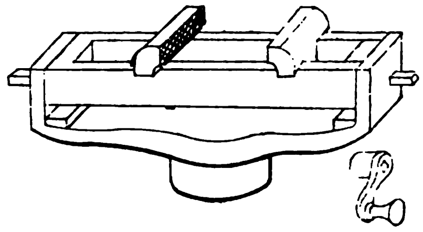
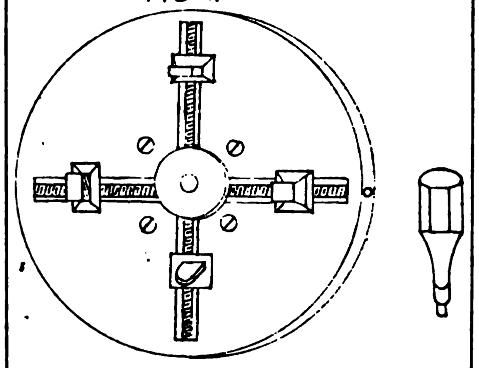


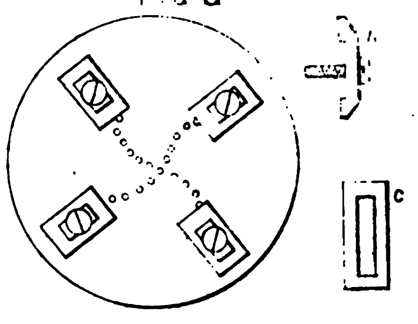
Fig. F



In order to get at the centre with greater certainty there may be made at the edge of each slot some very exact divisions which will mark the traverse of the jaws, which will be also very handy when it is desired to chuck the piece to a given degree of eccentricity, and as there is the capability of advancing either of the screws which may be considered necessary, it is easy, by withdrawing the opposite jaw, to find the centre of the work with the utmost accuracy. It may chance that the eccentricity may not be in the direction of either of the four screws, but between any two of them. In that case two must be advanced and the opposite pair withdrawn, and the piece will be moved on a diagonal. There have been some chucks made of two plates of brass with gearing, between which, by means of a corresponding pinion, move the four jaws simultaneously; but these are very liable to get out of order, and are in other respects by no means perfect. We have seen others composed of two plates, turning the one upon the other on a common centre or bolt fixed to the one which is mounted on the mandrel. In this latter is a spiral groove of quick curvature from the circumference to near the centre. The tenons of the jaws are fitted to slide with accuracy in this groove. It is easy to understand that if the plate which carries the jaws is made to revolve, these jaws are made to follow the groove, and they thus advance or retreat to an equal and uniform degree, and that if at first they have been accurately centred, they cannot get displaced; and as these plates, in the process of turning, always tend to tighten the work still more between the jaws, the piece can be turned without fear of its displacement. From this, however, there frequently results a grave drawback—namely, that the work cannot be readily removed when completed.

For turning pieces which are very thin, of various sizes, the chuck, Fig. G in the margin, becomes indispensable. We have but to describe it to show its efficiency. We know that a thin bit of stuff presents at its circumference an almost cutting edge, which is difficult to hold in a wooden chuck, and as these pieces are nearly always out of truth, they do not readily bed down on the bottom

Fig G



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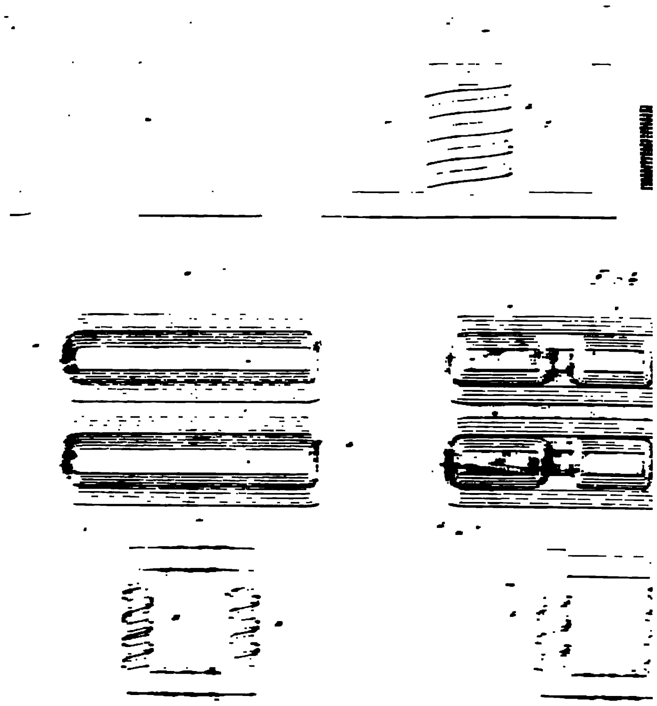
* icks and face-plates here described by Bergeron
.

* In the description here given, it is not easy to understand how the jaws of which the grooves embrace the thickness of the plate are to be got into place. Valicourt gives an account of the same chuck, and recommends the four slots in the face-plate to be milled out with a circular cutter. He also gives a sectional view of the jaws grooved on each side to embrace the plate on each side of the slots; but as these slots are said to terminate at six lines or half an inch from the edge of the face-plate, it seems possible to get them into place unless the grooved part turned circular, which appears not to be the case.

LVII.—No. 1,214.

[illegible]



[illegible]

NOMICAL NOTES FOR JULY, 1888.

The Sun.

s.	At Greenwich Mean Noon. Right Ascension.	Declination North.	Sidereal Time.
	h. m. s.	° ′ ″	h. m. s.
49PM	6 43 31	23 4 30	6 39 52·48
04 ,,	7 4 7	22 38 1	6 59 35·27
70 ,,	7 24 35	22 1 44	7 19 18·05
83 ,,	7 44 51	21 16 1	7 39 0·84
54 ,,	8 4 53	20 21 16	7 58 43·62
88 ,,	8 24 41	19 18 1	8 18 26·40
63 ,,	8 44 15	18 6 47	8 38 9·18

od of finding the Sidereal Time at at any other station is described of Vol. XLVI.

pots may be detected at rare in- the sun's disc. Up to July 20th real night in any part of Great

l, at 5 p.m., the Sun is in Apogee: rds, the Earth is then in that part at which she is most distant from e assume the solar parallax to be nterval of 93,941,978 miles will from the mighty centre of our at instant. There will be a partial ie Sun on July 8th; but as it will in this country, no further refer- led to it here.

The Moon

Last Quarter at 3h. 52·6m. a.m. on is New at 6h. 16·7m. in the morning She will enter her First Quarter after Noon on the 16th; be Full . a.m. on the 23rd, and enters her ;, for the second time this month, . in the evening of the 30th.

Moon's Age at Noon.	Souths.
Days.	h. m.
21·8	6 8·6 a.m.
26·8	9 46·2 ,,
2·2	2 0·8 p.m.
7·2	6 11·0 ,,
12·2	10 53·6 ,,
17·2	2 32·1 a.m.
22·2	6 10·6 ,,

will be in conjunction with both l Venus at 5h. a.m. on the 9th, at 8h. p.m. on the 10th, with Mars n the 16th, and with Jupiter at he 18th.

be a

al Eclipse of the Moon

arly morning of the 23rd, of which ginning will be visible in this

	H.	M.
ntact with the Pen- rs on July 23 at...	2	56·9 a.m.
Contact with the	3	55·0 ,,
ginning of Total	4	54·0 ,,
. will set at Green-	4	10 ,,

ontact with the shadow happens the Northernmost point of the owards the East.

Mercury

se of Southing after Noon, an p to the 8th, but at 5 a.m. on n inferior conjunction with the uently becomes a Morning Star, reatest elongation West (19° 27′) e 29th. His angular diameter, t the beginning of the month, 8″ about the time of his con- uently steadily diminishing as the Earth to 7″ by the 31st.

Occultations of (and a Near Approach to) Fixed Stars by the Moon.

Day of Month.	Name of Star.	Magnitude.	Disappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.	Reappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.
			h. m.		°	°	h. m.		°	°
17	ξ¹ Libræ	6	7 22 p.m.	Dark	142	145	7 40 p.m.	Bright	170	176
18	θ Libræ	4½	9 2 ,,	Dark	357	8	9 23 ,,	Bright	325	339
18	49 Libræ	5½	†12 20 ,,	N. by E	168	202				
19	B.A.C. 5700	6½	10 26 ,,	Dark	128	142	11 14 ,,	Bright	211	232
21	o Sagittarii	4	12 42 ,,	Dark	157	173	1 15 a.m.	Bright	213	235
23	20 Capricorni	6	9 35 ,,	Bright	92	64	10 46 p.m.	Dark	287	269
25	74 Aquarii	6	12 57 ,,	Bright	96	80	2 11 a.m.	Dark	311	308
31	f Tauri	4	11 44 ,,	Bright	63	25	12 22 p.m.	Dark	335	297

† A near approach. A description of the construction and use of the above table, illustrated by a diagram, will be found on p. 403 of Vol. XLVI.

Jupiter's Satellites.

Day of Month.	Satellite.	Phenomenon.	H.	M.	S.	Day of Month.	Satellite.	Phenomenon.	H.	M.	S.	Day of Month.	Satellite.	Phenomenon.	H.	M.	S.
1	II	Ec R	10	57	27PM	10	*I*	*Oc D*	8	36	P.M.	19	*I*	*Ec R*	8	10	18PM
1	*I*	*Oc D*	12	21	,,	10	*I*	*Ec R*	11	47	,,	24	*II*	*Tr I*	8	44	,,
2	I	Tr I	9	30	,,	11	*I*	*Sh E*	9	1	,,	24	*III*	*Ec R*	8	57	59,,
2	I	Sh I	10	24	,,	13	*III*	*Tr I*	8	39	,,	24	*II*	*Sh I*	11	9	,,
2	I	Tr E	11	43	,,	13	III	Tr E	10	34	,,	24	*II*	*Tr E*	11	16	,,
2	*I*	*Sh E*	12	37	,,	15	*II*	*Oc D*	11	30	,,	25	I	Tr I	9	27	,,
3	I	Ec R	9	52	25,,	17	*II*	*Sh I*	8	34	,,	25	*I*	*Sh I*	10	38	,,
6	*III*	*Sh I*	8	54	,,	17	*II*	*Tr E*	8	50	,,	25	*I*	*Tr E*	11	40	,,
6	III	Sh E	10	53	,,	17	I	Oc D	10	25	,,	26	*II*	*Ec R*	8	7	55,,
8	*II*	*Oc D*	9	5	,,	17	II	Sh E	11	5	,,	31	*III*	*Oc R*	8	5	,,
9	I	Tr I	11	19	,,	18	*I*	*SH I*	8	43	,,	31	*III*	*Ec D*	11	7	51,,
9	*I*	*Sh I*	12	19	,,	18	I	Tr E	9	49	,,	31	*II*	*Tr I*	11	12	,,
10	*II*	*Sh E*	8	30	,,	18	I	Sh E	10	56	,,						

Ec Eclipse; Oc Occultation; Tr Transit of Satellite; Sh Transit of Shadow; D Disappearance; R Reappearance; I Ingress; E Egress. The printing of a phenomenon in *italics* indicates that its visibility is rendered doubtful, either by the brightness of the twilight, or by Jupiter's proximity to the horizon.

About this time he may be detected with the naked eye in the E.N.E. before sunrise.

Day of Month.	Right Ascension.	Declination North.	Souths.
	h. m.	° ′	h. m.
1	7 31·5	18 15·5	0 51·5 p.m
6	7 20·1	17 40·0	0 20·4 ,,
11	7 6·9	17 38·1	11 47·6 a.m.
16	6 57·1	18 7·6	11 18·2 ,,
21	6 55·3	18 58·8	10 56·7 ,,
26	7 3·5	19 56·2	10 45·3 ,,
31	7 22·5	20 40 2	10 44·5 ,,

This curiously-looped path is described in a comparatively void part of Gemini. At 6 a.m. on the 9th Mercury and Venus will be in conjunction, Mercury being 5° 32′ South of his sister planet.

Venus

Is technically a morning star up to July 7th, and an Evening Star for the remainder of the month; but as she comes into superior conjunction with the Sun at 7 p.m. on the 11th, she is, for the observer's purpose, invisible throughout the month. Her circular disc subtends a constant angle of 9·6″ throughout the month, so that she is really not worth looking at, when towards the end of it, she may be perhaps picked up with a powerful telescope.

Day of Month.	Right Ascension.	Declination North.	Souths.
	h. m.	° ′	h. m.
1	6 31·2	23 40·9	11 51·4 a.m.
6	6 58·1	23 23·5	11 58·5 ,,
11	7 24·7	22 48·7	0 5·4 p.m.
16	7 51·1	21 57·1	0 12·1 ,,
21	8 17·2	20 49·5	0 18·4 ,,
26	8 42·8	19 26·9	0 24·3 ,,
31	9 7·9	17 50·5	0 29·7 ,,

Starting, then, from a point between μ and η Geminorum, Venus travels right across that constellation and that of Cancer, on the confines of which and Leo she is found at the end of the month. Her conjunction with Mercury has been spoken of under the heading of that planet. She will also be in conjunction with Saturn (0°35′ North of him) at 1 p.m. on the 27th.

Mars

Is an evening star, but is becoming a comparatively insignificant object; his little gibbous disc, which subtends an angle of only 11·6″ on the first, shrinking to 9·8″ by the end of July. It is needless to add that it requires a large and powerful telescope to make out his superficial detail under these circumstances, and, moreover, to be seen at all he must be looked at as soon as ever it is dusk enough, even at the beginning of the month. He is in quadrature with the Sun at 7h. p.m. on the 22nd.

Day of Month.	Right Ascension.	Declination South.	Souths.
	h. m.	° ′	h. m.
1	13 15·9	8 45·7	6 34·9 p.m.
6	13 23·3	9 37·0	6 22·7 ,,
11	13 31·4	10 30·6	6 11·2 ,,
16	13 40·1	11 26·0	6 0·1 ,,
21	13 49·3	12 22·8	5 49·7 ,,
26	13 59·1	13 20·5	5 39·7 ,,
31	14 9·3	14 18·7	5 30·2 ,,

It will be seen from the above ephemeris that the path of Mars in the sky during July commences a little to the north-west of Spica Virginis, and bends in a south-easterly direction to the confines of Virgo and Libra. On the night of the 3rd Mars will be rather more than 1° north of Spica.

Jupiter

is visible until between 1h. and 2h. a.m. at t beginning of the month, and does not set past eleven o'clock at night at the end but his South Declination is still so considerable that he is very indifferently placed for the observer with the telescope, and must be looked at as near to the Meridian as possible. His angular equatorial diameter steadily diminishes from 40·4" on July 1st to 37·4" by the 31st.

Day of Month.	Right Ascension.		Declination. South.		Souths.	
	h.	m.	°	'	h.	m.
1	15	40·5	18	41·8	8	59·2 p.m.
6	15	39·4	18	39·0	8	38·4 "
11	15	38·5	18	37·2	8	17·8 "
16	15	37·9	18	36·4	7	57·5 "
21	15	37·6	18	36·6	7	37·6 "
26	15	37·6	18	37·9	7	18·0 "
31	15	37·9	18	40·3	6	58·6 "

The very short pendulum-like path indicated in the above Ephemeris lies to the W.N.W. of the 4th magnitude star λ Libræ.

Saturn,

for the observer's purpose, has now left us until the late autumn; a remark which applies equally to

Neptune;

but

Uranus

may still be picked up in the West as soon as it is dusk during the earlier part of the month. His diameter decreases quite insensibly from 3·8" at the beginning of July to 3·6" before he is lost in the Sun's rays. He is in quadrature with the Sun at 8 p.m. on the 4th.

Day of Month.	Right Ascension.		Declination South.		Souths.	
	h.	m.	°	'	h.	m.
1	12	49·5	4	36·3	6	8·7 p.m.
6	12	49·7	4	38·0	5	49·2 "
11	12	50·0	4	40·1	5	29·8 "
16	12	50·4	4	42·7	5	18·3 "
21	12	50·9	4	45·8	4	51·4 "
26	12	51·4	4	49·3	4	32·2 "
31	12	52·0	4	53·3	4	13·2 "

This very short arc is described a little south of a line joining γ and θ Virginis.

Shooting Stars

May be looked for with the greatest chance of success between the 17th and 20th; and again from the 25th to the 30th of July.

Greenwich Mean Time of Southing of Seven of the Principal Fixed Stars on the Night of July 1st, 1888.

Star.	Souths. h.	m.	s.
β^1 Scorpii	9	17	33·30 p.m.
Antares...	9	41	6·57 "
α^1 Herculis	10	27	58·60 "
α Ophiuchi	10	48	7·00 "
γ Draconis	11	12	19·79 "
Vega	11	51	21·62 "
ζ Aquilæ	12	18	23·87 "

The method of finding the Greenwich Mean Time of Southing of either of the stars in the above list for any other night in July, as also that of determining the local instant of its Transit at any other station, will be found on p. 404 of Vol. XLVI.

PROTECTION OF BUILDINGS FROM LIGHTNING.*—I.

By Prof. Oliver J. Lodge, D.Sc., F.R.S.

ONE hundred and fifty years ago the nature of lightning was unknown. Several persons surmised that it had some connection with the phenomena excited in a piece of glass tube when rubbing it, phenomena which were called electric; but no proof of the connection was attempted. The proof that lightning was in fact nothing but a large electric spark was given, as you know, in 1751, by that marvellously comprehensive and commonsense genius, the Philadelphian printer, Benjamin Franklin.

From the time that Franklin flew his kite at Philadelphia and ascertained beyond cavil the true nature of lightning—from that time to the present, the protection of buildings and ships from its destructive agency has been mainly a matter of detail and application of the laws of electricity so far as they were known.

For a long time the erection of lightning conductors was opposed by the religious world as heretical and impious. But, first in some Protestant provinces in Germany, and later in France and England, the use of the heretical rods gradually extended. The extension of their use in England and their application to ships, were greatly aided by the labours of that enthusiastic worker, Sir W. Snow Harris. Their extension in our South African colonies, where violent thunderstorms are frequent, is largely due to the influence of the late Dr. Mann, in whose honour this course of lectures has been established. Anyone who has read or heard of Dr. Mann's contributions to the *Journal* of the Society of Arts must have been struck, not only with his keen interest and enthusiasm, but also with his grasp of fundamental principles, his open-minded receptive attitude to new controversial views, and the thoroughly practical and business-like way in which he handled the subject.

Concerning the origin of atmospheric electricity, I have not much to say, It seems to me probably due to friction, like Armstrong's hydro-electric machine. Faraday showed that the exciting cause in that apparatus of Armstrong's was the friction of water spray driven by steam over the solid surface of the jet; so also I picture winds in the atmosphere driving the spray of mist against rock and ice surfaces, and so gradually producing a certain difference of potential between the upper layers of the atmosphere and the surface of the earth.

I have spoken as if I thought the friction had to be between mist globules and solid matter. It seems doubtful whether friction against *air* will suffice to render water electric. If it is efficient, then it is well to notice that, though there is no finite slip between bodies and the common air through which they move, yet this does not apply to rarefied air. The viscosity of rare air is as great as that of dense, but the slip of solids through it is another matter. In rare air there is an actual slip at the surface, and accordingly the *apparent* viscosity of rare air, as observed by the settling of dust or the falling of a feather in a vacuum, is less than in air at common pressure. It may be, therefore, that the finite slip of mist or dust-particle through the upper layers of the atmosphere is one effective cause of atmospheric electrification; and after a spell of dry weather there is liable to be an accumulation of electricity, because it has had no recent opportunity of escape.

In the plar regions electrical discharges are mainly silent, or brush like, giving the fantastic forms of aurora. But in our latitude these silent discharges in the upper semi-conducting rarefied layers of atmosphere are seldom visible. We see the effect in another form. The electrification gets occasionally conducted down by clouds into the lower and denser layers of atmosphere. By the aggregation of small globules into great ones the potential is enormously raised, until in the lower atmosphere they flash either into each other or into the earth, and the strain is partially relieved.

It is important to note that clouds appear to play only a secondary part in the phenomena. The upper regions of atmosphere are at a different potential from the earth—cloud or no cloud. Clouds are able to conduct it down towards the earth, and thick dense clouds are therefore the usual prelude to a thunderstorm.

We have now to think of ourselves as living always between the coatings of a large condenser or Leyden jar, the upper coating the sky, the under coating the earth, the common air is the dielectric between. Ordinarily the sparking distance is far too great. Every now and then portions of the upper coating protrude down as clouds, and we are then liable to a disruptive discharge. Some square miles of cloud and some square miles of land are the two coatings, and the interval of separation need not be extremely great. If the cloud and the earth were perfect conductors, all this great area would be relieved in a single flash of awful size; but, fortunately, the conduction of cloud is a slow process, and it usually takes a good many flashes from different parts to remove its charge.

The total maximum energy of a given area of cloud at a given height from the earth is easily estimated, for it is well known that as soon as the electric tension of air reaches the limit of about half a gramme wt. per square centimètre, disruption occurs. Supposing it all equally on the verge of giving way, the energy of the dielectric per cubic centimètre is therefore $\frac{981}{2}$ ergs, and per cubic mile is $\frac{4{,}110 \times 10^2}{2 \times 3 \times 10^7}$ foot-tons = 70,000,000 foot-tons.

Given, then, the whole area of cloud facing the earth, and its height when on the point of discharging at every point, and you have
of cubic miles of strained dielect
approximation to the energy of the s
rate of 70,000,000 foot-tons per cubic m

The potential needed to give a spark
is so enormous (the difference of po
spark a mile long, between flat plate
16 × 10^7 electrostatic units) that the
electricity required to give this energy
very great; 2,176 × 10^8 electrosta
quantity per square mile would give
tension. Now, 2·176 × 10^{11} electrost
just about 70 coulombs, or not enough
one-hundredth of a gramme (one-s
grain) of water. Faraday stated this, b
disbelieved.

Thinking now of a cloud and of the
it as forming the two coats of a Leyd
dielectrics of which houses and peo
have now to consider what determine
and what happens when the discharge
maximum tension which air can stand
wt. per square centimètre. At whate
electric tension rises to this value sn
air. The breakage need not amount
must give way along a great length to
if the break is only local nothing
brush or fizz need be seen. But wher
occur it must be the weakest spot th
first—the place of maximum tension
commonly on the smallest knob or s
rears itself into the space between th

If there be a number of small kno
the glows and brushes become so nu
the tension is greatly relieved, and t
moderate thundercloud might be disch
way without the least violence. T
the best way of protecting anythin
ning; do not let the lightning flash
can possibly avoid it. But one canno
vent it, even by a myriad of points.
more might be done in this direction t
but still, sometimes a cloud will
quickly, or it will have such a trem
of energy to get rid of, that no poi
ciently rapid for the work, and crash
at once. One specially noteworthy case
are no protection occurs when one
into another, and thence to the gr
general, whenever electric strain is t
suddenly upon a layer of air.

When a flash occurs, a considera
relieved of strain, and the rush of elect
the cloud and along the ground toward
flash sets up a state of things very enc
another or secondary flash or flashes
simultaneous with the first.

One consequence of this is known a
stroke or return stroke. It was studie
Mahon, and depicted in his work, "Pri
Electricity," published in 1780. Prof.
has made it extremely well known, so th
ence to it is made in almost every el
science school in the country. But the
account of the matter is, I believe, ve
quate. It says the man's electrical co
disturbed by the inductive action of the c
that on the cloud being discharged t
original condition is restored; the passa
induced charge from his hat to the grou
enough to kill him.

Now the shock that a man could get th
but feeble; it is only twice what he wou
completely isolated and exposed to i
action. The amount of charge stored
man's hat is not great; the electric tensio
likely to pull his hat off than its release
to do him any damage.

I do not deny the existence of this stati
shock, but I assert it to be impotently feeb
can feel all there is to feel by holding a
an electric machine till nearly bursting
and then discharging the machine. Th
special object in waiting for a thundersto

Now proceed to the kind of damage do
building is struck, and to the custo
orthodox modes of protecting them from t
of the flash when it does occur, as well
sible of warding off the flash altogether
discharge. The two main destructive a
lightning flash are—(1) its disruptive, or
or exploding violence; (2) its heat.

The heating effect is more to be dre
the flash is slow and much resisted; th
effect when conducted well except at a fe
noteworthy though obvious thing is, that
of the discharge must be got rid of some
question is, how best to distribute it.
trying to hocus-pocus the energy out o
by saying you will conduct the charg
quite easily and quietly.

The disruptive effect is shown by t
lightning on trees. It is as if every cell
by the expansion in the path of the disc
effect on conductors is, however, just as
Ships may have a mast utterly de
split to pieces—thick iron hoops bindi
being rent asunder and flung about by t

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* Extracted from the Dr. Mann Lectures before the Society of Arts.

idea into practice in punching steel, it will lead to making the die of larger diameter than the punch, as there is a cone of compression formed on the end of a punch in the material subjected to its operation, and the less this cone is opposed and shaved off by the die, the less dense is the compression, and the less the consequent strain tending to rupture the plate. In punching steel plate $\frac{1}{4}$in. thick with a punch $\frac{5}{16}$in. in diameter, I have used a die $\frac{9}{16}$in. in diameter, making the hole $\frac{5}{16}$in. on one side and $\frac{9}{16}$in. on the other; but all of the holes were not smooth, which indicated that the angles allowed for the cone were too obtuse. That some were smooth and others were not, was proof that the shape of the natural formation of the cone varied with the nature of the material, and that the nature of the material was not uniform in the plates which were punched.

It is an opinion into which anyone is liable to fall, that if the punch is smaller than the hole in the die, there will be a burr carried down all round it. My impression that this was the case came from noticing that when a die had become worn out large, a burr invariably formed around the punch, but found the cause of this in the fact that the die wears out "bell-mouthed"—larger at the top than it is a little ways down—and the metal which forms the burr thus receives support from below. When this support is removed by making the hole the largest on the lower side, and the sides straight, there will be no burr formed, provided the size of the hole does not exceed the size of the base of the cone of compression.

Some difficulty was experienced at one time with some steel washers which were to be punched out of $\frac{1}{64}$in. steel, 2½in. in diameter. The hole in the all-steel die contracted irregularly in hardening, and was not lapped out. The tools were set by a careful man, but, of course, the hole was a little marred, and the steel, being tough, showed the defect in a slight, sharp burr. This was not wanted, and the die was ground out, and made $\frac{2}{100}$in. larger than the punch, and after this was done the washers were punched without burr. Washer dies of all sizes that I have tried, on iron or steel, work better when this allowance is made than when they are worked with close fits. In punching, the general rule is safely given, that fair iron can be punched when the thickness to be punched through does not exceed the diameter of the punch. Practically, fair iron can be punched more profitably than it can be drilled, with ordinary methods, when the thickness of the stock is not more than one and one-half times the diameter of the punch. By the use of special tools this limit may, in some cases, be exceeded.

PLATINUM PRINTING WITHOUT DEVELOPMENT.

CAPTAIN PIZZIGHELLI'S new process of direct platinum printing has excited great interest in all countries, and it seems, indeed, to be destined to mark an era in the production of matt surface printing. In preparing the paper after the formulæ published, many operators failed, however, to obtain satisfactory results, though the manipulations are very simple and easy, and I still receive many letters and inquiries as to the coating of the paper, &c. To those it will be of interest to learn that the new paper for direct printing may now be procured ready prepared from Messrs. Adolf Hesekiel, Ph.D., and Jacoby, Ph.D., of Berlin, Landsbergerstrasse 32. I have myself made many experiments with this paper lately, and I am quite satisfied with the results. The process is really simplicity itself. The paper is printed under the negative until the image appears sufficiently intense (no longer), which requires considerably less time than in the case of albumen paper. Then the print is placed for five minutes each time in three baths of diluted hydrochloric acid (about 1·70 water), until the lights will appear perfectly white. Finally the print is washed out in water for about a quarter of an hour, when it is dried and mounted. No toning and no fixing bath is required, and, half an hour after printing the paper, you will have the picture finished and mounted. Though before printing the paper should be kept dry, it wants a certain degree of dampness to make the picture appear directly during the printing process. The dampness required will either be absorbed by the paper itself from the atmosphere, or it must be produced in an artificial manner. This may be done either by breathing upon the paper, or by exposing it to the vapours of boiling water. As the simplest method, I have experienced the following one. The paper with its yellowish, i.e., prepared surface—is laid on the negative, which should be neither thin nor flat, and the whole placed into the printing-frame. To see how far the printing process is advanced, open the frame from time to time, breathing always on the same half of the paper, that is to say, on the film side. The negative itself must always remain dry. When the half of the print which you have breathed upon appears sufficiently dark, take the paper off the negative and breathe on the entire surface, or expose it to the vapours of hot water. The print is then at once placed into the acid bath. The mounted prints may very easily be retouched with Chinese ink. In the case of portraits, it is recommended to print them on white ground, that is to say, vignetted. Under-printed pictures may be continued to print by placing them in a cold solution of oxalate of soda or in a 5 per cent. solution of soda. The ready prepared paper is kept either in chloride of calcium tin plate envelopes, or simply in pasteboard covers. Two kinds are on stock: No. 1 for normal and the harder kinds of negatives, the pictures produced with it having a brownish tone; and No. 2 for somewhat softer negatives, the pictures produced on this kind showing the deepest shadows and the purest whites.—H. E. GUNTHER in *Photographic News*.

TECHNICAL INSTRUCTION: THE PROFESSOR AND THE STUDENT.

IN an article on this subject the *Chemical Trade Journal* says: There is but little opportunity in England for a lad to have any real choice of his own, and the question is often asked by parent to parent—What are you going to make your son? without either of them ever thinking that without the lad's own free-will it is impossible to *make* him anything but a commonplace individual. Over and over again, cases can be pointed to in this country where a student has found himself absolutely unsuited to the profession to which he has been articled, and by his own energy and perseverance he has struck out a fresh path of his own, and has excelled in it without the aid of any instructor whatever. But men of this calibre are few, and the ordinary student would not progress favourably unless under the systematic training of an instructor whose duty is, or should be, to put himself so in touch with his pupils as to command their esteem and respect, and who will be ready to follow his lead as a faithful guide and friend. It is this fellow-feeling that has endeared the German chemists to their former teachers and the professors to their students, and it is the absence of a similar feeling in this country, except in a few instances, that has stagnated the progress of industrial chemistry.

If a professor is needed at all it is for the purpose of instructing his pupils, and in several distinguished seats of learning in this country it is a common complaint that the professor is never seen amongst his students, being always in his own private research laboratory, and even the instructor to whom the general teaching of the students is left is too much engaged with his own private work to give his undivided attention to his students. It would be invidious to mention names. What we have sketched here is a true picture, and is not a solitary instance, and explains much that has been privately said, that very often indeed does a pupil in an outside laboratory progress far more satisfactorily than in a large college or university, and simply because his instructor takes an interest in his work, and sees that he does it correctly. Judging from a chemical standpoint, the existence of the present state of things is a standing disgrace to the educational system of this country. The student is sent to college mainly to have the advice and assistance of someone who is supposed to devote a little time to one of the chief duties of his office, and if the student does not get the professor's attention, can it be wondered at that he fails to receive any satisfactory employment, and that foreigners, who have been well cared for in their educational establishments, fill the most lucrative posts in our commercial enterprises? The disease is a most serious one, but it is not incurable, and it is only by someone speaking out boldly that it will be properly diagnosed.

PROF. LÜTKEN, Director of the Zoological Museum of Copenhagen, has addressed a strong appeal to country people in Denmark to protect the sand grouse. He points out that the only countries in which the birds nested in 1863 were Denmark and Holland, but that owing to people gathering and eating the eggs no birds were hatched. He trusts that this wanton conduct may not now be repeated. Prof. Lütken feels sure that the bird can be acclimatised in Denmark, as the sandy cliffs and shores of that country are particularly suited to its breeding. The Zoological Gardens in Copenhagen have obtained a live specimen of the bird, caught in the Island of Fünen. Flocks upwards of a hundred in number have of late been seen in many parts of Denmark.

IT is stated that many of the electric-light wires at Pittsburg rapidly become coated with dust. This is attributed to the magnetic field set up round wires traversed by an electric current, as the phenomena does not occur in the case of wires carrying alternating currents, in which the rapid changes in the magnetic field cause the resultant force on such powders to be zero.

SCIENTIFIC SOCIETIES.

ROYAL METEOROLOGICAL SOCIETY.

THE concluding meeting of this society for the present session was held on Wednesday evening, the 20th inst., at the Institution of Civil Engineers, 25, Great George-street, Westminster, Dr. W. Marcet, F.R.S., President, in the chair.

Mr. F. de B. Collenette, L.R.C.P., M.R.C.S., Mr. J. Ewart, M.R.C.S., Mr. F. A. Velschow and Mr. J. T. Wills, F.R.G.S., were elected Fellows of the society.

The following papers were read:—

1. "First Report of the Thunderstorm Committee." This report deals with the photographs of lightning flashes—some sixty in number—which have been received by the society. From the evidence now obtained, it appears that lightning assumes various typical forms under conditions which are at present unknown. The committee consider that the lightning flashes may be arranged under the following types: (1) Stream; (2) sinuous; (3) ramified; (4) meandering; (5) beaded or chapleted; and (6) ribbon lightning. In one of the photographs there is a *dark* flash of the same character as the bright flashes; but the committee defer offering any explanation of the same until they get further examples of dark flashes. As the thunderstorm season is now coming on, the committee propose to publish their report at once, along with some reproductions of the photographs by the Autotype process, in order that observers may be prepared to notice the various forms of lightning.

2. "The Cold Period from September, 1887, to May, 1888," by Mr. C. Harding, F.R.Met.Soc. The mean temperature for each of the nine months from September, 1887, to May, 1888, was below the average, whilst in the case of October there has been no corresponding month as cold during the last half-century, and only three colder Aprils. In London the mean temperature for the period was only 42·4°, and there has been no similarly low mean for the corresponding period since 1854-5, which will be remembered as the time of the Crimean War, and only three equally cold periods during the last fifty years. The temperature of the soil at Greenwich at 3ft. below the surface was below the average in each month from October to April; in October and April the temperature at this depth was the coldest on record, observations being available for the last forty-two years, and in November it was the coldest for thirty-seven years.

3. "Observations on Cloud Movements near the Equator, and on the General Character of the Weather in the 'Doldrums,'" by Hon. R. Abercromby, F.R.Met.Soc. The author gives the results of observations made during four voyages across the equator and the "Doldrums," with special reference to the motion of clouds at various levels. Two voyages were across the Indian Ocean during the season of the North-west Monsoon, and two across the Atlantic in the months of July and December. The nature of the general circulation of the atmosphere near the "Doldrums" is discussed as regards the theory that the Trades, after meeting, rise and fall back on themselves; or, according to the suggestion of Maury, that the Trades interlace and cross the Equator; or as following the analogy of Dr. Vettin's experiment on smoke. It is shown that the materials at present available are insufficient to form a definite conclusion; but details are given of the general character of the weather, and of the squalls in the "Doldrums," with a view of showing what kind of observations are required to solve this important problem. The old idea of a deep Trade—with a high opposite current flowing overhead—is certainly erroneous; for there is always a regular vertical succession of the upper currents as we ascend, according to the hemisphere.

Solidifying Petroleum.—For years sanguinary inventors have been trying to solidify petroleum. We are told now that experiments are being carried on in Russia with the view of finding a process, at once practicable as well as desirable, on the score of economy and cleanliness, of solidifying the petroleum used as fuel. According to the report made to the Russian Government by Dr. Kauffmann, who has had the principal charge of these experiments, a successful method of accomplishing the desired result consists simply in heating the oil, and afterwards adding from 1 to 3 per cent. of soap. The latter dissolves in the oil, and the liquid, on cooling, forms a mass having the appearance of cement and the hardness of compact tallow. The product is hard to light, burns slowly, and without smoke; but develops much heat, and leaves about 2 per cent. of a hard, black residuum.

PALMIERI has observed that in a bright clear sky, with a high and steady barometer, and every indication of continued fine weather, the electrometer will give an indication of change long before the barometer.

SCIENTIFIC NEWS.

◆

HE death is announced of Mr. Edmund Gurney, joint secretary of the Psychical iety, author of "The Power of Sound" and r works. Mr. Gurney, who was born about 7, was the son of the Rev. Hampden Gurney, Rector of Marylebone. He received his cation at Trinity College, Cambridge, of ch college he became a Fellow, after taking degree as Fourth Classic in 1871. Besides large work above mentioned on the philohy of music, which has attained a standard ition, Mr. Gurney was the principal author "Phantasms of the Living," and had ntly published, under the title of "Tertium d," two volumes of collected essays. He ered from obstinate sleeplessnes and occaal neuralgia, and succumbed to an overe of chloroform, incautiously taken when ne at an hotel in Brighton, whither he had e on business.

he Council of the Royal Meteorological iety are desirous of obtaining photographs lashes of lightning, and they ask for the coration of all who have photographs of htning, or who can procure them. ast r a similar request was made, and about 60 tographs were received, many of much erest. The report of the Thunderstorm nmittee has been published with some tographic representations of the lightg flashes, and an illustration of the charge from Mr. Wimshurst's large inmce machine, showing bright beads in streaks of light. The council of the iety state that the photography of lightning s not present any particular difficulties; if a rapid plate and an ordinary rapid lens h full aperture are left uncovered for a short e at night during a thunderstorm, flashes lightning will, after development, be found ome cases to have impressed themselves on plate. The focus should be that for a dist object. It might be worth while taking this subject now that suitable materials available. There ought to be no difficulty so arranging an automatic camera with able paper wound on rolls by clockwork, o catch any flash that might occur whilst sensitive paper was passing through the era. The photographs already received e disclosed facts about lightning which e quite unsuspected; but at present the understorm Committee do not think they ld be justified in making any generalisa. They require more photographs.

he *Journal* and *Proceedings* of the Royal ety of New South Wales (Part III.) cons a paper by Mr. Lawrence Harvey which interest aëronauts, as it is entitled "Autohic Instruments used in the Development lying Machines." The title, however, will e many as being rather of an anticipatory acter. Is there a flying machine to be loped? The paper is, perhaps, of more ordinary interest because the Committee he House of Representatives of the United es has reported in favour of a Bill approting 75,000dols. for carrying out the mes of a sanguine inventor who believes he construct a vacuum balloon of great power. lloon rises, as most schoolboys know, bee it is filled with gas that is lighter than therefore, if it is "filled" with perfect ptiness" it must be all the more capable ating. The inventor proposes to construct vacuum balloon of thin steel, but some hematician has just shown that no steel uum balloon could be constructed which ld raise its own weight, for the simple on that a vacuum balloon strong enough to st atmospheric pressure would be too heavy ise.

t a recent meeting of the Edinburgh Royal iety Prof. McIntosh, of St. Andrew's, read a er on the early stages of development in tain fishes, especially the cod, and cleared several unsolved problems in connection h natural history. Prof. McIntosh, with aid of the marine laboratory, has traced the ryo fish from the ovum to the adult condi.

t may interest some of our readers, espely those taking part in the discussion on lution, to learn that, in a recent number of *Naturwissenschaftliche Wochenschrift*, Prof. Nehring discusses the question as to the origin of the dog. He expresses his belief that it is descended from various still-surviving species of wolves and jackals. The training of jackals, he says, presents no particular difficulty, and many attempts to domesticate wolves have been successfully made in recent times. Herr Rongé has so completely tamed a young wolf that it follows him exactly as a dog might do.

Those of our readers who are interested in organ matters may like to know that one day last week Dr. Hopkins, organist of the Temple Church, gave a recital, the occasion being the bicentenary anniversary of completion of the purchase of the organ from Father Bernard Smith in 1688. The contest between Smith and Harris for the honour of supplying the organ lasted nearly four years, during which time the two organs, which were both erected in the church, were played upon by various celebrated players of the day. In the result, Smith was victorious, and Harris's organ was removed and divided, a portion being sent to the Cathedral of Christ Church, Dublin, while the remainder was erected in St. Andrew's, Holborn. The organ was latterly, in 1842 and 1849, repaired and enlarged to its present form. Dr. Hopkins, in an interesting little pamphlet issued to the visitors, says—"In preparing the programme for this afternoon it has been thought appropriate to the occasion to impart to it somewhat of an historical and national character; hence five of the numbers selected were written by English organists of former days. Most of the remaining items, including those of the great 18th-century German composers, Handel and Bach, are inserted by desire." The Rev. J. M. S. Brooke, writing in reference to this matter, says that Father Schmidt's instrument was chosen in preference to Renatus Harris's not by those organists who alternately tried them, but by the notorious Chief Justice Jeffreys, who was appointed to decide the burning question by the Societies of the Inner and Middle Temple. He believes the contest lasted about a year, not four as alleged.

The fifty-fifth annual report of the Royal Cornwall Polytechnic Society is, as usual, full of useful information, the most interesting paper being probably that by Mr. M. Dunn, of Mevagissey, entitled "Remarks in Connection with the Laws, Capture, and Natural History of the Herring and Pilchard."

The *Transactions* and Annual Report of the Manchester Microscopical Society has been received, and proves that the Society is flourishing in one way, for there is quite a collection of interesting papers, and the members evidently take a pride in doing the most they can to promote the objects of the society.

The Annual Reports of the Aëronautical Society of Great Britain for 1885-86 have just reached us. They are published together.

General W. H. Hutchinson, of Eastbourne, has published, through Farncombe and Co., of that town, his pamphlet on "The Navigable Balloon in War and Peace." It is an interesting paper on the subject with which it deals, for General Hutchinson is conversant with his subject, and fully appreciates the value of navigable balloons in warfare.

The Report of the Comptroller of Patents, Designs, and Trade-marks for the year 1887 shows that the total number of applications for patents in 1887 was 18,051; designs, 26,043; and trade-marks, 10,586; numbers higher, we believe, than any previously recorded. Just a trifle more than three-quarters of the applications for patents came from persons in the United Kingdom, and of the total applications 53 per cent. were proceeded with. The total receipts for the year amounted to £124,279, of which £105,599 was for patent fees, while only £5,360 was received by sale of publications, the expense of printing which amounted to £22,300. Not less a sum than £47,110 was expended in salaries; but still a surplus of £42,000 was left at the end of the year.

For several years the committee of the Royal National Lifeboat Institution have been endeavouring to find a means of propelling lifeboats mechanically. In April, 1886, a special sub-committee was appointed to inquire fully into the question, but was "unable to recommend the adoption of any pattern of steam lifeboat at present." The following May the committee of the Institution offered gold and silver medals to competitors all over the world for "models or drawings of a mechanically-propelled lifeboat best adapted to meet the conditions under which lifeboats are called upon to perform their work." In response to this offer numerous models and drawings were received from all parts of Great Britain, the Continent, and even from the United States. These were submitted to Sir Frederick Bramwell, F.R.S., Sir Digby Murray, Bart., of the Board of Trade, and Mr. John I. Thornycroft. These judges, after a careful and lengthy examination of all the models and drawings which had been sent in, reported that not one of them was suited for the purpose for which it was intended. The committee nevertheless still hoped that science might yet help them in the matter. At the beginning of the present year a model of a steam lifeboat was submitted to the Institution by Messrs. R. and H. Green, of Blackwall, which, having passed through various modifications, as the result of consultation with the committee and their professional officers, was accepted by the Institution, and Messrs. Green have now been instructed to build, as an experiment, a steam lifeboat on the proposed principle. The new boat is to be 50ft. long with 12ft. beam, and to be propelled by a turbine wheel worked by an engine developing 170H.P. Such a boat, if successful, will necessarily only be able to be used at a limited number of stations.

Dr. E. A. Opie, writing to the *Lancet*, gives reasons for believing that eczema is contagious. His case is one in which the disease spread from one person to another in a family of eight; but it is necessarily inconclusive, as the same cause may have produced similar effects in the whole family. There is, however, something more than a suspicion that eczema is contagious, and consequently care should be used to avoid contact with those suffering from that troublesome affection.

Mr. J. Ellard Gore, F.R.A.S., &c., has in the press a volume entitled "Planetary and Stellar Studies: papers on the Planets, Stars, and Nebulæ," which will be published shortly by Messrs. Roper and Drowley.

Noxious Salts in Fruits Prepared in Tin Vessels.—Dr. Leonard W. Sedgwick says that the harmlessness of the salts of tin other than the chlorides is generally taken for granted, but the following facts appear to show that the assumption is incorrect.—"In October, 1886, I saw nine persons in one well-managed, healthy household simultaneously suffering from watery diarrhœa, sickness, and great pain in the abdomen. A close investigation served to show that, excluding the water they drank (which was pure) and the air they breathed (which was free from drain contamination), there was one thing, and one thing only, they had done in common, and that was the eating of pears stewed in a newly-tinned copper pan. It came out, too, that many of them had suffered from two or three similar attacks on previous days, and that these attacks all occurred on days when they had eaten stewed pears I therefore obtained some pears so cooked, and, on testing the juice, found it laden with tin salts, but containing no copper. That the diarrhœa gave way in a short time to simple remedies, that the drainage and the water supply of the house were perfect, that the eating of stewed pears preceded on the same day each attack of illness, and that pears similarly stewed were found to contain large quantities of tin salts, were to my mind conclusive, if circumstantial, evidence that the attacks of diarrhœa were caused by the tin salts. And then occurred the thought that, if the cooking of a somewhat acid fruit for a short time in a tinned vessel effected the formation of a poisonous salt of tin, the keeping of an acid fruit for months in a tin can must have a like result. I therefore tested the contents of cans of apricots, pine-apples, peaches, and tomatoes, and in every instance found a large amount of a salt of tin. In this I was confirmed by my friend Mr. Hugh Power, who also in one specimen detected a salt of zinc. Since then I have seen several instances where painful diarrhœa followed the eating of a tinned fruit, especially in one case, where tinned pine-apple was eaten by several persons, who all suffered in like manner. And so I am compelled to believe that many cases of casual and unexplained nausea and diarrhœa are caused by the use of tinned fruit. Indeed, since the occurrence of the cases in 1886, I have lost no opportunity of relating these things to my personal acquaintances, and of advocating the use of bottled fruits only."

my mind *can* possibly be cognisant of is—its ideas: and hence he proceeds to argue that out a percipient mind, the sum of sensations h we call a table must and does cease to exist; ort, that we have no warrant whatever for the f in matter, in the absence of mind to per- the bundle of sensations which we group r that name. It may furnish "Esne Caralita" some not wholly uninstructive mental exer- to endeavour to find his way out of the diffi- thus suggested; and it may further give him insight into the weary logomachy and beating e air which, under the name of "Philosophy," afflicted the souls of men from Thales down to resent day.

bserver" (query 65667, p. 382) may put a 1in. over the object-glass of his transit if he is ous about observing the sun with his whole ture; but spider-lines bear a charmed life, in some mysterious fashion stand a very great of solar heat, much more than any form of will.

ellow of the Royal Astronomical Society.

SAFETY LAMPS.

28903.]—ALTHOUGH so much has been said written upon this most important subject, yet ay be said that much of it has been irrelevant misleading and very much to be regretted, not for the sake of truth, but for the lamp trade eneral. The constant recurrence of these fear- accidents is so appalling that they must certainly bviated, or the lamp trade will soon extinguish f. Such a calamity at a time like this, when beyond dispute that the cost of the light given me of the better class of oil lamps is even less half that of coal-gas, would be deplorable; es which there is every indication that before the prices of petroleum oils will certainly be much lower than they are at the present time, with none but properly-constructed safety s it must certainly supersede all other ods of artificial lighting as well as heating.

ere can be no such a thing as a safety lamp out a safety burner, and at the present time ers of this description are few and far een. It may be truly said that the markets looded with the vilest rubbish in the shape of ers as well as lamps, one half of which may be to be of foreign make. The whole catalogue isasters arises from no other cause than the heating of the oil in the reservoir, and this heating is entirely due to badly-constructed ers, which are fitted into lamps and sent out heir mission of destruction with palpable in- ence by the makers. The only wonder is that dents are not more numerous. Nevertheless, element of danger exists in most lamps, the liability to show itself is always present the lamps are in use. Therefore, the most able point of safety can only be obtained eping the oil in the reservoir perfectly cool, no lamp, however constructed, is worth the of "safety" in which the oil is heated more from 5° to 10° beyond its ordinary temperature. instead of this, it can be easily proved that of the burners, even of the best makers, will mit as much as from 30° to 40° additional heat oil soon after lighting up, or reaching to 100° F., which is far beyond the flash point of of the oils now in use, and more than suffi- to cause the most direful results. For in eated state there is a continuous escape of ar gas, for the escape of which some of the ers provide by means of safety-valves, vent- and such appliances. These are, in some nces, independent of the burners. Others de openings direct from the reservoir through ody of the burner, and thence to the flame, ing that the vapour may safely escape that or be taken up and gradually consumed by lame as fast as it is generated. But this is reatest fallacy, for before the heated gas can the flame it gets so thoroughly mixed with ir as to become pretty well harmless, and it is it is so, or the chapter of accidents would be much greater. These are the kind of burners are the chief cause of most of the accidents do occur, for in attempting to extinguish the by blowing down the chimney, or by suddenly g them to any height, the flame, by being d downwards, meets the escaping gases before ning so harmless as before described, and quently an explosion is evitable. But if we t a greater amount of safety to those lamps are constructed with appliances for the escape e gases independent of the burner, it cannot nied that the same element of danger still , for although it may be safe to extinguish ght by blowing down the chimneys of such , it may at any time show its existence in ways, such as being accidentally dropped or n over. In either case the over-heated oil rapidly ignites, even without actual contact the flame, as the escaping vapour is quite mable enough to start the mischief.

th a properly constructed burner we need no such appliances as safety-valves or vent holes, nor even automatic extinguishers; in fact, the less appendages to a burner the better, for every addition only tends to augment the body of heat, which in time is transmitted to the reservoir; besides which the burner is less complicated, and is the more readily kept clean. Every means should be adopted to prevent the heating of the oil while the lamp is burning, for it is well known that petroleum of any decent quality cannot possibly be ignited in the bulk at its ordinary temperature, nor is there any risk from its evaporation, for it does not evaporate half so much as water, and at the ordinary temperature it is quite as safe. Therefore, with the most fragile glass containers becoming fractured by any kind of accident, there would be ample time to prevent conflagration in most cases, provided the oil had not been previously heated in the reservoir. How can a lamp be termed absolutely safe when in a very few hours after lighting up the oil in the reservoir becomes heated in the manner already described? Yet such are being advertised. Surely, if the question were gone into at all, it could certainly go on no better lines than those I advocate—that is, to condemn all such burners or lamps whereby the oil in the reservoir or container becomes heated more than a very few degrees, if any, beyond its ordinary temperature. No other method could be so absolute in preventing accidents, or better for the good of the lamp trade and the safety of the public.

G. B. Postlethwaite.

THE FATAL THIRTEEN.

[28904.]—THERE is a commonly received tradition that if, from some cause or other, the last guest at a dinner party happens to make up the number to thirteen, one of them will inevitably be found missing before the year is out. It may, however, be doubted whether those who favour this superstition are sufficiently enlightened to credit the fact that if these thirteen persons thus gathered round the table were privileged to live only long enough to exhaust as many of the changes as they were capable of making in their relative positions during that year one and all of them would escape this calamity. That such a number of changes can be effected in a reasonable space of time the following calculation will prove, and will, moreover, show that No. 13 will be conspicuous rather as a beneficent factor in the same than otherwise, and that the unlooked-for guest who made up the supposed ominous number should be greeted with a marked expression of welcome.

Assuming that these 13 persons were alert enough to make as many as 13 changes in three minutes, and agreed to amuse themselves for 13 hours a day, and to devote the 313 working days of the year to this little game, they would accomplish in that time 105·7940 changes out of the number which No. 13 is capable of making. Seeing, then, by the vast number of changes they had then accomplished, they would naturally think there could not be many left to complete the remainder of the number, and that it would be no unreasonable request to have the like privilege so far extended as to enable them to do so; but what would be their astonishment on being told that in order to finish their self-imposed task they would be doomed to spend upwards of 5,000 years before they had exhausted all the changes of which this notable No. 13 was susceptible. It may be added that two more guests would have brought the number of possible changes up to a billion.

People often speak glibly of millions and billions, but probably few are capable of realising the meaning of the last-named sum, unless it could be presented to the mind in a more lucid form than by an array of figures.

The readiest and most palpable way of illustrating the magnitude of a billion is to treat it as a money question, and to put it, as it were, objectively before the eye as so many coins, drawing no further on the imagination in the way of figures than to assume for a moment in the present instance that it is no figure of speech to talk of the streets of London being paved with gold. All that is required is to imagine a road of the ordinary width covered with a layer of sovereigns so closely fitted together that little or nothing is to be seen of the surface except gold. Now the simple question is, What must be the length of such an auriferous road to allow of it being thus covered with a billion of sovereigns? At the first blush, some might say a mile, while others more venturesome would say ten miles, but that it could not possibly exceed that limit. Now, it can be readily proved by an accurate measurement of the space occupied by a score or so of sovereigns placed as to fill up the interstices arising out of their close contiguity, that if this road measured exactly 32ft., or 10⅔ yards in width, it would, incredible as it may seem, have to run once round the world, or 25,000 miles, in order to receive the number of sovereigns which would be represented by a billion.

The accuracy of these calculations can be very readily tested, and they are set forth simply with the idea of dispelling the hazy notions generally held about these sums, and to show how this can be done by a novel way of "putting the matter."

A. Z.

HOW TO LIVE FOR EVER — PURE MATHEMATICS — THE EXTERNAL WORLD.

[28905.]—AS "Kappa" (28890, p. 373) specially asks me for an opinion on the letter which he extracts, headed "No More Death," I will begin by saying that no more terrible infliction could be conceived, alike for the individual and the community, than a discovery such as is suggested. Even if confined to a special few, how utterly weary of existence they would become—if general, an end would have to be speedily put to birth as well as death, or we should have no room to move; and what would existence be worth when family interests and all that child-life means were taken out of it? Life and death are inevitably united, each absolutely necessary to the other, both parts in the whole scheme of existence, and each good in its order.

But, as "Kappa" suggests, "there is something in 'W. A. W.'s' ideas"; only, to use the hackneyed saying, "That which is new is not true, and that which is true is not new." The use of acetic acid is not new; there is a professed system of "acetopathy" set forth long ago as a universal remedy. What "Kappa" says he finds true is no novelty. It is well known that strong acetic acid dissolves the epidermis, and can be used to remove the semi-dead skin which forms where care and cleanliness are neglected. That is why it has become one of the most commonly-used corn solvents.

That the skin is one of the most important of the eliminating organs is no new information, though the average human who is very anxious about his liver, and about his lungs when he catches cold, and sometimes about his kidneys, rarely understands that his skin plays an equally important part, and is very often the real source of the bad working of the others, and the proper place to which the remedy is to be applied. But any one who knows this truth and takes good care of his skin, brings about the very effects which "W. A. W." attributes to his acetic acid. That is the very action of the Turkish bath, and the man who regularly washes himself thoroughly all over every day in cold water and once a week takes a good hot bath, with occasionally a hot-air bath, will, I am pretty sure, be just as thoroughly cleared of all impurities, and likely to live just as long as on the system of "W. A. W."

I do not say that the acid may not remove something which the water may not dissolve, even with the aid of soap; but I much doubt it. But what I do not doubt is that in due course "W. A. W." will effectually disprove his theory in the usual way. He may defer that for some time yet, because the description favours his longevity. This capacity for long life depends partly upon the inherited constitution, partly upon the mode of life, freedom from care, &c., and partly upon the care taken of the body.

What is pure mathematics? (My one definition of its ultra form would be pure bosh!) Some time ago a writer urged upon chemists the study of what he called "pure motion"—that is to say, motion, leaving out of consideration any substance or matter moved. Such suggestions ought to qualify people for treatment in a lunatic asylum, and—well, it may be my own ignorance; but when people talk about space of four (or *n*) dimensions, I am forcibly reminded of the suggestion which Festus made to Paul, "Much learning hath made thee mad." The fact is simple; these ultra-mathematics are not mathematics at all. They have drifted over into the worst type of metaphysics. True mathematics deal, and can deal, only with *realities*—the actual and possible relations of things which really exist. The moment a mathematician pretends to deal with merely imaginary matters he becomes an impostor, and can only lead his disciples into chaos. All talk about space of four dimensions belongs to the same order of folly as the old scholastic discussions about the number of angels who could dance on the point of a needle. They come under the old definition of the "oppositions of science, falsely so-called," which were simply the elaboration of deductions from merely imaginary starting points. As Mr. Grey says (28880, p. 371), we probably shall always have such people, just as we will always have persons who believe in dreams and similar nonsense. The mystery is that he does not see that four-dimensioned space is a mere dream, and that argument about what creatures could do who existed in it is —well, nonsense. We might just as well calculate how long it would take to build a castle in the air, the labourers getting up to the clouds by turning a ladder up when they had got to the top of it; and *assuming the fundamental facts* that the labourers could do this, a mathematician would easily work out the details of the

[illegible]

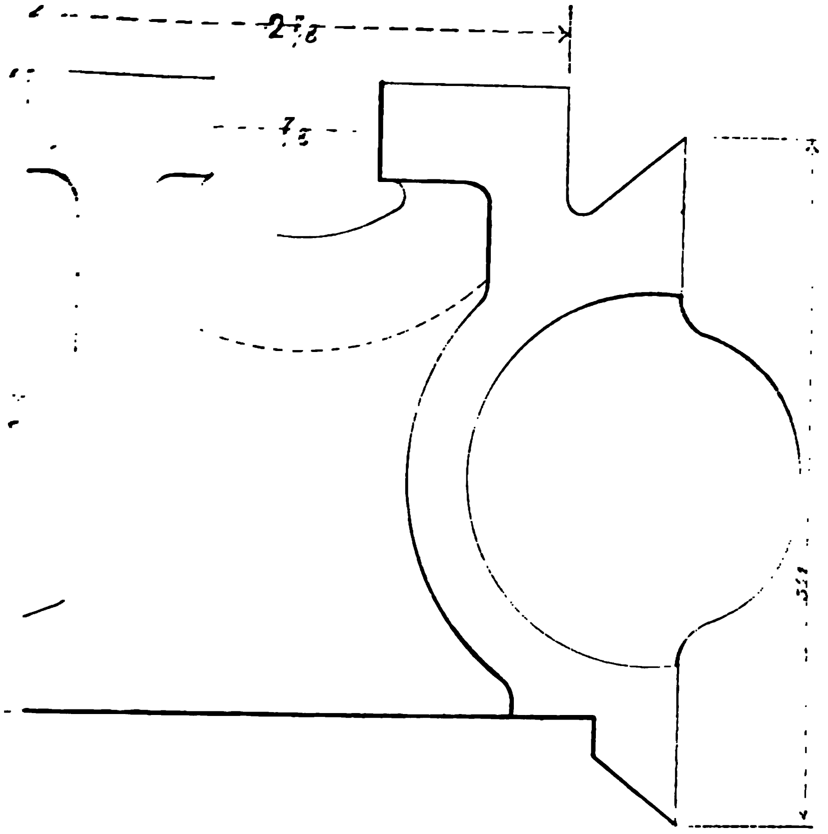
[illegible] LATHE.

[illegible]

Orderic Vital.

[illegible] UNIVERSAL FRONT-SLIDE LATHE.

[illegible]



[illegible] so that a back gear [illegible] arranged [illegible] for screw-cutting [illegible] lathe. My [illegible] for amateurs and [illegible] a screw-cutting complete [illegible] when they like. [illegible] screw is covered in, so [illegible] damaged; as the bed [illegible] "E. M." was reduced so [illegible] proper size. I inclose [illegible] and hope Mr. Editor [illegible]

[illegible] "E. M." cannot understand my [illegible] the T-slot table [illegible] and the tool-[illegible] the work when the [illegible] its full size—[illegible] required, not, as stated [illegible] see my way to [illegible] away with longi-[illegible] if a leading screw [illegible] not supply [illegible] some expen-[illegible] to supply it [illegible] made at; besides, [illegible] more handy, as [illegible] variety of work. It is [illegible] plenty of money [illegible] when those whom [illegible] scrape enough to [illegible] I am prepared to alter any [illegible] purchaser. But, if [illegible] over six years to [illegible] my principle. I am [illegible] who earns his [illegible] as many readers can [illegible] my acquaintance.

[illegible] Rev. F. Carre wishes me success; [illegible] like it. I may add [illegible] patterns of beds, [illegible] style, if all the work this [illegible]

R. Price.

[illegible]—WHEN next W. H. Taylor comes [illegible] a correspondent with "unfairness," [illegible] as well for him to see that, [illegible] another, he is not condemning [illegible] I have nowhere stated that a purchaser [illegible] Mr. Price's lathes will be grievously disappointed. What I have said is quite a different [illegible] that the owner of such a lathe, if he ever contemplates converting it into a self-acting lathe, will be grievously disappointed at the rapidity with which it will wear untrue.

Let those who doubt this ask the opinion of any impartial person, whose knowledge of such matters is admitted, and I fancy the answer they will get will not materially differ from what I have said.

I can say I wish Mr. P. all success, and I think I have said he deserves it. I think his lathe is an exceedingly convenient one, which, did I not seek for a front-slide lathe, I would be ready at once to purchase; it has so much to be said in its favour. But for self-acting and screw-cutting I maintain it cannot, spite of the most accurate fitting and the best materials, continue for long to give satisfactory results. I do not know what W. H. Taylor or "Comparison," whose argement is the same, considers accurate and satisfactory work. I wonder the irrelevancy of the reference to shaping and milling machine beds does not strike these writers. Do they mean us to understand that the strain and pressure brought on the V's of a F. S. lathe-bed used for turning is the same either in direction or amount that would come on the same bed if used for milling or shaping purposes? In milling machines nine-tenths of the pressure the bed has to bear is longitudinal, not vertical. In the shaping machine, where the bed is fixed, the inaccuracy of the bed, even if it was so great as to utterly disqualify it for turning purposes, if lathe-heads were fixed on it, would hardly be perceptible in work shaped, for the reason I have already given to "Comparison": because, in shaped surfaces, there seldom, if ever, is such an extent of surface across the feed as to show the inaccuracy of the bed. Bad or loose fitting is most injurious, either in the table or the moving head. In the lathe the accuracy is mostly tested across the feed, when the inaccuracy of the bed at once shows itself.

Drilling a hole through a sixpence is ridiculous when brought forward as a proof of the abiding truth of the bed of a lathe whose whole bearing surface is little over ⅛in. in surface. It might do this equally well if it had not ⅛in., and were newly and well fitted. But what has this to do with the matter on which alone any question has been raised by me?

I see with surprise "Orderic Vital" likes the arrangement of the V slips better than any previous design. I thought he knew that the F. lathes of 50 years ago were condemned, simply because of this bad design of the bed. The wearing surface was quite insufficient to give any lasting truth.

Will anyone tell me what is supposed to be the advantage of centring the heads in this lathe. I presume it is not intended to do the milling with the vertical slide? It does not secure a solid support for the work under the cutter, for this is destroyed by the slide-rest being made to swivel on a pin in the centre of the bracket, at least 3in. away from the line of centres. This will also destroy the solid support on the bed for the tool when doing turning up to 1in. or so, which can be secured when the heads are not centred.

It may be said the support is solid enough for such a light lathe; but I do not admit this at all—no matter how light the lathe is; it is a most decided advantage to have all the solidity which can be had under the tool. In a F.S. we must sacrifice some of this; but let it be as little as possible, and that lathe is not, in my opinion, to be

recommended which sacrifices more than is necessary.
Fredk. Carre.

[28909.]—ALTHOUGH I have carefully read Mr. F. Carre's letter relating to the above, I cannot agree with him, especially when he makes the statement that the life of this lathe bed will be about one year against 14 to 21 years of ordinary top bed, which is going too far.

Some of the best lathe-makers, such as Pfeil and Co. and Brittania Company, use exactly the same form of bed in their front-slide lathes; and also Mr. Hines, in his "combination" slide-rest, which is for adapting ordinary lathes into self-acting sliding and screw-cutting, and has a front slide as long as the lathe-bed, exactly like Mr. Price's, the front-slide can be had 5ft. long, I believe. All this is proof that the above lathe has not the serious defect Mr. Carre would have us to believe.
H. F. C.

[We cannot carry the discussion on the merits of Mr. Price's lathe any further.—ED. "E.M."]

LATHE MATTERS.

[28910.]—I HAVE to thank the contributors who so kindly took notice of my former letter, especially Mr. J. C. Linscott for his very generous offer, which I hope to take advantage of a little later; but, for the present, I am too busy to make the change in my lathe. Another thing is that I would not attempt to make patterns of gear wheels, and so it would be more important if I knew where to procure suitable castings. The lathe mandrel is 1⅜in. in diameter.

My numbers of the "E.M." extend only a few years back, so I cannot refer to Vol. XI.; but I beg to thank "F. A. M." all the same for his trouble in hunting up the subject.

For slow motion, I have a pulley on the crank shaft, a counterpart of that on the mandrel. By this means I can reduce 3 to 1; but, for metal turning, the band (¼in. gut) slips terribly. I could turn metal three times the diameter on a 3in. back-geared that I can now with the 6in.

Of course, I might use a countershaft with double or treble pulleys; but it would be too much bother, and, after much experience with back-gear, I have decided to put up with the row. I might also use ½in. gut, but I am afraid that on a 3½in. pulley its life would be very short, and it should be very tight. What I want is the same belt to suit four speeds, as it does for wood; then to put on the gear, and have four for metal.

I should be very glad indeed if my lathes were fitted with a front slide; but, as it is, I can easily change from sliding to hand-turning. Across the saddle is fitted a female slide, with T-slots cast in it. The top slide, with slewing arrangement, is bolted to this with two bolts. I have only to loose the nuts of these bolts one turn, draw the top slide to me, slide in a pillar with T-rest—all done in about half a minute—and I can turn away by hand. I don't think I could rack away the saddle and put on the hand-rest as quickly.

As I have not a front slide, perhaps some of our contributors could tell me how best to fit a vertical slide for milling and other work.

To return again to the internal gear. I cannot quite make out "Engineer's" description (letter 28852). If the block he mentions is eccentric with mandrel and fast to cone, it will act as a key, and the cone and recessed plate will run together. If the block is eccentric with itself and works on a pivot, it will get out of gear sometimes—at least, so I think. If "Engineer" would be good enough to send a rough sketch, I am sure many would be glad to see it. Would it not be worth Mr. Carre's while to make a pattern and core boxes for his own plan of bed?

I made the entire set of patterns, with the exception of flywheel, for my 6in. screw-cutting lathe, and found the job not at all overwhelming.

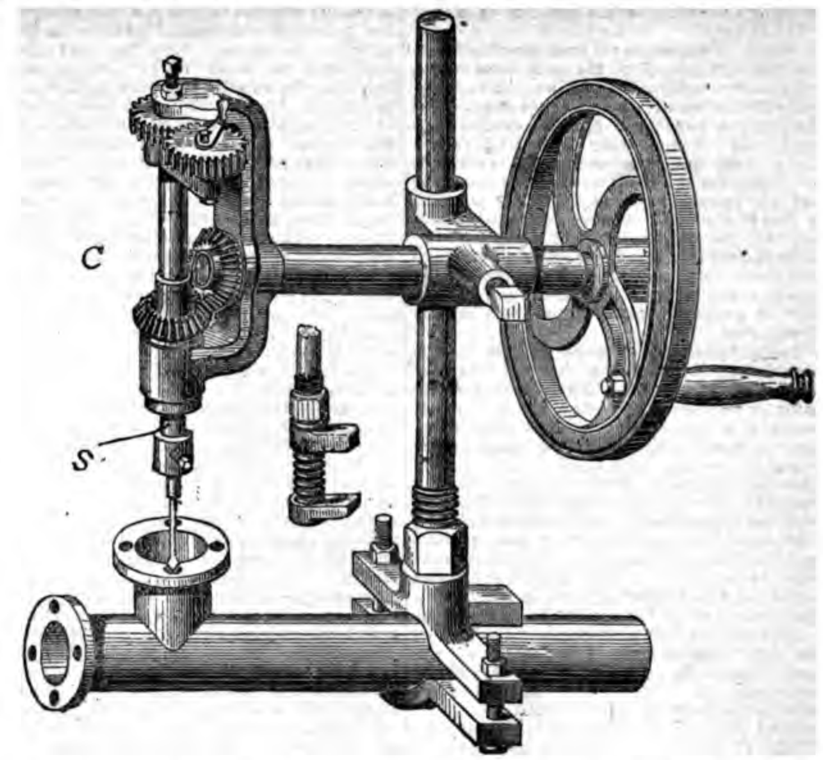
I trust somebody will be able to say some more about Pfeil's screw-cutting gear, as it is a puzzle to me how "any number of threads from 3½ to 60 can be cut with only nine gears." How many threads to the inch in leading screw?
J. L. D.

INTERNAL GEAR FOR LATHE.

[28911.]—HAS not "Engineer" forgotten to state that the toothed ring, inside of which the eccentric works, must be in some way prevented from revolving, else the mandrel would not revolve at all? If the pulley be held firm, what is to prevent the mandrel with the internal toothed ring, when revolved, acting on the toothed eccentric ring, as if it were an ordinary pinion, and the eccentric its pivot, and causing it to rotate.

The internal gear referred to by "F. A. M." is not the Jewsbury gear, and is not recommended by "J. K. P." I think it is the same as referred to by me, as given by Holtzapffel.

Would someone kindly explain how the feed on the "Monitor" self-acting drill is obtained? I send an illustration with the description of the action from the trade list, as follows:—



"Screw the drill-stock or bracket firmly to the work-bench or the article to be drilled. This being done, lock the upper tooth wheel, by turning the eccentric gearing against it to the left hand. Then run down the spindle, by turning the handle until it reaches the article being drilled. Put on the feed motion, by turning the eccentric to the right hand. After the hole is drilled, the spindle is immediately drawn back, by locking the upper wheel, as before, and reversing the handle."

There are evidently two wheels on the top of the drill-spindle, gearing into the single broad wheel on front of the bracket. Query: What is "the upper toothed wheel locked to"? Where does the eccentric gear work? It is not represented in the cut. Is C a sleeve in which the spindle S can move up and down, but not revolve, same as the barrel of the lathe poppet? To what respectively are the two wheels A and B attached—screw, spindle, or sleeve?
Fredk. Carre.

THE GLACIAL PERIOD AND ITS CAUSE.

[28912.]—AS "E. L. G." has for so long a period, in the pages of the "E.M.," advocated a world-wide deluge of water from extra-mundane sources falling scalding hot both at the Equator and at the Poles, perhaps I may not be too persevering, even at this date, if I point out some of his further mistakes and errors.

In letter 28641 he defines *superheated* steam as dry steam even at low atmospheric temperatures. Superheated steam, as its name implies, is steam at a higher temperature than 212° F., which can only be obtained by high pressure. How then could such superheated steam exist in the high regions of our atmosphere where the barometer is far below an inch in height, and where the thermometer would indicate 200° below freezing point at least. A volume of water striking our atmosphere would of course generate heat sufficient to instantly convert it into vapour at a comparatively low temperature; but even if at 212° F., would it not rapidly condense and freeze long before it reached the earth below? Our atmosphere has been variously estimated at from 50 to 200 miles high, and there are reasons drawn from the observation of meteorites which point to its extension for 500 or 600 miles. How is that for superheated steam and scalding water! "E. L. G.," in his letter 28755 ("E. M.," May 18), questions my statement that "more heat is received about the Poles than about the Equator annually." Dr. Zenker, of Berlin, estimates the amount directly received from the sun as about one-tenth greater at the Poles than at the Equator, and let "E. L. G." add to this the amount carried by ocean and air currents. "E. L. G." says my statement about the recession and shrinkage of glaciers is "most amusing," and to disprove it he cites a work written in the year 1794! He will learn a great deal on the subject if he reads Tyndall's "Forms of Water," which embodies a course of lectures originally delivered to children. Tyndall describes the shrinkage and recession as it is and as it has been, and says that a glacial period requires more heat than cold for its causation. I suppose "E. L. G." will call this a ridiculously paradoxical statement, but nevertheless it is true. The extra heat required existed in the former high northern and southern warm climate, together with such heat as might be derived from first impact of the water with our atmosphere.

The well-known example of superheated water and steam in volcanoes and geysers also tells against "E. L. G.'s" theory of a scalding hot Deluge and parboiled mammoths. It is known from observation in Iceland and in the Yellowstone Park that the lower portion of the subterranean column of hot water in the geyser funnels is 50° F. above the common boiling point. When this superheated water is relieved from pressure at the geyser's or volcano's orifice, a large portion of it at once explodes or flashes into steam. How would it behave *in vacuo*, or how would it behave on the confines of our atmosphere 500 miles away, where every degree of its temperature would have to compete with low pressure, intense cold, existent moisture, and length of travel? The atmosphere would be hyper-saturated, and the moisture already dissolved or suspended would first be precipitated to the earth before the newly-arrived moisture would be sufficiently diffused. In fact, the whole process would follow the cycle of the sun and seasons in both hemispheres.

Mr. Drayton (28669) names three of the usually assigned causes for the Glacial Period. Two of these I have noticed in my letter 28199. His first or geographical reason appears to me to have this difficulty among others:—How could a change in the geography of the earth cause a glaciation over the same extent of Northern Hemisphere in Europe, Asia, and America, and also of the Southern Hemisphere at the same time, as evidenced by glacial action in Australia and other lands of similar latitude? The very fact of the glacial action being evident over places still existing proves the land to be still more or less the same. This is a difficulty to which the supposition of added water from outside space is not subject.

I leave my theory in the hands of your readers, for I cannot longer trespass on your kind indulgence. Permit me also to thank your many readers who have considered it worth time and trouble to discuss the subject matter of the moon's water and the Glacial Period.
Francis E. Cane.

NOAH'S FLOOD AN ACCIDENT.

[28913.]—THOUGH the diluvial waters were of course "a meteor," in the strict etymologic sense that we call shooting stars or aërolites "meteors," yet everybody, or at least "F. S. S.," in pp. 332, 371, by "meteorology" means only atmospheric meteors, which I have all along denied the Flood to have been. Why am I, or the French scientists, to explain atmospherically a "shower" we deny to have come from the atmosphere, but from skies above it? They have, as I said on p. never ascribed it to any but an astral cause short, no other than such as Halley discusse our Royal Society in 1694. Of course reader the last column of p. 353 will have seen

"1794" was a misprint, as the next line calls it 30 years before 1724.

The sufficient answer to all such sneering ignorance as that of "Delta," p. 254, is in three words, "Regard modern science." Not a word of this your insolent rubbish has ever been science at all. But cometary orbits have been positive science these two centuries. Nature, ever since Halley's and Newton's time, has been constantly, yearly or oftener, thrusting before all noses, or at least the eyes of all learned societies, Royal or not, this broad fact (for which I referred you to the atheist Comte), that the "great deep" of the infinite sky does always hold stores and "fountains," exhaustless and countless, of water and of everything else, each ready at any moment to pour a Noah's Flood, or fiftyfold greater catastrophe, on this or any world whatever.

No harder, stranger, or more notable in this visible universe, than accidents that kill a baby or a gnat, are such accidents as the Noachian world-drowning, or as Peter's predicted conflagration of the heavens, with your "cloud-capt towers and gorgeous palaces." Hardly in the most prying telescope, if they are only equal to ours, in the neighbouring Venus or Mars will such event be perceptible. The spectroscopists have found in none of the latest few comets, "F.R.A.S." says, trace of water, but have compared nearly all to the hydrocarbon gas "acetylene." So, for aught that can be known, the body is now shining at Sydney or Cape Town that by next Monday, without being observed at Greenwich, may plunge our globe in acetylene, so that while "Satine" or "Delta" is mending a pen to answer this, "the heavens, being on fire, shall be dissolved, and the elements melt with fervent heat," and the evolution of all organic species here be over.

The same that, regarded from the theistic side, was a "day of judgment," regarded from the physical is, you see, merely an accident—the only one, of all historical events, answering to the strict etymology of the word, "a disaster,"—*dis-astrum*, a fatality brought about by a star.

My statement that Bible-readers cannot suppose us all derived from a single parent is attacked from contrary sides by "Satine" and "J. R. C.," p. 354. If "J. R. C." insists on his grandmother's, Milton's, and the Monk's ignorant making of the creative days human work days, what will he make of the Exodus reason for the Sabbath command? Was God's working at creation six days, and resting ever since for a million, an example for men to work six of every seven, and rest only one? Deuteronomy shows the reason for the Jew's Saturday, to commemorate their escape from Pharaoh. Their first Sabbath had also been their first Passover, just as with us the Sunday is a weekly Easter. But. Exodus gave another and world-wide reason, and one fulfilled by keeping one day in seven, no matter which. The sixth creative ended, and this seventh began with Noah's flood.

Returning to "F. S. S.," p. 371, I have claimed no monopoly of "non-miraculous meteorology," but do of "non-miraculous geology," because all the facts to be accounted for, and which none of your scientists, I maintain, can account for, even with miracle—assumed though they pretend not—but which the Bible does, without miracle, are facts of geology. The gravel-beds, gravel stratum under deltas, bone-caves, drowned mammoths, buried and frozen, fossil ivory traffic, flint-folks weapons, new vale-scooping, are all in geology books—not in those of meteorology.

In a Swiss pastor's sermons on the Deluge, A. Rochat, dated 1848, I find this quotation from Prof. Gaussen, of Geneva:—"God has a thousand means of destroying men, for none of us would live three seconds if God ceased to make our heart beat. He might have destroyed them by a sickness, as the cholera, the yellow fever, the plague, or any epidemic. But no trace would then have remained of this judgment, and God willed that we should have the traces. He willed that after this judgment had been executed on the earth, all coming generations, we, for instance, thousands of years later, should always have its evidence before us.

"Suppose troops entered this building to kill us all, and in the noise and struggle this place would be reduced to great disorder. There would be blood, and the shot-marks on the walls. Twenty or thirty years later the traces would still be shown. Well, we still see the traces of the Deluge over the whole earth, so that this event must impress us just as if related to us by witnesses who had seen it fifty years before we entered the world, and pointed out its effects! It is not merely in our country its traces are seen: but equally in America, in Africa, and in Asia. Everywhere they have the traces of the Flood, as those of our storm of the 20th of May were seen a week later. [You may remember, some years ago, there was on that day a frightful storm around Geneva.] When we walked out of the city, we saw trees uprooted, walls overthrown, and stones heaped in the gardens. Now the Deluge can no more be doubted to-day than you could doubt this building had been burnt, if you saw its burnt columns. Look in the caves and crevices of the soil, and everywhere we find gravel of water-rolled pebbles, in the midst of which are bones. And the same gravels we find, with the same rolled pebbles and bones, lodged in the vales of even the highest mountains in Europe. On our border we have Mont Blanc; but in America there are higher lands, and in Asia still higher. Savants have found the unquestionable traces of the Flood at many thousand feet above sea-level. A learned Englishman, who lately visited the Asiatic mountains near China, found them at 17,000ft., [or] higher than Mont Blanc. Waters alone could have lodged those gravels and those animal bones at that height. So, then, you see God has willed that this event should be as if present to all the generations, by the traces it has left on the earth. He has willed that the story thereof should make the same impression as a recent event."

The fact is, we may challenge the production, I believe, from all history, of more than two nations and periods ever besotted and quack-ridden enough to ignore this. The two are the degraded cat- and crocodile-worshippers of Egypt's final decay under the Ptolemies, and the similarly wretched race of Britain in Victoria's reign, swallowing such stuff as Lyell's for "science"! Among all symptoms of this frightfully dying age, I know of none more radically shocking than this note in a lecture to us on "Geology and the Deluge," by the Duke of Argyll: "Comparatively a short time ago—some 20 years ago—my own state of mind was one of entire suspense in regard to the Deluge as an event which had ever affected any considerable area of the globe (!) Only within the last few years has it seemed to me that facts have been accumulating which prove there has been a great submergence of the land over a great portion of the globe, which really corresponds with the human tradition of the Deluge." He still clings to that fallacy of Ed. King, you see, and is blinded by it. Deluge and *submergence* are two totally distinct things, and on no large area is there trace—indeed, on no present lands—of a temporary submergence; whereas of deluge there is trace everywhere, even up Mount Everest. But the duke's lecture is poisoned all through by the "submergence" notion, and at the beginning he deprecates all attempt at assigning "physical causes" for the event. But in Genesis nothing about it is plainer laid down than the physical cause! A deluge not caused by "rain from heaven" would not be the Scriptural deluge at all! What I call astounding, however, is, that when the traces of an event have always been glaring, and much the same as to notoriety a century ago as now, a nation can be deluded—not its children or its rabble, but a duke and a royalty's father-in-law—into such a state of mind as that!

E. L. G.

CREATION IN GENESIS NOT TOO PLAIN.

[28914.]—OBJECTION is made, on very different sides, by "J. R. C." and "Satine" (p. 354), to my calling it impossible for "Bible readers" to suppose us all derived from one ancestor; but on reconsideration I still think it impossible. Doubtless "Satine" may, with equal reason, say "most people fancy that we are all descended from one," but does he mean to call "most people" Bible readers? Or does "J. R. C." think many Englishmen have a chance of reading "the Bible in a common-sense way"? Alas! I fear I shall never learn Hebrew enough to make the least pretence to do that! But Bibliolaters, let me observe, such as the clergy and sects made our fathers for the last several generations, are never by any means readers (or true students in any sense) of their fetish or talisman, whether it be a book, or collection of books, or aught else. It is marvellous, indeed, how such a man as Milton could fancy such beliefs as this (which he doubtless held), or as a snake bringing "death into the world," or sin into the world, were deducible from the Bible. But it only convinces me he could not be truly a "Bible reader." Nor, if restricting the term "Bible" to what the Jews call so, can I reckon even St. Paul among "readers" of it, when he founds an argument on the position that in "Adam all die," whereas his books told him neither Enoch nor Elijah died. But, of course, Bible *writers* could in general have no chance of being what I mean by "Bible readers." It is a collection of documents by various writers, some often inspired, others never so, holding various and sometimes inconsistent traditions, and real readers thereof, in any "common-sense" way, have to be able to take a bird's-eye sort of view of these, and combine what is essential in them all and harmonious.

Genesis especially is a compilation, and the writer of the substance of the second chapter had no more read that of the first, than he had read Darwin. But the inspired compiler of both into the present form, and translator of them into his local Canaanite tongue (now improperly called Hebrew), and whom Sir Isaac Newton quite convincingly proved, I think, to be the prophet Samuel, did not think them contradictory, or that either could be dispensed with; and nobody has yet convinced me Samuel was a fool. Now, of course, I admit that if you like to pit this second chapter against the first, and draw therefrom, first in flat contradiction to the former, that when Adam was placed in the garden, the earth contained no human race, either male or female (the former chapter saying there were both), next, that a wife for Adam was miraculously made from one of his ribs, and, then, lastly, that either the same miracle was repeated for Cain, Seth, and every other married son of him (but not recorded, nor hinted at), or else they all married their own sisters, which Leviticus declares to be always "abomination to the Lord"; you can thus make out your desired pedigree from "one ancestor." I admit its possibility by these three steps, all equally necessary; flying in the teeth of Chapter I., going out of known nature into miracle, and out of Mosaic morality into "abomination."

Observe that, when Leviticus is called a "Book of Moses," it is with far less unreason than Genesis is called so, because it contains not, as Genesis does, at chapter xxxvi., history of several ages after Moses. On the whole, I cannot allow then that Bible *readers*, in any true sense of the term, have come to hold (even if Milton, or St. Paul, or any Bible *writer* did), our derivation from a single ancestor. Of course, what is outside of known nature, which every "origin of species" must be, whether of one species, or a million species, and whether Darwin's imagined way (if he had one, which I deny), or any other way, and whether by "one ancestor," or a million pairs of ancestors, was equally miracle, in any case. But when "J. R. C." would drag in "doctrine of original sin," I protest that religious doctrines have nothing to do with questions of physical fact: they must, and will take care of themselves; and fact or fiction will suit them alike.

What odds can "J. R. C." find between people having visited on them the sins of a remote ancestor, or one fictitiously accounted their ancestor? Why is not one as good as the other?

So, again, either a real or fictitious Noah's flood, or any number of partial ones, the clergy have now settled, will equally suit their theology. But I am only on science, and maintain they will not both suit geology, or astronomical or terrestrial facts. Physics is more exacting than religion, and what is true enough in church for prayers or creeds may be by no means true enough at school. Lyell's and Darwin's "300 million years" of "causes now in action," to explain the state of the weald, or any of their other "unlimited drafts on the bank of time," may suit the parsons well enough, so some of them at least say, but will not explain what they are invented to explain, and, moreover, Nature's bank utterly dishonours the drafts. For the earth to avoid all comet encounters during those years, requires comets to be less than a thousandth part as abundant as in any known period, or known universe; and going out of known nature is going into *miracle*, just as much, whether you see it yourself or not, equally whether you intend miracle, like the Evangelists maintaining Christ had but one human parent, or whether you blunder into it as unawares as Lyell, Darwin, Proctor, Clodd, &c., in sheer judicial blindness.

No scholar will honestly let "J. R. C." assume that Genesis, in any modern version, is quite "fairly translated." All translators since Jerome, if not he and the LXX., have had to read into it their church dogmas, and this more and more as time rolled on, and mere errors of oversight became reduced. Such a phrase as "the first day," was never in the Hebrew, but always imported. It had no such word as "firmament," but, of course, the fact of the fowl flying "*in*" the said firmament shows us we must give the word a new meaning. Taking the seventh day of creative rest to include all human history, and, therefore, each of the six of creation to have been at least longer, which "J. R. C." calls "the clerical hypothesis" has been only a revival of the earliest known view, and most wide-spread. Not only did St. Augustine hold it, but the various heathen versions of the same seven periods, mostly calling them days, made each at least 1,000, but more commonly many thousand years. The Hindoo still calls each "a day of Brahma," while making it 432,000 years in his briefest system; in others, from 10 to 1,000 times that. The phrase "there was evening and morning, a second day," &c. (always evening first, observe, though a day begins with morning), was the only way so primitive a tongue could express, for aught we know, the idea that "there was time," or succession of nights and days, "through a second period." It is but yesterday we have learnt, for certain, our earth must have had day and night for ages before it had a sun.

E. L. G.

EVOLUTION.

[28915.]—THE war between evolutionists and those who take the Bible as more or less literally true, is surely conducted on a lower level than that which the conflict for truth should be fought.

It should be considered that the two chief ays of explaining the mysterious fact of life are th imperfect, because of the stupendous nature the fact. There is the Mosaic way, highly sugstive and figurative, and wrongly accepted by any in its literal sense. There is the scientific ay, beginning at the other end, in the patient cumulation of a few handfuls (comparatively eaking) of facts, and the attempt to deduce a w. Does anyone who expects much from either ay ever consider what a fact this is we try to rasp at and write in a book? Darwin, to comlete his "Descent of Man," tries, in the conclusion f that book, to deduce the law of moral feeling, nd to show how magnanimity and heroism are erivable from evolution, from the organism adapting itself to circumstances, and moulded by suroundings. This attempt is the ultimate result of great intellect acting, as intellect often does, on xternality only, and, quite in the modern spirit, onsidering means, tools, and resources as the only ings. A fact, very much the reverse of all this, as been repeatedly affirmed in all ages. The fact , stated in one way, that it is the unexpected that ways happens in life. The philosopher who eals with the subject of life is like a creature of wo-dimensioned space speculating about solid eometry. He follows a progressional series, and deducing a beautiful law therefrom, when all at nce a quite sudden development takes place, and itiates all his conclusions. It is as if a man hould speculate as to the behaviour of water at 0° from what he observed as to its expansion etween 50° and 60°. Perhaps the physical strucure of man *is* partly built on that of the lower eatures. Perhaps a series of individuals conecting man with the lower creatures really existed. hat then? Nay, man every day *eats* these eatures, and obtains the substance of his body om them, which perhaps is as important a conderation as that of form!

Now, one ought really to reflect how little we now of laws in general. Does a man suppose he uite knows all the influences in which this planet wims as in a sea, and by which it is permeated, ecause he has read his Darwin and Herbert pencer? The source and law of *crises* is a matter o often ignored. Occasionally, and at rare inervals, an event happens of a transcendent kind, bscure in its causes, and dependent apparently on ome vast law of which we have no cognisance. erhaps the scientific man encounters such a fact, nd notes it as a sudden development; but because proceeded out of what went before, or appeared o do so, he thinks that it is of like nature with hat went before. Or perhaps he cautiously leaves to others to draw a conclusion which he secretly vours. To use an illustration, the scientific man otes that a waking man proceeds from a sleeping an, and the conclusion is at once drawn that eep and waking are the same thing in different grees.

That the conflicts of the lepidoptera, or the wars "dragons in their slime" should ever issue by derly series, or by known physical laws, in ballom etiquette even—not to speak of morals and ligions—is a thing incredible to me and to many hers. I am very far from denying evolution—it ems to me entirely probable; but I do deny that is the sole and efficient cause of the phenomena. he astronomer who considers the effect on each her of the members of a system must not leave it of his calculations the nearest surrounding stems, if these exercise any appreciable effect. he miraculous in human life is an historical fact, daily fact, and to leave it out of consideration, or attempt to veil it under such words as "altruism," speaks a mind wholly devoted to the laws of exrnality—true in themselves, but not the only uths.

E. Willmore.

33, Albert-road, Walthamstow.

EVOLUTION—ANCIENT PHILOSOPHERS.

[28916.]—"H. B. F." (letter 28873, page 369) jects to my "poisonous gases" which I said surunded the earth when first life was produced. I sed the word "poisonous" as relating to man or e higher animals, as none of these can live in an mosphere different from the normal mixture of ygen and hydrogen; but, on the other hand, the wer animals can live in most poisonous gases, d also these first animals would adapt themlves to their atmosphere of "smells." It is quite ssible that protoplasm and chlorophyl were prouced by the electric discharges aided by the exact mperature.

No one ever thought, as "J. A." (letter 28874, age 369) seems to think they do think, that ature would first make coal-tar, then from this bstance produce saccharine and aniline; but she ight make a short cut and produce both subances from some natural product.

I never could understand why the psyche or soul epped into life. I consider life as a mere property, sweetness is a property of sugar, and as the power of driving away fever is a property of quinine, so life is a property of protoplasm.

The very fact of our cosmos being a well-adapted one is utterly inexplicable on the anti-Darwinists' theory; for circumstances are constantly changing, and the animals that can change with them survive, but those who stick to their old habits perish.

I quite agree with "Sigma" that the older philosophers had more purity of thought than the present ones. This is owing, I think, to their simplicity and their ignorance. Every thought, every passage in these ancient authors, remind me of children between the ages of five and eight. The habits and thoughts of our childhood determine our moral state in manhood, and so also the thoughts of these ancient children are always ready to impress themselves on our minds.

Satine.

[28917.]—If "Satine" is correct in his theory that only a few scores of years are needed for the evolution of a new species, the gathering of all kinds of animals into the Ark was a very simple proceeding, as Noah only had to collect the type animals, who would be few in number, and if they were young would not take up much room. The constant discovery of fresh orders and genera of animals, birds, insects, fishes, and molluscæ seems to support "Satine's" idea. Most evolutionists would say that all the creatures that are new to us have existed for ages (like the "pearl of purest ray serene"), though out of the reach of the ken of man. But that would be simply begging the question. Of the Helices only 500 species were known a few years since, and now 3,000 have been seen and described; and it certainly is asking us to concede too much when we are begged to admit that all the 1,500 novelties are from as antique a pattern as the 500. I have known a family of human beings (doubtless still existing) who had no teeth in their upper jaws; therein following the lead of their mother, who, I believe, was the first to display this peculiarity. Suppose jaws of this sort to be found in a geological deposit; what numberless millions of years would be said to have elapsed from their date before human beings escaped from the sheep level and became armed with clashing teeth! A fright will suddenly cause all sorts of peculiarities.

K.

[28918.]—In the second paragraph of letter 28871, "Satine" says "Bushmen with the brains of men." Exactly, the brains of men, not apes or their cousins; consequently when called upon these Bushmen begin to develop (though latent) all the power and ability of learning several languages as well as intellectual thinking, derived from the original *human* ancestor; and as "Satine" admits in letter 28862, p. 354, that apes could never learn a language, as also in 28871, "all other animals either brains or articulate voice, or both, are wanting, so man remains the only reasoning animal," my whole contention is fully established by "Satine" himself; and as no animal can rise above or out of the circle of its brain power, may I ask "Satine" where the evolution does or can come in as regards man, whose brain power is only limited by his physical strength?

In regard to the books mentioned in 28865, p. 354, I may say that there is no need to give the particulars asked for, as there has never been any question or dispute as to the animal remains, either for or against evolution ("Satine" should give them a read up); but I may say that when Prof. Boyd Dawkins went to Kent's Cavern to determine the bones there were no less than 50,000 labelled and set aside for examination; but there were no remains of the "hairy quadruped" among them. "Satine" says this quadruped is living to-day in the from of lemurs. Perhaps so; but I was not aware that Madagascar was at any time considered as the "cradle of the human race." It's a great pity these lemurs have given over evolving. As to the extinction of the sea-cow and the dodo leaving room for other animals, I never knew, and don't know now, that the coasts and bays of the higher temperate and polar regions were so crowded up, or that the harmless dodo was in the way of any other birds in the South Seas. As to why the auk should become extinct is a mystery, as there are thousands of places round the coast where it could breed, secure from man or other enemies, just as in the past ages, yet it has died out (for the last time I saw two just over 35 years ago), and they have left nothing behind. I do not know of any details of hairs that I could not refute, and if the fact that men in the hair and fur line of business can distinguish, as also the evidence of experts in a court of justice when a man's life is at stake is accepted is not enough for "Satine," then he must go further afield; it's enough for me.

"Satine" also asks, "Who can maintain that man has his own peculiar organism?" Why, if he had not, how could human remains be distinguished from those of other animals? "Satine" then admits that there is little or no proof that animals can go outside their order. Well, that's accepting the "basis" pretty well. He then asks, "Where did the animals come from?" Who knows—it's a matter of faith either way. "Satine" then goes on to say, "Now, suppose these circumstances change, what is the animal to do?" Why, do the best it can to suit the alteration, and if it's too strong the animal dies; circumstances often prove too strong for men even, and they also die; there is certainly no evolution. The sentence about the animals and the shillings is rather involved, so will let it alone.

Would "Satine" explain (as per letter 28862, p. 354) how the hairy covering of his ancestor would become useless and rudimentary, because there are tribes of men who are exposed to wind and rain and who as to clothing wear only a few feathers and a scanty breech-cloth, yet have no more hair on their bodies than the average European; and there is no evidence whatever that their ancestors ever had any more or less hair than is at present on their own bodies.

Dens.

EVOLUTION—ERRATUM—BLAST FURNACES.

[28919.]—By a printer's error in letter 28873, p. 369, I am made to ask whether "the explanation is not *likely to come* to the same objection," instead of "whether the explanation is not *open to* the same objection."

I am still without a copy of that number of the MECHANIC in which my letter, referred to in query 65520 by "One in a Fix" appeared; but from a note I find the assumed slag-forming materials in the example then given were—

CaO	2	per cent.
MgO	1	"
Al_2O_3	6	"
SiO_2	18	"

In the above there is an obvious excess of silica, amounting, as it does, to 67 per cent of the whole; while to form the most fusible multiple-silicate with the bases above assumed only 7 per cent. of silica is necessary. This is found by drawing lines from 2, 1, and 6 on the base, parallel to the lime, magnesia, and alumina lines respectively.

Now, to take up this 11 per cent. excess of silica, draw a line from 11 on the perpendicular parallel to the lime line C D, and it will be found that 20 of lime are requisite.

Had the slag-forming material contained only 10 per cent. of silica, as proposed by "One in a Fix" —*the given bases being the same*—only 10 — 7 = 3 per cent. of silica would then have to be provided for, and by drawing a line from 3 on the perpendicular, parallel to the line C D, it will be found that 5½ per cent. of lime would in this case suffice.

H. B. F.

SODA CRYSTALS v. SODA ASH—BLAST FURNACES.

[28920.]—In query 65128, as I stated, I gave approximate figure, and consequently stick to a 56 per cent. as containing about 94 per cent. Na_2CO_3. "H. B. F." is evidently not aware that soda ash, &c., is invariably sold on what is known as the 32 equivalent.

The atomic weight of sodium was discovered by alkali makers (by what means goodness only knows!) to be 24, thus making the equivalent of soda (Na_2O) 32 instead of 31. Thus a 56 per cent. ash, as sold, really contains about 55 per cent. It will certainly be a very good thing when this troublesome, irrational, not to say dishonest practice is given up; but at present there are no prospects of such an inestimable benefit being wrought to the alkali trade.

On looking over my letter, I find a stupid mistake in my arithmetic. Instead of making 2½tons of crystals, which contain 37 per cent. Na_2CO_3, to contain 18½cwt. Na_2CO_3, I have made it 20cwt. Thanks to "H. B. F." for drawing my attention to my carelessness.

Chemist.

THE CHEMIST NOT A CREATOR.

[28921.]—With the Editor's kind permission, I wish to say in reply to my brother reader, "Satine," with reference to his query and remarks relative to my letter and his own (No. 28871, p. 369), that I do not know who he is; but that Prof. Roscoe is known as one of the most eminent chemists of our time, and not a likely person, being an expert, to make statements of a "foolish" nature. He, selected as the exponent of science, would not have said in his presidential address that "the barrier which exists between the organised and unorganised worlds is one which the chemist at present sees no chance of breaking down," if a succession of constructive efforts were at all likely ever to result in the production of a living structure called protoplasm, as "Satine" imagines; but let anyone read the address themselves, and they will see the position of chemists in such matters from the scientific standpoint of an acknowledged authority. And as to the religious aspect of the question, which seems constantly to be coming to the front in such discussions, I should not care for my own part to meet with a better answer than that of the late Dr. Fraser, who said before members of the British Association in York Minster, 1881, that "they had the choice between three theories, either they must believe that the innumerable varieties of creatures now existing and all the forms of geological series had been spontaneously generated, or that each had been produced by a special creative fiat, or they must accept the doctrine of descent. But was it the province of science to tell him what he was to believe or what he ought to know? Whichever of these theories was adopted, if no other was possible, he still fell back on that higher truth that there are diversities of working; but it is the same God which worketh all things in all. A conflict between the claims of religion and the claims of science on the allegiance of the human mind was a conflict which no wise man would provoke, for it would be raised upon a false issue, and each could pursue its own way if it would bear in mind its own limitations without violating the territory of the other. We felt that there were invisible things beyond the visible. We had hope that stretched beyond the grave—we were not content with the assumed immortality of the human race, nor with the cold comfort of the posthumous immortality of the famous and renowned. It did not satisfy him, who was neither renowed nor famous, to say, with the old heathen, 'My life's work is done, let darkness once more cover me.' The hope of immortality could not be extinguished in the human breast. Conscience and feeling alike demanded it. Science certainly had neither the right nor the power to rob us of the hope of immortality. Humanity, at least the mass of it, was not so rich that it could afford to part with what to it was no illusion, but a revealed truth, which had proved by actual experience in the hours of darkness, temptation, sorrow, and trial an unspeakable comfort and stay. He earnestly deprecated even the appearance of a conflict between science and Christian faith."

John R. M. Thompson.

PROBLEM IN MAXIMA AND MINIMA.

[28922.]—THE problem proposed by "M.I.C.E." (vide his letter 28876, with accompanying diagram, p. 370 of "E.M.") may be worked out thus:—The road is in form a horizontal annulus, of which the radii of the outer and inner circles are respectively R and r, the height of the light above the centre being h. Let x be the horizontal distance of any point, which I shall call P, on the road from the centre. The rays fall on it through a distance $\sqrt{x^2 + h^2}$, and at an angle of incidence of which the cosine is $\frac{h}{\sqrt{x^2 + h^2}}$. Now, the illumination of P is expressed by $C . \frac{\text{cos. angle of incidence}}{(\text{distance})^2}$ and is therefore $= C . \frac{h}{(x + h^2)^{\frac{3}{2}}}$, where C is a constant dependent on the strength of the light, &c. Hence, the illumination of an indefinitely narrow ring, of which P is a point in the circumference $= 2\ C. \frac{\pi h x}{(x^2 + h^2)^{\frac{3}{2}}} . dx$. Integrate this between the limits $x = r$ and $x = R$, and we have for the illumination u of the whole road—

$$u = 2\ C\pi \left(\frac{h}{\sqrt{r^2 + h^2}} - \frac{h}{\sqrt{R^2 + h^2}} \right).$$

Differentiate with respect to h, and, since u is a maximum, equate the result to zero. Thus, we find—

$$\frac{r^2}{(r^2 + h^2)^{\frac{3}{2}}} = \frac{R^2}{(R^2 + h^2)^{\frac{3}{2}}}.$$

This gives us—

$$h^2 = \frac{R^2 r^{\frac{4}{3}} - R^{\frac{4}{3}} r^2}{R^{\frac{4}{3}} - r^{\frac{4}{3}}}$$

Divide numerator and denominator by $R^{\frac{2}{3}} - r^{\frac{2}{3}}$, and we find, after taking the square root—

$$h = \frac{(Rr)^{\frac{2}{3}}}{\sqrt{R^{\frac{2}{3}} + r^{\frac{2}{3}}}}$$

which is the result arrived at by "M.I.C.E."

Charing. **J. R. C.**

A MATHEMATICAL PUZZLE.

[28923.]—THE fallacy in "F. S. S.'s" mathematical puzzle is sufficiently obvious, and lies in the last step. From $\sqrt{-4} = \sqrt[4]{16}$ we cannot say that $\sqrt{-4} = 2$, simply because 16, like other numbers, has four fourth roots, and we must not arbitrarily take the wrong one. The fallacy is similar to that which would be committed if we said that an angle of 45° was equal to one of 135 because their sines are equal; or that since the differential co-efficient of $x + 2$ is equal to that of $x + 3$, that, therefore, $2 = 3$.

We must always distinguish between direct processes, such as addition, multiplication, involution, differentiation, and inverse processes, such as subtraction, division, evolution, integration.

The former class of processes can always be carried out, and lead to a single rational result. The latter class is interrogative and tentative, and sometimes leads to several results, some or all of which may be impossible, irrational, or undiscoverable.

If we go along Cannon-street to St. Paul's, and come back by Cheapside, we have not proved the identity of Cheapside and Cannon-street.

Calculus.

A MATHEMATICAL PUZZLE — THE FOUR DIMENSIONS VAGARY — NEGLECT OF LOGICAL EXACTNESS.

[28924.]—THERE is a misprint in my letter, 28878, p. 371, owing, no doubt, to carelessness in my writing. $4\sqrt{(-4)^2}$ and $4\sqrt{16}$, should have been printed $\sqrt[4]{(-4)^2}$ and $\sqrt[4]{16}$ respectively. Very likely, however, the error has been detected by my readers.

I am not particularly anxious to discuss the "Four-dimensions" conundrum. To me it seems so utterly frivolous to discuss the possibility or otherwise of what we cannot even imagine. As Mr. Monck says (28877, p. 370), Mr. Hampden's astronomy is sound sense in comparison with it. Nevertheless, I should like to say a word or two in reply to Mr. Grey, 28880, p. 371.

I must adhere to my former statement that the assumption of a two-dimensioned space, and intelligent beings dwelling therein, in order to argue for the existence of a four-dimensioned space, is a *petitio principii*. Mr. Grey says, in effect, that two-dimensioned space is already admitted by everyone, and mentions the (plane) superficies of Euclid. If Mr. Grey likes to call a superficies "space," and if I, on the other hand, point out that the usual meaning of "space" is "*three* dimensions," and that only, it will be only a quibble about terms. But I wish to point out what Mr. Grey and those who think with him seem to ignore, that a superficies is an abstraction. It exists not, except in the imagination. The same with the lines and points of Euclid. To calmly talk about beings living in an abstraction seems to me most purposeless. It would be every whit as sensible to talk of beings living in a sensation, or living in motion, or living in gravitation, as living in a Euclidean superficies.

To make the matter seemingly still more absurd, Mr. Grey actually discusses the effect on its inhabitants of crumpling or bending a superficies. As if it were possible to crumple a thing of the imagination, *except in the imagination!*

I don't in the least object to Mr. Grey believing that if he started off from his front door he would return in the opposite direction, and re-enter by the back door. All I say is, that if he did do so, the line describing his progress would be a curved or bent line. I see he avoids saying that his journey would be in a straight line from its commencement to its end. But I do see that there is a contradiction in speaking of returning at all, when he says his journey is to be an infinite (i.e., endless) one. For the moment he returned his journey would be at an end; and it would then have been a finite one, not an infinite one.

I have not had the good fortune to meet with a modern work on solid geometry, in which the word "trace" is used. However, I do not see that it is of much consequence. For, if the idea is contrary to Euclid, then it is unmathematical and incorrect; if it is in accordance with Euclid, it is simply a new way of expressing old thoughts. If the latter is the case, I confess I cannot see the reconciliation. I supposed (and still suppose) that the word "trace" was used in the way an analytical chemist would use it, when saying there is "just a trace of arsenic in that water, and no more."

That way of speaking of the imaginary lines and superficies of pure geometry I should certainly consider most incorrect. A trace of arsenic is a very very small portion of arsenic; but a point is not the trace of a line in that sense. For it is not a line at all—not even a very very small part of a line. A point has *no* length; a line has. There is a difference between "none" and "just a very very little." It seems to me that it is the neglect of these little, but most important, logical differences that breeds all this confusion of terms and ideas.

F. S. S.

MISTAKES—SPACE OF FOUR DIMENSIONS — EVOLUTION AND THE BIBLE.

[28925.]—I VENTURE to begin this letter by calling attention to two mistakes in your last issue. "Satine" (letter 28871, p. 368) declares that it is impossible to support the weight of the body by the neck without dislocation. What about numerous cases of recovery from hanging? I think the doctors will agree that death from [illegible] *per coll*, where no "drop" is used, results simply from apoplexy or suffocation, and that dislocation of the vertebræ is rare. I do not myself see the least reason why a light, healthy person with good teeth should not hang by them for some time. Of course, we know Leona Dare does not.

"Sm." (letter 65576, p. 379) speaks of casting silver in a mould of plaster of Paris. It may be possible; but I have tried it again and again, warming the plaster and taking every precaution, and the result was always the same—namely, spluttering of the metal in all directions.

I am glad that a discussion has been opened upon space of four dimensions. I don't suppose it can ever be proved that such exists, but think no one has a right to pronounce it impossible. Of course, a creature living in a two-dimensional space would consider three dimensions as out of the question as most of our race do that of four. I read an amusing book some time since called "Flat Land," which treated of a world of two dimensions, and of a sphere which descended into it, and tried in vain to convince the inhabitants of his solidity. The book has some errors, but is in the main very good, especially where, in the last page, it treats of Pointland taking a daring flight to *no* dimensional space. Naturally the point imagines itself to be the whole universe, the self-contained, and, in short, absolute perfection.

Might I suggest that the ether, which is supposed to pervade our universe, and enter all things, solid or otherwise, might very reasonably be supposed to have four dimensions? It is not a whit more difficult to understand this theory than to imagine a three-dimensional imponderable body with power to pervade all things.

I must confess that I find some of the present correspondence upon evolution rather painful, owing to the free manner in which many of your correspondents claim the right to determine what parts of the Bible are legends and what are fact. I am glad to be behind the times in this respect myself, and to base my theories as to protoplasm and all the learned doctrines of Haeckel of Jena upon the first verses of the Gospel of St. John—"In the beginning was the Word, and the Word was with God, and the Word was God. All things were made by Him, and without Him was not anything made. That which hath been made was life in Him, and the life was the light of men." Of course, I am a believer in evolution. I do not see how anyone can doubt it in the face of recent discoveries; but as to evolution of life out of matter, which is what some correspondents are driving at, I say it is a doctrine which is unscientific, as all known facts point the other way (witness Tyndall's experiments on so-called spontaneous generation); un-Christian, because it is directly contrary to the inspired Word of God; and pantheistic, because it substitutes nature for the God of Nature. I see no use in argument on such a question. I left off subscribing to *Knowledge* some years ago on account of a series of papers written to prove that whatever conduced to the happiness of the majority was the highest form of morality. The writer entirely ignored the New Testament view of the question, and I therefore wrote to the editor to ask, If we were to put Christianity altogether aside, would it not be decidedly for the happiness of the majority to kill off painlessly all the incurable idiots and lunatics? I never got a satisfactory answer. There are some questions which, I think, cannot be argued by Christians on scientific grounds alone.

T. Preston Battersby, Capt. R.A., F.R.A.S.

TURRET CLOCK-MAKING.

[28926.]—I WISH to thank S. Maddison very sincerely for his wish and effort to help me. There are a good many helpful hints in his letter; but the one point on which I have as yet been able to get no information is the diameter of the different spindles. Mr. Maddison does not mention this point, nor is it given anywhere that I can find by Beckett. The drawing in "E.M." is not to any scale so as to enable me to form any guess as to the proper sizes.

I also intended using Lloyd's cast-iron wheels, but I do not know what gauge to order—10 or 12 would, I thought, be abundantly strong. I have only one bell, so I can only have the hours struck. The bell is about 5 or 6cwt. Of course, the drawing given is only intended as a rough sketch. I think the frame would need some stays to keep it from altering in shape, as the one diagonal shown as forming the bearing for the striking great wheel would hardly be sufficient.

I thought of making a pattern somewhat after the A model, illustrated in "Clocks, Watches, and Bells," as set up by Dent at Meanwood Church. It would to me be simpler and better than the made-up frame. It would certainly be steadier. I do not know whether such castings could be obtained anywhere; I suppose each maker has his

n, and makers are hardly likely to
ımateurs to trespass in their field.
ıce Mr. M. has five wheels in his train.
; speaks so much in favour of three-
s, that was what I intended using. I
ow what width the frame should be.
ıppose, mostly decided by the length of
necessary to put in. The clock should
ıt day one. What weight will be
ɔr the going part, and what for the
I believe it is the striking side which
ı the heavy weight, and the strength in
axle.
r one tell me where Meanwood Church
' I would, if I knew, venture to write
rector if he would kindly give me one or
ıs which would enable me to work from
tion in "Clocks, Watches, and Bells,"
ugh small, is evidently quite accurate
ıtly to some scale. I am particularly
this design. Besides, in using it I
the help of what Beckett says in his

ıd paragraph, 3rd column, has not S.
nade a mistake, saying his "second
twice in an hour"? Should it not be turns
hours? Does his pendulum hang from
tself or from a bracket attached to the
ɔarate from the clock?
ınegal, June 23. **Fredk. Carre.**

SQUARE ROOT OF – 4 AN
[POSSIBLE QUANTITY.

-I BEG leave, through your columns, to
letter of "F.S.S." in your issue of
with reference to the above. I think
s will agree with me that the fallacy
—
· I make no change in the reasoning of
nt, if I express it in the form:

$$- 4)^{\frac{1}{2}} = (-4)^{\frac{2}{4}} \sqrt[4]{(-4)^2}$$

$$= \sqrt[4]{16} \, [= \sqrt{\sqrt{16}} = \sqrt{4}] = 2.$$

ıxpression $\sqrt{16}$ is equivalent to either
hings—viz., +4 or –4. But clearly apart
ıathematical rule, $\sqrt{16}$ cannot be equal
ıe values in the same calculation which,
ur correspondent has made it, saying
$(-4)^2 = \sqrt[4]{16}$ (which implies that
) and (2) $\sqrt[4]{16} \, [= \sqrt{\sqrt{16}}] = \sqrt{4}$ (im-
$\sqrt{16} = + 4$). Thus he gives exactly the
two values differing by 8, which is
ıcorrect.
ɔo, that the statement $(-4)^{\frac{1}{2}} = (-4)^{\frac{2}{4}}$ is
For $(-4)^{\frac{1}{2}} = \sqrt{-4}$ and $(-4)^{\frac{2}{4}}$ is
Vow $(-4)^1$ is $= 4$, and $(-4)^2$ is $+ 4$.
and $\sqrt[4]{(-4)^2}$ cannot have the same
not be really equal in all respects.
have not intruded too long on your
ace; but these notes seems to me to
ıllacy in "F.S.S's." reasoning.
H. R. B.

›LISHING CALC-SPAR.

-AS this has been held to be a trade
s not probable that "A Distressed
'ill receive any information from an
is line. Some years ago I had occasion
ɔets on a number of pieces of Iceland
xperimental purposes. Whether my
similar to that used by professionals
:her know nor care, as I was successful
my object without finding any difficulty
r. I therefore describe the operation.
of spar must first be divided into
ıitable size by cleavage; an old razor-
a somewhat obtuse edge will best suit
ɔose. This is held parallel with the
spar, and struck a very sharp, quick
back with a truncheon, consisting of
in. round steel rod, and the spar will
a clean fracture. It will not do to be
this act, for a light tap will only frac-
face and spoil the spar. For dividing
; of the direction of cleavage a thin
r fed with emery will answer; but it
to grind a wider groove round the de-
th a thick slip of copper. There is less
ng up the surface in the after use of
er.
ɔughed out the piece nearly to form, the
:on is to bring it to the exact size and
ıd angles by grinding on a cast-iron lap
ıery; then proceed to the smoothing.
ı.pose emery is not suitable, as, on
h· soft nature of the spar, emery cannot
oI" as in glass grinding—that is, in
ın of glass smoothing the emery be-
ıs the surface comes to a finish, and the
icles are constantly washed off from
vith a wet sponge, till at last, in skilful
ıng is left on the lap but a dark smear of impalpable emery. With calc-spar the emery never loses its grit. I therefore used finely-sifted pumice stone for smoothing. A portion of this is put on the lap with water, and spread and worked down with the "bruiser"—that is, a piece of ground plate-glass—till, both by feeling and hearing, all grittiness has gone. You can now proceed to smooth your facet, wiping off constantly all outside accumulation on the lap. If carefully worked, the result will be a semi-polish without any scratches. Next, attach to the lap, by thin dextrine, a strip of rather soft paper of uniform texture (such as this journal will suit very well), and when dry dust on some finely-washed putty-powder; work the facet of the prism on the paper till the best polish obtainable in this step is arrived at. There is no fear of losing the figure in this process, but in case there might be any lumps in the paper I have generally first rubbed it over very lightly with a piece of flattened pumice-stone—of course being careful to leave no grit behind. The surface remains now to be fine polished. For this purpose a piece of very thin velvet of the finest pile is attached to the lap by means of what the lens-polishers call "tacky." Thick Stockholm tar will serve for this purpose, but it is generally made of pitch with turpentine added, and a few drops of boiled oil, to a semi-fluid consistence. The middle finger is touched with this and dabbed uniformly over the lap; the cloth or velvet is then laid on and well rubbed down with a piece of well flattened glass. The "tacky" must not be laid on thick, or it will soak through the fabric and spoil the whole thing.

Next mix some of the finest and softest jewellers' rouge (not crocus) with water and lay it on the velvet with a feather, rub the prism on it, and in a very short time the final polish will be attained; but the prior one should be as perfect as possible, as if the facet is kept too long on the last polisher the flat figure will be lost. There is, however, a peculiarity in polishing calc-spar, for it sometimes happens that a good polish may be obtained by rubbing in one direction, and a bad polish by the opposite one. This is caused by the laminated structure of the soft crystal, and knowing the cause the remedy is found at once.

I have spoken of the prisms as being worked singly; of course, for small surfaces the edges can be surrounded with extraneous pieces of spar or guards, as in glass work. It will not be safe to use hot pitch, cement, or sealing-wax for the holders of the spar, like in the practice for glass. The best holding material is rather slack or old plaster of Paris that will not set too hard. Prisms in block can be made up in this and left to get dry, and when such plaster is soaked in water it can easily be broken up and separated with a wood spatula.

F. H. Wenham.

A LAUGHING PLANT.

[28929.]—CANNABIS SATIVA, CANNABIS INDICA.—A full description of the action, medicinal, poisonous, and curative, is to be found in "Hempel's New and Comprehensive System of Materia Medica and Therapeutics." (Leath and Ross, 5, St. Paul's Churchyard, London.)

That which "Eos" says as to this plant, be it eaten in its green state, or taken as a tincture made either from the green or dried leaf, as a powder of the dried leaf, or smoked as tobacco—i.e., "so potent in producing exaltation, laughter, and cheering ideas"—is true; but he says nothing as to the *reaction* or opposite effects resulting from its use; while, as to his statement "that it never fails in bestowing *euthanasia* on patients dying of hydrophobia or tetanus," I challenge him to produce authority for his said statement. Moreover, if any such a patient should be met with here, would he undertake to verify his said statement by proof on the sufferer, to whom euthanasia in his last moments would be so beneficent?

Lydney Dispenser.

LEONA DARE.

[28930.]—MAY I trespass on your space to correct the statement made by "Satine" with regard to the inability of the neck to bear the weight of the whole body?

It is quite possible to lift persons by the head without hurting them. If your correspondent does not believe this he may prove it by placing one hand under the chin and the other at the back of the head of any person that he can lift, and he will then find that he can raise him from the ground without causing any pain. "Satine" will then see that anyone with strong teeth could support the weight of the body with comparative ease.

One Who Has Tried.

THE TERM "TRACE" IN SOLID GEOMETRY.

[28931.]—SINCE writing the letter that probably appears in another part of this number, I have seen a modern work on solid geometry; and I find that my guess at the meaning of the word "trace" was wide of the mark. It seems that a "trace" simply means (in such books) the intersection with a plane. Thus, if a plane is pierced by a line, the point of intersection is called that line's "trace." And if a plane is cut by a superficies, the line of contact is called the "trace" of that superficies. Of course, there is nothing in this at all incorrect or contradictory to pure geometry.

Mr. Grey's remark, however, that something might have a solid for its "trace," is quite wrong; for a "trace," or intersection with a plane, must lie wholly in that plane. And that a solid could not do.

F. S. S.

NATURE OF MOLECULES.

[28932.]—I SHOULD be very thankful for those extracts from "Un Voyage à Sirius," which "Liege" so kindly offered me last week, and I have no doubt but that they will be very acceptable to all the readers of the "E.M." In what way was "Liege" struck by my theory? Was it that it was so improbable, or the reverse?

B. H. L. Schwarz.

College-road, Upper Norwood.

HOW TO LIVE FOR EVER.

[28933.]—WILL "W. A. W." (28860) kindly answer the following questions for the benefit of his readers? Is the acid used in cold or hot water? Will it injure or irritate a cut or broken place in the skin? Will it stop the growth of hair on the face? How often should the acid be applied? Do you consider any special kind of soap an advantage—if so, what kind? **Edelweiss.**

[28934.]—SOME time ago I was troubled with warts on the hands. I read in some book—I forget the title now—that glacial acetic acid applied every night would rid me of them. I tried it; the warts became soft and rubbed off, and at last I was able to pull them out without much pain. Are warts similar matter to that which "W. A. W." is extracting from his flesh? Would also someone competent give me the medical theory of death from old age as taught to students? I have heard or read that the flesh is renewed completely in a given time. Is this true? If so, and the waste matter is left in the body, as "W. A. W." seems to think, would not the body steadily get larger as old age approaches? People seem to get thinner. I wish somebody would set me right. **Weird.**

METHYLATED SPIRITS—A CAUTION.

[28935.]—SOME time since a correspondent signing himself "T. C." replied to a query 65000. Last week I noticed an advertisement in address column to "T. C.," and not having the number containing 65000 by me, thought it might refer to me, and so I answered advertisement. I received annexed in reply. I think it is fair to original querist and the "T. C." who replied to forward same for insertion in ours.

The only point left is, Does Mr. Higson read the "E. M." for his own gratification, or in order to pounce upon unwary correspondents?

T. C., Bristol.

"Inland Revenue Office, 12, Bonnington-road,
"Leith, Edinbro, June 21, 1888.

"**Methylated Spirits.**—(Query 65000.)

"SIR,—Referring to the above, I request to direct your attention to section 183 of 43 and 44 Vict. Ch. 24, 'Spirits Act, 1880,' which refers to the purification of methylated spirits, or, as it is termed, methylic alcohol. You will there see that purified methylic alcohol is to be deemed low wines, and to have been prepared for the purpose of distilling spirits therefrom, and shall be chargeable with duty and otherwise subject to the regulation to which spirits are subject under part 1 of the Act.

"The penalties are very heavy, and include forfeiture of materials and vessels.

"I have considered it to be my duty to call your attention to the above provisions of the Act in reply to your query.—I am, Sir, your obedient servant,

"W. HIGSON, Supervisor,
"H.M. Inland Revenue, Leith, 1st. District.
"To T. C., Esq., Bristol."

SOME LITTLE KNOWN PLANTS OF THE FLORA MEDICA.

[28936.]—ACANTHACEÆ.—*Justicia paniculata* (Maha Teeta, or "great Bitter" of Hindostan), a coarse-looking shrub growing in dry, shady places, all over India, long celebrated as a stomachic bitter, used in cholera and dysentery. I remember a case where the infusion did much good; an elderly European with the digestive powers greatly impaired by a long residence in the country, used to take a wineglassful before each meal. It is the basis of the French cordial *Drogue amere*, the root of the above plant being obtained under the name of *Kreat* from the coast of Malabar. It is said to give the fine flavour to the flesh of the wild Bison, with which it is a favourite fodder. When I was in the higher tracts of the Upper Brahmaputra, my game trackers used to search for the patches of Maha Teeta, and judge whether the foliage had been recently bitten, on which fact their operations depended. **Eos.**

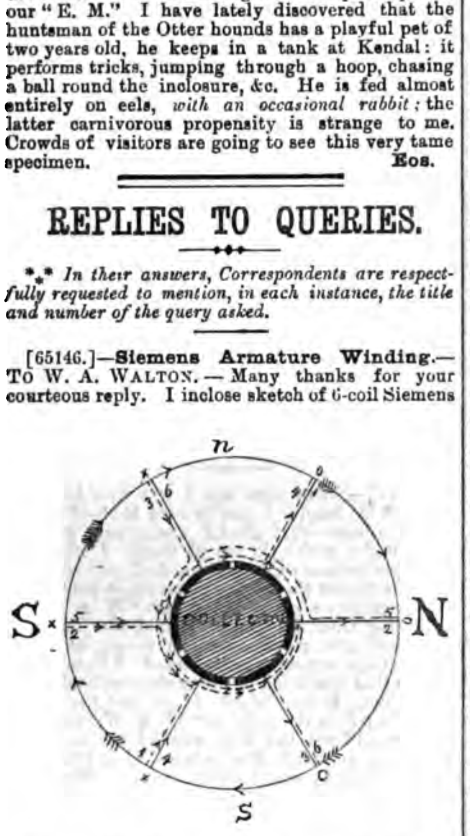
THE OTTER DOMESTICATED.

[28937.]—SOME months ago I sent a brief article on this interesting British quadruped to our "E. M." I have lately discovered that the huntsman of the Otter hounds has a playful pet of two years old, he keeps in a tank at Kendal: it performs tricks, jumping through a hoop, chasing a ball round the inclosure, &c. He is fed almost entirely on eels, *with an occasional rabbit*; the latter carnivorous propensity is strange to me. Crowds of visitors are going to see this very tame specimen. **Eos.**

REPLIES TO QUERIES.

*** In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[65146.]—**Siemens Armature Winding.**—TO W. A. WALTON.—Many thanks for your courteous reply. I inclose sketch of 6-coil Siemens



armature of ordinary type—i.e., wound 2 coils deep. What I meant was this: Suppose our armature is running towards N. pole as shown, then by Lenze's law the currents flowing in armature coils must be in such a direction as to produce north polarity at *n* (between pole-pieces). In sketch, you are supposed to be looking from the collector end. All coils in which the currents are flowing from back to front are marked *x*, and all which are flowing from front to back are marked *o*. Now you will see that all currents are flowing outwardly on N. side (i.e., in a generator) and inwardly on S. side, thereby producing *n* pole at top and *s* pole at bottom for the direction of rotation figured. You can always get at the direction of the currents in a machine by a little study and a knowledge of this law, that the current produced in a conductor cutting lines of force must be of such a direction as to oppose the motion producing them. I worked out this method for myself and very useful it proved; but I find Mr. C. M. Dorman, of Manchester, anticipated me in *Electrician*, March 22, 1884. I was inexact to call your mistake last time a "short circuit," but was short of time—and, in fact, only saw it in time to write and post my letter to the Editor. The mistake was this (please look at coil Nos. 4 and 2*a*): that assuming brush was on plate connected with these ends, coil No. 2*a* is feeding, and coil No. 4 is exhausting, so to speak. It may be as well to point out, for the sake of our readers, not to consider the direction in which the currents are flowing in the connecting wires shown, but to confine their attention to the wire outside drum. The connecting wires have nothing to do with it.

Govan. ENGINEER.

[65208.]—**Electroplating.**—Single-cell method is impracticable with articles of iron, because iron coats itself by simple immersion in a solution of copper sulphate (coating is not adherent). Use following solution:—Dissolve 6oz. of copper sulphate in water and add a solution of 2½oz. of carbonate of soda or 6oz. of washing soda, allow precipitate to settle and decant clear liquid; wash ppt. several times with water; add to ppt. a solution of potassium cyanide till all is dissolved; it will require about 2lb. of cyanide; dilute to half gallon, and work with current two pint Bunsen cells (connected in series—carbon of one connected to zinc of the other). This solution is used almost boiling, and article must be well cleaned before immersion. After the first coat has been put on, the article may be transferred to ordinary sulphate solution to receive a thicker coating. To get a good brass use the following:—Dissolve 3oz. of copper sulphate in water, and add ammonia as long as a ppt. is produced, allow ppt. to settle, and decant clear liquid, dissolve ppt. in ammonia. Serve 3oz. of zinc sulphate the same way, and mix the resulting solutions, add about 4oz. of potassium cyanide and dilute to half a gallon. Solution is best used hot, and may be worked with the same current as the copper solution.

Birmingham. H. H. L.

[65281.]—**Slide Rule.**—If "M." has a bit of wood 2in. by 2in. by 1ft., or, in fact, any length he likes, let him take a gauge and set it at 2 on the 8-square line of his rule, and run it up each side of each angle, and knock the angles off with his jack plane down to the gauge line, he will have an octagon piece with all sides the same size: all other numbers in proportion. A COUNTRY CHIP.

[65330.]—**Plating Dynamo.**—As Mr. Bottone appears to have misunderstood my remarks respecting his answer to this query, I will endeavour to be more explicit. I never mentioned angular velocity, and I never advised faster driving as a means of increasing the voltage of a dynamo. What I did say, was that the speed at which a dynamo is to run is always an element in calculating the dimensions of a dynamo. Will Mr. Bottone say in what way a low angular velocity is antagonistic to economical working. That it has an effect upon the price, I will admit; but I fail to see why we cannot make a dynamo armature with a low angular velocity just as efficient as one with a high velocity. Again, most modern dynamo armatures have a low angular velocity, and are they not far more efficient than the older dynamos with large diameter armatures run at high speeds in a weak field? Putting aside for the moment, as Mr. Bottone says, "mechanical reasons," let us suppose we have a 50-volt 300 ampère dynamo, used for working, say 250 50-volt 16c.p. lamps, and we wish to change to 100-volt lamps of the same c.p., may we not increase the speed of the dynamo (say shunt wound) until we get 100 volts, and as we should have about half the former current, the work done would be about the same, and thus we have increased the speed vastly without the dire results, increase of amperage and consequent flare-up, prognosticated by Mr. Bottone. The shunt could be kept all right by the addition of an extra resistance. I cannot agree with the statement again made that 1 volt per yard of armature conductor is a fair average for modern dynamos, and if Mr. Bottone will refer to S. P. Thompson's book, second edition, page 510, he will find an Edison-Hopkinson dynamo running at 800 revs. gives 2·6 volts per yard of wire on the armature, while a slow speed Kapp dynamo gives only ·5 volt per yard. The Manchester dynamo, described on page 511 is the only machine giving the result described by Mr. Bottone as "average." I am obliged to Mr. Bottone for his recommendation as to the books I should study, and he will no doubt be pleased to hear that I have both editions of Thompson's "Dynamo Electric Machinery," and I defy anyone to design a dynamo (from either edition) where the electrical dimensions and speed are fixed. Better far is Kapp's book, together with his recent papers, and last, but not least, those valuable papers by Dr. Hopkinson. Did not Mr. Bottone forget a book he is fond of recommending? In conclusion, I may say that to design a dynamo is not to wind so many wires upon its armature and magnets, and then find the speed at which it must be run, to give the required result. H. C. B.

[65335.]—**Indicating Air Pressure.**—Will an aneroid do; or even a mercury tube something like the barometer? M. C.

[65337.]—**Iron.**—Does a "Constant Reader" mean a mixture that will do for all kinds of work? Or does he want mixtures suitable for various kinds of work? If the latter, he will know that such have been given in back volumes; if the former,—no such mixture exists. BLACKY.

[65342.]—**Preventing Rust.**—A varnish or paint to do what "S. O." requires would indeed be very valuable! Will not the Bower-Barff process for rendering iron rustless answer, or must the metal be coated? NUN. DOR.

[65344.]—**Bichromate Trough Battery.**—"G. D." will find instructions in many back volumes for making trough batteries; but why does he want a bichromate for electro-plating purposes, when the Daniell is better? SMEE.

[65379.]—**Dynamite.**—The reason that dynamite shatters a stone on which it is laid is because its action is so quick. Even the resistance of the air is sufficient; but it is usual to cover slightly. F. C. P.

[65384.]—**Steam.**—"Puzzled One" says he has known an engine of 500H.P. requiring something like 60lb. of feed per H.P. I say that engines of that power with triple expansion and high pressure and condensing are working with of feed water only per hour, and at gr with only 16lb. The inference is th instanced was a rascally bad one. Whe One" has made such progress that he an engine of, say, 100H.P. to use only 16lb H.P. per hour, it will be time enough to further economy. A long stroke, in my always good, but within reasonable lir to 2½ times diameter of cylinder. H calculated the size and the increased an engine which expands to 0lb. The engine in large powers is a small item cent.—and the slides swallow the ma that. How does "P. O." get over los condensation in cylinders and radiation, the amount of water carried off in th priming, however slight?

Bristol.

[65385.]—**Switch.**—In "Wierd's" this query (page 312) there is a slight e series connection the last plug on the of sketch must not be inserted, else the short-circuited.

W. PERREN-MAYCOCK,

[65387.]—**Duplex Telegraphy.**—Ce can be adapted to needle instrument— I believe the Post-office use Wheatston matic receivers—at all events, on long li Culley's "Handbook," which contains The system has also been illustrated volumes.

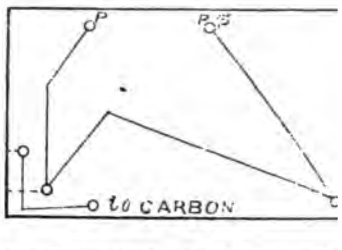
[65410.]—**Tennis Balls.**—I would say they be immersed in the vapour of car phide for some time. This being a sulphur and also a semi-solvent of rubbe soften the time-hardened balls to their elasticity.

[65425.]—**Model Gas-Engine.**—The my gas-engine is packed with one bras by $\frac{1}{64}$in., the cut being at the bottom Asbestos is of no use for packing the p gas-engine, as the fire will burn it an out of cylinder. The air-valve may similar to gas-valve if desired; but it heavy enough to give the required st suction to open the ignition-valve. J

[65428.]—**Throttle Valve.**—I aske describe this, but you do not. If it is a wing valve you may find the seat groove valves are not ground in, but eased, if with a fine file; but should be prope between centres of lathe to bore of pi The centres are afterwards filed off. It the best plan is to rebore and return sure the governor is right, but I believ to lie here. Are you sure the strap do

Bristol.

[65455.]—**Medical Coil.**—To "E Electrician, Torquay."—I append sketch



my coil, awaiting any further infor promised by you on page 357. J. N

[65491.]—**Galvanised Iron Wire.**— BEAUMONT."—The current carried by coating will arrive simultaneously with th by the iron wire. Let us suppose the curre by the zinc to travel a little quicker flowing through the iron; as the two c metals are in metallic connection throug obvious that the moment the current in coating is, say, $\frac{1}{1000}$ of an inch in advance the iron, the greater portion will immediat the zinc and pass to the iron, and this repeated each time the zinc current arrive little in advance of that in the iron wire. the speed at which electricity is great, that a signal sent between the United Kingdom occupies no in its transit. H. C.

[65499.]—**Amylic Ethers.**—Th essences so widely used are blends pound ethers and allied bodies di For example, essence of pines 3 parts of glycerine, 1 of chlorofo 5 of butyric ether, and 10 of amy with 100 of spirit. Amyl acetate basis of Jargonelle pear flavour, ling together 3 parts of potassium of amyl alcohol, and 2 parts Afterwards the distillate is r er" has had considerable experience in ganic chemistry, he is hardly likely to aking these satisfactorily.

J. A. HOGG.

Theory of Leclanche.—Mr. Grey is of course it should be 2 MnO_2. The s not copied from Guthrie; but from enkin, and from Cumming. Why I 2, I do not know.

SM.

Wimshurst Machine.—May I be uggest that the source of the electri- Vimshurst naturally results from the lates being revolved in contrary direc- each plate moves forward, it has a ten- ry the air lying immediately close to it direction as it is itself moving, thereby wo distinct and opposite air-currents, would cause a very violent friction particles of air forming these two rents, it seems to me that this ought to the self-induction of the machine. At it does not, why doesn't the machine if the plates are revolved in the same Why must the motion be contrary? my remarks refer exclusively to the d consequent electrical action going on d air-space between the pair of plates, any such action which may or may not outside faces carrying the sectors, as tside faces, would I presume, receive ive charges inductively from the fact surfaces being electrically excited by air-motion suggested.

W. J. GARDINER.

Ventilation. — Your workroom, the description given by you, seems to l illustration of the narrow neck and bottle experiment, the open ridge the neck, the room floor the base of nd the workpeople the lighted candle. nstead of acting as an outlet only, has as an inlet as well, the air descending n heated under the skylights, a current ished by the movements of the work- he additional heat generated by their ventilate the room, if the only wall is a north wall, I should bring a pipe m., or a 9in. square zinc) down from n the outside of wall and turning er the floor, continue on with a closed entre of room; then turn it upwards f basin covered on top, and from the is basin run zinc troughs about 7in. 1. deep, the four ways of the room floor space will allow). Let these overed for about 3ft. from basin; then room with a small perforated grating ngth, putting small lugs underneath y from the supply so as to direct the the wall is not a north wall, and un, then bring your pipe through the t is least exposed to the sun, and down all you have inside the room, and pro- same way as above. Let pipe stand bove slates or ridge, and protect by 2ft. square by 2ft. 6in. high, with all sides. This inlet will answer nditions of weather better than wall f you can't put troughs in the floor, down pipe come into a zinc box about , 1ft. wide, and 1ft. 9in. deep, placed the down pipe to reach half-way into e top of box take a branch on each nd left) and run along the walls, rising you go (say from 1ft. at box to 2ft. at from floor), and if you graduate your in size from, say, 9 by 6 at box to at further end, they will work better; o be perforated openings on face, with nside nearest to supply, in preference bes. Limewash the skylights on the e sun shines on them, and as a further ling you could make an outer case on hat is, if you carry it down inside the ing a space of about 1in. all round; rior with silicate or anything else to sion. This space could be filled with small tap being placed at the bottom ter off when required to renew it. By pipe down the division wall between doubling the dimensions of down pipe nd running similar pipes round other th rooms could be ventilated from the

J. T.

Water-Motor.—Get a Ramsbottom's r water-engine, no dead centre. I 4½in. lathe, &c.

M. A. M. S.

Dynamo.—To "H. H. E., Elec- uay."—I read your kind offer in last ne 22) "E. M.," and would be much etch and dimensions of a dynamo, as would give current enough to light s, with carbons $\frac{3}{16}$in. diam., and four escent lamps of 12 volts each; and would you say what power and revolutions per min. would be required to work the dynamo?

J. H.

[65571.]—**Shocking Coil.** — Join up as for giving shocks. Put one handle in a basin of water and hold the other. Put a coin in the basin, and then you will experience sharp shocks on attempting to take it out.

FELIX HOLT.

[65576.]—**Chloride of Silver**—May be reduced to the metallic state by fusing a mixture of the chloride and fusion mixture (10 sodium carbonate + 13 potassium carbonate) before the blowpipe flame. It may also be reduced by placing all waste precipitates of silver chloride in a flask, together with some scrap zinc or tin, and allowing it to stand for some time. The silver will be deposited on the zinc or tin as a black powder, an equivalent amount of zinc or tin being dissolved.

Chesterfield. H. H. B.

[65584.]—**Gas-Engine.**—I have tried the slide ignition-valve on the model gas-engine I made, but could not get on with it at all. Sometimes the charge would explode before the valve was shut, when it would blow out the jet; at other times it would not ignite, so I dispensed with the slide and fixed a valve with a flap; then the engine worked very well. The reason the flap-valve makes such a noise (or rather, allows a portion of the explosion to escape) in some instances is because it is allowed to open too wide. The date of the Otto patent was May 17th, 1876, No. 2,081, so if a patent lasted fourteen years under the old law, it would expire May, 1890.

J. SEAL.

[65591.]—**Enamelled Iron.**—Somewhere about date 1845-55 a Mr. Paris sank at his Bradford-street works, Birmingham, several thousands of pounds (said to have been close upon £10,000) in working and endeavouring to perfect his patents in the above-named process, the chief articles he made being culinary dishes, formed by stamping them out of thin sheet iron, the result being an article beautiful in appearance, strong, light, and apparently everlasting; but first principles, such as may have been learnt by a study of an elementary work on physics, were ignored—i.e., the unequal or disproportionate expansion and contraction of iron, and of the vitreous matter forming his enamel. I have seen (and heard) baking dishes which had remained, never used, on the shelves of the stores for years suddenly commence to chip and shell off the enamel, a phenomenon visible at the present moment in the street name-plates of towns, and which is generally a puzzle to all who happen to notice the same. Numerous instances illustrating the flagrant errors committed by so-called scientific men, and which would have been avoided by consultation with practical rule-of-thumb artisans can be quoted, notably that of the late James Watt, of Aston Hall, Birmingham, about 1845, who, on his Welsh property, on the rugged banks of the Wye, built, at a cost of £10,000, a corn mill driven by a high-breast water-wheel, some 60ft. diameter, having cast-iron shrouding and wrought-iron arms, the unequal contraction of which resulted in collapse of the wheel. By the bye, no corn could be grown in the district, owing to the poverty and geological formation of the soil—error No. 2, which any peasant of the locality could have foreseen; but James Watt was no agriculturist.

THE LYDNEY DISPENSER.

[65600.]—**Saw-Mill Machinery.**—"Saw-Mill Owner" should first place a spirit-level on engine-shaft and see that it is perfectly level. Then take a small line and stretch it tight across outside of belt-wheel to the outside of saw pulley, and get the wheel in perfect line with pulley. Should the pulley be narrower than the face of wheel, equalise the difference, then look to all the bearings, and if any brasses require closing, file them to a nice fit and see that all keys are tight. No doubt this will stop the knock. The saw spindle must be level, and in making joint in belt the ends must be square or the belt will not run true. 31ft. is too great a distance between centres, as you are driving direct from engine, I suppose. A long belt is worked so as to cut long timber. An over-long belt will sag and injure the bearings. If you could put a short counter shaft under the floor-level and 20ft. from engine-shaft, and fix the saw-bench so that saw spindle would be 18ft. from counter-shaft, and drive from it, seeing that the shafting are level and pulleys in line, it would be far better than the present way of working.

SCORRIER SAW MILLS.

[65602.]—**Evolution.** — With reference to a remark by "H. B. F." on p. 369, I may, in his own words, point out that if he had "taken the trouble to read" my note (p. 218) he might perhaps have been able to understand it. The reply referred to as a "little bit," &c., was the reply commended by "H. B. F." on p. 193—certainly not one written by "F.R.A.S."

NUN. DOR.

[65605.]—**To Compute Change of Trim in a Ship.**—

Let D = ship's displacement in tons.
W = weight shifted in tons.
L = ship's length in feet.
l = distance W is shifted in feet.
H = height of metacentre (M) above centre of ship's gravity (G).
d = distance (G to g), the ship's centre of gravity is shifted by the shifting of W.

B is to the normal centre of buoyancy, and b is the shifted ditto. The height of metacentre (H) for transverse shift (heeling) is in practice considered constant for all angles of heel less than, say, 10 to 15°. Likewise for longitudinal shift (trimming), H is commonly treated as constant for any change of trim occurring in practice from, say, 1in. upwards. In point of fact, H varies with the angle of heel or trim; but by treating it as constant within the limits above named, no error of practical importance accrues. The value of H is determined by the ship's lines. It can be found by a very laborious calculation. But it is more easily and accurately found by actual experiment in the practice of modern naval architects. Weights or other means are employed to heel the ship, and her angle of heel is shown by long plumb-lines on board. Change of trim = difference of draught at stem + difference of draught at stern post. Change of trim = $L \times d$—*i.e.*, = $L \times$ tangent of angle θ. G to $g = d = \frac{W\,l}{D}H$. The difference between H of transverse metacentre, and H of longitudinal metacentre, varies as the difference between the force required to heel the ship one degree, and the force required to change her trim angle one degree; a difference which (as "Sailor" must be well aware) is enormous.

Sunderland. FRANK CAWS.

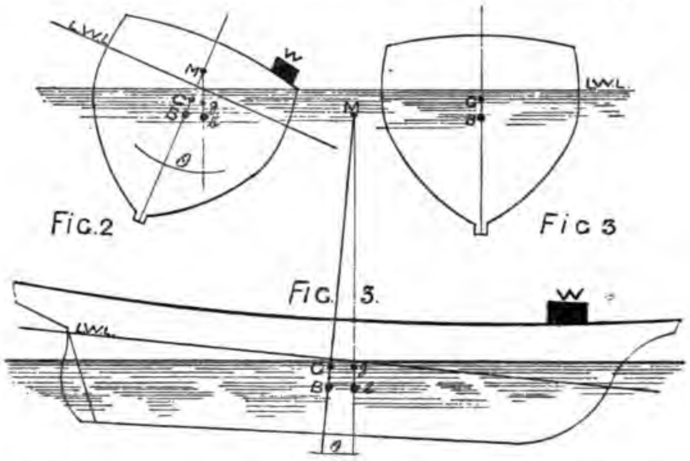


FIG. 2

FIG 3

FIG. 5.

[65607.]—**Natural History Divisions.**—The following arrangement of the Articulata was recognised a few years ago, and probably still is. Whether other arrangements have been proposed since, I do not know. Four classes. Crustacea (lobsters, crabs, shrimps, &c.); Annelida (leeches, worms, &c.); Arachnida (spiders and scorpions); Insects. Insects are divided into nine orders:—Aptera (millipedes and centipedes, fleas, lice, and other parasites, &c.); Coleoptera (beetles); Orthoptera (cockroaches); Hemiptera (bugs); Diptera (flies, gnats, &c.); Lepidoptera (butterflies and moths); Hymenoptera (bees, wasps, ants, &c.); Neuroptera (dragon-flies and ant-lions); Rhipiptera (stylops). For rest of the question, see reply to 65618, p. 380.

F. S. S.

[65615.]—**Polarisation.**—Erratum, p. 880.—For "apparatus" read "apparatus catalogue."
Sm.

[65616.]—**Wheels.**—Find the highest number that will divide into both wheels without a remainder—in your case 16, $\frac{32}{16} = 2$ and $\frac{48}{16} = 3$. Your wheels are therefore in the ratio of 2 to 3; or put the wheels in the form of a fraction and reduce to the lowest term, thus—$\frac{32}{48} = \frac{2}{3}$; that is, the driver will revolve three times to the driven twice.
W. W. C.

[65617.]—**Micrography.**—A four-line epigram written in 1-318,000th of an inch is sold by Watson and Sons, 313, High Holborn, London, for £3 10s. This is equivalent to the Bible being written 20 times in one square inch. Their catalogue gives full particulars. J. A. Hogg.

[65625.]—**Boiler.**—Make your boiler 6in. diam. by 12in. high; firebox, 5in. diam. by 6in. If you want to work at a moderate pressure—say 20lb. or so—1-16th plate will be strong enough if well made. Prove it to double the pressure you want to work at. W. W. C.

[65626.]—**Geometry.**—The querist will find the information he seeks in most works on practical geometry as well as those on descriptive geometry, which are closely allied. On this subject some practical information may be supplied by giving a list of authors other than Angel and Payne already mentioned. The largest work of the kind which has come under my notice is the "Mathematics for Practical Men," by Olinthus Gregory, fourth and last edition, revised and corrected by J. R. Young, 1862 (Lockwood and Co., London), published at 21s., but now priced at 10s. 6d. by Batsford, High Holborn, W.C. There are also the "Practical Geometry, Perspective and Projection," by T. Bradley, 1834; the "Geometrical Drawing," by Binns, and that by Winter, the "Practical Geometry," by R. Burchett, fifteenth edition, 1877; the works on "Descriptive Geometry," by Hall, Heather, Millar, &c.; and the "Practical Geometry for the Architect and the Engineer," by E. Wyndham Tarn. On the subject of perspective some separate works have been specially written for the use of artists in general, one of which, by A. Jewitt, in 1840, is a very neat and instructive little book. Vladimir.

[65628.]—**Raspberry Drink.**—Pare two Seville oranges and six lemons as thin as possible, and steep them four hours in a quart of hot water. Boil 1¼lb. of loaf-sugar in three pints of water, and skim it. Add the two liquors to the juice of six China oranges and 12 lemons; stir the whole well, and run it through a jelly-bag till clear; flavour with raspberry or orange water. To make raspberry vinegar: Raspberry juice, 5½ pints, strong acetic acid, ½ pint, white sugar, 5¼lb. Boil it. J. J.

[65629.]—**Testing Bleach.**—The following is the best method of testing bleach, and is used in all the alkali works, where bleach is manufactured, in the world. It depends upon the action of calcium hypochlorite on arsenic trioxide, a process of oxidisation taking place according to the following equation—

$$As_2O_3 + Ca\,(ClO_2)_2 = As_2O_5 + CaCl_2.$$

A standard solution of arsenious acid is prepared by weighing out exactly 4·95grm. of As_2O_3, which is then dissolved in about 200cc. water, to which has been added 25grm. quite pure Na_2CO_3. The water is kept at boiling temperature until the As_2O_3 is quite dissolved, and is then diluted up to 1,000cc. This will constitute a decinormal solution of arsenious acid and 1cc. = ·003546grm. chlorine. In order to test bleach with this solution, 7·1grm. of the sample are weighed off, triturated in a mortar with cold water, and then washed into a litre flask, which is then made up to the mark, well shaken up, and 50cc. of the milky liquid extracted. The arsenious acid solution is then run from a burette in the 50cc. of solution until a drop brought in contact with paper which has been dipped in starch paste which contains potassium iodide produces no colouration; 50cc. of the bleach solution contains ·3546grm. bleach, and the standard solution = ·003546grm. chlorine. Therefore, the number of cc. used will represent the percentage of available chlorine in the sample. I read Mr. Bottone's paper on the above subject with very great interest; but I am afraid, as far as practice goes, it would have been very much better left unwritten. The thiosulphate method presents great expense in potassium iodide, and has no advantage over Penot's method, which I have described. The ferrous sulphate is useless, as it gives results within 2 or 3 per cent. of the truth. The last method described is worse than the ferrous sulphate one, and is never used now. Mr. Bottone's knowledge on the subject seems, in my eyes, rather antiquated, and if he were to take my humble advice, he would look up information a little more modern than 1871. Chemist.

[65637.]—**Model Engine.**—Length of connecting-rod is usually 2½ to 3 times length of stroke As yours is to be a double engine, a small flywheel will do—say 12in. or 14in. diameter. If you get the "E. M." for April 23, 1886, Vol. XLIII., you will see plan and elevation of double engine with other details. If you are going to make the engine yourself I should advise you to get the articles on "Engine-making at Home," in Vols. XLI.-XLII., which give full details of all the parts and instructions for fitting up for an engine a little larger than yours; but you could reduce the dimensions to suit. W. W. C.

[65637.]—**Model Engine.**—These will give, say, 5in. stroke, so make connecting rod 13in. to 15in., and flywheel 20in. diameter.
Bristol. T. C.

[65641.]—**Bunsen Cell.**—To Mr. Bottone.—Provided the Bunsen were in good condition, and the wire sufficiently fine, say No. 40, either iron or German silver, you can easily fire the gunpowder. To make sure of the matter, you might construct an Abel or Statham's fuse. S. Bottone.

[65643.]—**Cutlery.**—Rosin is chiefly used. By being placed in hot water, expansion causes the "tang" to leave the handle, and the knives present an unsightly appearance. I have seen an instance in which this has been prevented by boring the base of the hole larger. The "tang" is made larger at the end and cut centrally, and so springs into its place. R. Bunting.

[65643.]—**Cutlery.**—A cement is made of rosin and brickdust or fine sand; it is dried and powdered; the handle is than "packed" with this powder, and the "tang" of the knife having been heated to a dull red is inserted in the handle; on cooling, the handle will adhere to the blade and the excess of cement can be cleared off. Take care to put the put the blade in straight. Another recipe for the cement is 2 parts bath brick, 1 part resin, and 1 part beeswax. Will o' the Wisp.

[65644.]—**Paraffin.**—Benzoline. Sm.

[65644.]—**Paraffin from Cloth.**—This was answered a week or two ago. See pp. 357-8.
Principia.

[65644.]—**Paraffin from Cloth.**—If paraffin-wax is meant, see reply on page 358 of the "E. M." for June 15, 1888. If paraffin oil, the following treatment will be found efficacious: Get some good benzine collas, rub it over the soiled places with a sponge, place blotting-paper above and below, iron with a rather hot iron. Repeat this treatment (keeping away from any naked flame) until the stain be entirely removed. If the cloth be such as will stand washing, it may then be washed with dilute ammonia and plenty of water. S. Bottone.

[65646.]—**Vacuum.**—The vacuum would be uniform.
Bristol. T. C.

[65646.]—**Vacuum.**—Gauge at surface, no vacuum; 16ft., 14·7in.; 32ft., 29in.
Medical Student.

[65646.]—**Vacuum.**—The 32ft. column of water is supposed to balance the atmosphere, and taking the pressure of the atmosphere at 14·7lb. per square inch, the gauge at the top would show no vacuum, the one 16ft. below would indicate 7·35lb., and the one 32ft. below would register 14·7lb.
Wigan. J. W.

[65649.]—**Eccentrical Turning.**—Your best plan would be to mill these; you will never make a good job in the manner you propose.
Bristol. T. C.

[65656.]—**Brazing.**—For delicate articles, nothing like silver solder used with charcoal, and the simple mouth blowpipe, or the spirit gas article. The natives of India excel in this branch of work, using the smallest possible amount of solder, propped up with stiff clay. For all brazing on a small scale, I have always found charcoal superior to coke as a fuel, employing double bellows for the forge, and they can be small, though a fan is better. This silver solder runs rapidly, like quicksilver, to the eye; the joints, when filed, scarcely perceptible. Tubes of all the metals, and broken parts of mathematical instruments are wonderfully correct. Eos.

[65657.]—**Improved Primary Battery.**—To Mr. Bottone.—This is very well where the battery has not to be moved about, and where short intermittent currents of some power are needed over long intervals of time. S. Bottone.

[65658.]—**Lead Poisoning.**—Boil the wine for some time so that, if any lead is present, the solution may be rather strong; when cool, add a clear solution of common salt; if lead is present you will get a white precipitate, which is soluble in hot water, being precipitated as the water cools.
Chesterfield. H. H. B.

[65658.]—**Lead Poisoning.**—Acidulate with a few drops of hydrochloric acid and pass into the solution sulphuretted hydrogen gas, from such an apparatus as is described on page 194 of this volume. A black precipitate indicates precipitate is insoluble in sulph ammonia. J. A

[65658.]—**Lead Poisoning.**—The a cheap and reliable test:—Add to a sa liquid a little potassium iodide soluti is present a yellow precipitate will b this will become soluble on boiling, b ing the liquid to cool it will deposit beautiful golden hexagonal scales.
Will o' Th

[65658.]—**Lead Poisoning.**—Get chemist a little piece of liver of sul sulphuris). Dissolve it in water. Pour of the clear liquid into the suspecte any appreciable amount of lead be pre brown precipitate will be the result. remains quite clear (it may change c shows no turbidity, it is free from lead
S. B

[65659.]—**Welding Tanks.**—This i trade, and is really a question of skill. remarkably cheap, and so well got up the castings.
Bristol.

[65660.]—**Water-Motor.**—Get set o from Wheeler. Very simple; no drawing
M. A

[65661.]—**Overhead Wires.**—If any need of protection it is the house, not As you surmise, lines running through are perfectly safe in that respect.
W. Perren-Ma

[65662.]—**Bubbles.**—Dissolve 1 par oleate of soda in 50 parts of distilled to every 3 volumes of the clear sol 2 volumes of pure glycerine. The pera bubbles depends on the purity of the s of soda) used. Bubbles made with solution will keep, if not exposed to from 1½ to 4 hours. J. A

[65666.]—**The External World's R** quite incapable of demonstration, and th succeeded in vindicating its existen would be a person of no ordinary me We are compelled to assume the e matter in order to account for a cer ideas we receive; but of it we know yond the fact that, under certain cir these ideas arise in our minds. Poss may have existence as mind has, and does not deny the possibility; but he that its existence is demonstrable to hu furnished with the limited faculties The psychologist always has at hand th of study, and does not need to resort t them; and querist can settle the matt he is individually concerned, by consid reads these lines, what he knows a beyond certain ideas. He feels some his hand which he has been accusto paper; certain impressions of black which he has been accustomed to cal in his mind, and association of ideas call up old and rearrange new series rapidity; but when he comes to ref the ideas are all he can lay hold on. T world is but a baseless fabric, and "chance" is the expression of our i law, so "matter" is the expression of of that which gives origin to our ideas.
D

[65668.]—**Island of Sumatra.**— grown extensively, and is distributed nent and here for the manufacture of not answer the other queries.

[65672.]—**Problem for the Seas** distance between window marks is vations, and distances of eye from are tangents of observations.

First observation { Radius =
{ Tangent =
Second observation { Radius =
{ Tangent =

2 (26x + 6) feet = distance travelled b in 400 seconds.

2 (6x + 6) feet = distance travelled b in 93 seconds.

$$\frac{2\,(26x + 6)}{400} = \frac{2\,(6x + 6)}{93}$$ = feet per se

From which equation we learn tha Then 102·3 × 26 = 2659·8ft. dista steamer's course from window-plane.

$$\frac{2\,(2659{\cdot}8 + 6)}{400} = \frac{2\,(6 \times 102{\cdot}3 +}{93}$$

second = 9·445 knots speed of
Sunderland. F K

[65678.]—**Insulation Test.**- the sensibility of your galv. I should say that higher E. such a test. W. Pe

[65678.]—**Insulation Test**— cells would give a sharper test.

testing is not recommended. See Mr. ›ok.

S. J. M.

— **Manchester Dynamo.**— To Mr. .—If you use the following dimensions ısily get the power you need. Armature ngs $4\frac{5}{8}$in. in diameter (see my advertise- ˙hese will make an armature about $2\frac{1}{2}$in. he field-magnet cores should be $1\frac{1}{8}$in. 6in. long. The top and bottom plates 12in. long by about 3in. wide and $\frac{3}{8}$in. ind armature with about 2lb. No. 20. 12lb. No. 22 on the field-magnet, connect vith the brushes, and if your engine is to its work you will certainly get four ıted well with a quarter horse-power. ;ht iron F.M. cores. S. Bottone.

—**Acid Stains.**—If the stains are fresh, with diluted ammonia (liquid); but if s old and the paper rotten, nothing will

Principia.

—**Nitric-Acid Stains.**—Irremovable. d corrodes the paper. If ammonia be nmediately, it somewhat lessens the f its action, but is of little use after.

S. Bottone.

—**Boiler.**—Say 30in. high and 20in. with internal firebox, and copper $\frac{3}{16}$in.

T. C.

—**Boiler.**—You had better have boiler al flue $3\frac{1}{2}$in. diameter, internal firebox eter, 2ft. high, boiler-shell 3ft. 6in. high, eter; water all round fire; $\frac{1}{4}$in., if well ld stand, but $\frac{5}{16}$in. is better.

;ton. C. Andrew.

—**Boiler.**—Your boiler should be 18in. firebox, 15in. diameter by 18in. high. nd it expensive if made of copper. I good boiler-plate $\frac{1}{4}$in. thick for 50lb. or ıest it to double the working pressure at

W. W. C.

—**Battery.**—

$$E = C \times R$$
$$E = 10 \times (7{\cdot}3 + 12{\cdot}7)$$
$$E = 200 \text{ volts.}$$

W. Perren-Maycock.

—**E.M.F. of Battery.**—Since the cur- pères is equal to the electromotive force ıvided by the total resistance in ohms, it ıt by multiplying the current in ampères ıse 10) by the total resistance in ohms e battery, and 12·7 in the conductor,) ohms), we shall get the electromotive erefore—

$$C \times R = \text{E.M.F}$$
$$10 \times 20 = 200.$$

ords, a battery or other generator must .M.F. of 200 volts to send a current of ı through a total resistance of 20 ohms.

S. Bottone.

—**Arithmetical.**—Work it thus:—

12 · 7
17
214 . 0
8 . 5
82 . 9
1712 0
27)1794 9
66½ nearly.

T. C.

—**Arithmetical.**—Area of two long

Sq.in. Sq.yd. ft. in.
)4 × 101) = 41208 = 31 7 24

ʋo short walls = 2 (151 × 101) sq.in.
Sq.in. Sq.yd. ft. in.
= 30502 = 23 4 118

of four walls
in. Sq.yd. ft. in. Sq.yd. ft. in.
24 + 23 4 118 = 55 2 142

paper required
Sq.yd. ft. in.
= 55 2 142.

Chi.

— **Algebraical.** — Will this suit "?—

$a - [b + (2a - b) - (a - b)]$
$a - [b + 2a - b - a + b]$.

ıging signs of quantities in the bracket minus sign before it—

$= 3a - b - 2a + b + a - b$
$= 4a - 2a + b - 2b$
$= 2a - b.$ (Ans.)

Chi.

—**Algebraical.**—This question is ex- easy, being No. 11 in the seventh collection of exercises in Todhunter's algebra for beginners. It is solved thus—

$$\begin{aligned} 3a - [b + (2a - b) - (a - b)] &= 3a - b - (2a - b) + (a - b) \\ &= 3a - b - 2a + a - b \\ &= 2a - b \end{aligned}$$

Wm. John Grey, F.C.S.
Analytical Chemist, Newcastle-on-Tyne.

[65689.]—**Algebraical.**— Removing brackets, this simple expression, fully worked out, is:

$$\begin{aligned} & -3a - [b + (2a - b) - (a - b)] \\ = & -3a - b - (2a - b) + (a - b) \\ = & -3a - b - 2a + b + a - b \\ = & -4a - b \end{aligned}$$

But, if $2a - b$ is the answer, it is evident that the − before $3a$ is only a dash which ought not to appear. Assuming that the first term is $+ 3a$, we get, as the value of the whole, $2a - b$. G. G. B.

[65689.]—**Algebraical.**— This involves one of the most elementary rules of algebra—i.e., that − outside bracket changes signs + they remain same:

$$\begin{aligned} & -3a - [b + (2a - b) - (a - b)] \\ & -3a - [b + 2a - b - a + b] \\ & -3a - b - 2a + b + a - b \\ & -4a - b \end{aligned}$$

the answer cannot possibly be—

$$+ 2a - b$$

Medical Student.

[65689.]—**Algebraical.** — A simple case of "taking out of brackets." The following are the steps a beginner would use:—

$$\begin{aligned} & 3a - [b + (2a - b) - (a - b)] \\ = & 3a - [b + 2a - b - a + b] \\ = & 3a - b - 2a + b + a - b \\ = & 2a - b \end{aligned}$$

Bristol. T. C.

[65690.]—**Lemon-Juice.**—To preserve lemon-juice, heat it to the boiling point, filter, and set aside in bottles completely filled. It may also be preserved by adding 10 per cent. alcohol to the fresh juice strained. W. E. Pond.

[65690.]—**Lemon-Juice.**—I remember that years ago, after the juice had been slowly filtered and placed in a deep jar, a lady friend of mine used to heat a bar of iron red hot, plunge it in the juice, and stir it about; when quite cold, the lemon-juice was again strained and put in 2oz. phials, quite filled, corked, and sealed. I was assured this simple process preserved it thoroughly for a long period. In hot climates I have found covering the surface of any perishable liquid with sweet oil (even beer in cask) preserved it from fermentation by protecting it from the air. Small bottles are advisable, that they may be used up quickly. Eos.

[65691.]—**Composition Gilt Frames.**—If the gilding is of imitation gold, you must take care to have a varnish perfectly free from acid, otherwise the metal will be attacked and turn green. Pure gold gilding will generally stand cleaning with soap-and-water; at least, such is my experience.

Sm.

USEFUL AND SCIENTIFIC NOTES.

Oil on the Waves.—An improved method of distributing oil on the waters has been patented in Germany. It consists of a rocket to which is attached a cylinder filled with oil. It is said that the rocket can be fired with accuracy from the ship, and that, when it explodes, the oil is scattered just where it is wanted. Several interesting experiments have recently been made between Bremen and New York. In one the rocket was fired a distance of 1,500ft. and less distances. By the explosion of five rockets at a distance of from 1,200 to 1,500ft. from the ship, a space of 1,500 to 2,000 square feet of water was covered with oil, and the waves were at once smoothed. The rocket was fired 900ft. against a gale. The importance of the invention to deep-water sailors consists in the certainty of explosion of the rocket at a sufficient distance to leave the vessel in calm water during a gale.

It is stated that Colorado is now producing 300 barrels of petroleum per day, sufficient to supply that and the adjoining States and territories, the value of the annual production being about 500,000dols. Four years ago not a barrel was produced, and now only one field is developed, that in Tremont county; but it is predicted that within a year the daily production will reach 1,000 barrels.

According to the *Essen Zeitung*, chief engineer Thier, of Erfurt, Germany, after battling on months to find a lubricant which would prevent iron surfaces welding together when subjected to rapid friction under heavy pressure, at last found one in mustard oil mixed with a small quantity of petroleum, which completely overcame the difficulty.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

65091. Zither, p. 178.
65119. Horsehair Manufacture, 179.
65135. Micro. Eyepieces, 179.

65338. Colouring Gold-fish, p. 266.
65346. Chemical Gilding, 267.
65347. Alpha Paper, 267.
65352. Creasote or Petroleum as Engine Fuel, 267.
65360. Oil Painting, 267.
65365. Bronze Medals, 267.
65370. Carbon Printing, 267.
65374. Fireclay Testing, 268.
65378. Model Gun, 268.
65381. Link Motion, 268.
65386. Hardening Parchment, 268.

QUERIES.

[65692.]—**Negative Varnish.**—Can anyone oblige with a good recipe for making varnish for dry plates?—H. C. M.

[65693.]—**Screw-Propeller.**—Can any fellow-reader tell me which is the best style for a good model, and why the propeller is reckoned so much better than paddle wheels?—Astarte.

[65694.]—**Ice Cream.**—In filling the machine for freezing what is the right proportion of salt to ice, or is there any better freezing process?—Frost.

[65695.]—**Valency of Sulphur.**—What are the most recent opinions upon this subject? All my books call sulphur a hexad element. Is it still considered so?—Young Analyst.

[65696.]—**Electrical.**—Will some reader kindly inform me how to charge a 1 quart Daniell modified cell? How long they last for bell work, and how to make a continuous ringing one?—Maymeth.

[65697.]—**To Chemists.**—Has chlorophyl a definite chemical composition, and, if so, what, or is it a varying organic compound? Is it merely the agent in the decomposition of CO_2 and the production of starch, or is the chlorophyl itself changed into starch?—Zero.

[65698.]—**Breathing of Plants.**—Is the statement of Eder, Abney, and others that plants exhale CO_2 and take in O during darkness generally admitted, and if so, does the fact prove, as is generally admitted (but I suppose erroneously), the unhealthiness of growing plants in bedrooms?—Zero.

[65699.]—**Animal Heat.**—I recently met with a statement that the heat of the body is due, not to the oxidation of fuel foods, but to the slow combustion of the tissues themselves. Is this so?—Zero.

[65700.] — **Hydrokinone Developer.** — Would "B.Sc., Plymouth," kindly inform me whether the solution of which he lately gave the formula can be kept for any length of time without undergoing decomposition?—H. C. M.

[65701.]—**Breaking Strains.**—A rolled iron girder, 20in. deep, $\frac{3}{8}$in. web, top and bottom flanges each 6in. by 1in., and 35ft. between supports. Please say ultimate breaking strain in tons, and at what tension per inch of area the calculation is made from. I notice "Fairbairn" gives as a rule for strains the following:—

W = breaking weight in tons
a = area of the bottom flange in inches
d = depth of beam in inches
c = a constant of 75
t = distance in inches between supports

$$W = \frac{a\,d\,c}{t}$$

And he proceeds to give a girder composed of plates 22in. deep, 5-16in. thick, angle iron $\frac{3}{8}$in. thick, riveted on both sides at bottom, and angle iron $\frac{3}{8}$in. thick on both sides at top, width over the top being $7\frac{1}{4}$in. and the bottom $5\frac{1}{2}$in. The breaking weight of this beam at centre would be as follows: 30ft. between supports,

$$W = \frac{75 \times 6 \times 22}{36} = 27{\cdot}5 \text{ tons in the middle, or 55 tons}$$

distributed equally. Now I cannot see where he gets the factor six for the area of bottom, unless it be that he takes the area of flange and half depth of beam. I would like this explained—"area of bottom flange." What is meant by the expression "effective depth of girder"? Also what is meant by "strain on top and bottom flange at centre in tons"? Does it mean that the areas are to be taken together by the tons allowed per inch for breaking strain, or otherwise?—Carino.

[65702.]—**Infinite Series.**—Has the following infinite series a definite sum or limit?

$$(\tfrac{1}{2})^2 + (\tfrac{1}{3})^2 + (\tfrac{1}{4})^2 + (\tfrac{1}{5})^2 + (\tfrac{1}{6})^2 + \ldots \textit{ ad infinitum.}$$

Is it a definite commensurable amount like that of the series $\frac{1}{2} + \frac{1}{4} + \frac{1}{8} + {}^{1}/_{16}$ *ad infin.*, or is it incommensurable like $\sqrt{2}$, or π, for example?—A. B. C.

[65703.]—**Hot-water Pipes.**—Will anyone inform me whether it is possible to heat a room 15ft. by 15ft. by 10ft. with a hot-water apparatus where oil lamps are used for heating the boiler? As I may require to have it all shortly I do not want to go to the expense of the ordinary hot water apparatus with boiler heated by coal or coke. I require to keep room constantly at temperature of about 80° Fahr., for drying chemical preparations, and a current of air will be necessary to accomplish this.—K. D. Y.

[65704.]—**Emigration.**—I have a friend (25) who thinks of settling in British Columbia. Can "Eos" or any other travelled contributor tell me anything of the prospects and occupations of the district? Farming would be out of question through want of experience. Would the terminus of the C.P.R., Puget Sound, or Port Moody offer any facilities?—X. Y. Z.

[65705.]—**Gaseous Paraffin.**—Can any of your readers tell me to what temperature paraffin oil must be raised in a closed vessel so as to have a pressure of 150lb. to the inch? Also what is the temperature of a jet of paraffin gas completely burnt? Also how can I calculate the volume of a certain quantity of paraffin oil heated to gas at a certain temperature?—R. D.

[65706.]—**Vulcabestos.**—Thanks to "T. C., Bristol," but have tried vulcanised fibre, but it will not stand steam. Should like some other flexible material that will stand screwing with a fine thread and resist steam pressure. Have tried indiarubber, asbestos, and compressed paper, but I am told that vulcabestos is a material which combines all the properties of indiarubber and asbestos. If so, I think it will suit me for my experiments. Should like to know if such a material is made or not?—VULCABESTOS. [Why not write Bell's Asbestos Company, whose advertisement you will see in this issue? They are by far the largest manufacturers of such substances, and will know all about the material if it is of any good.—ED. "E. M."]

[65707.]—**Damp Wall**—For some two or three years back a division wall in a building has been showing damp and all the time getting gradually worse. The wall has six flues inside it, and one of these takes smoke and fumes from a boiler used for heating the premises which is fired with coke, no coal being used. Inquirer has been forced to the conclusion that damp is caused by steam which evaporates from coke while burning, and as it goes up the flue condenses, and then the water percolates through the wall on both sides. This is strange and unaccountable, as the damp has only shown for about three years, and yet the flue has been used for 29 years. There is 20ft. of flue horizontally before it enters wall space, and the damp showed first in the third and second story of building, now it shows more in second and first floor, the third floor having nearly dried again. Do any of your readers know of such a cause for damp, and can they say if it is curable? SAM DUGDALE.

[65708.]—**Bee Hives.**—TO "SILKE."—I have to apologise for not thanking "Silke" for his kind and valuable answer, No. 64623, 9th March last, and as I have been abroad since the beginning of March until a few weeks ago I hope he will pardon my remissness. I have since my return made most of the hive described. My outside walls stand ⅞in. above level of frame tops. Shall I leave this or plane it off? I am much puzzled as to supers and section crates. In the bee shops I am told they are the same thing. Should a super be like another body box or hive, with the box or crate containing the sections fitted inside? In your hive where ought the super and section crate to rest—say in Fig. 5, p. 161, Oct. 14, 1887; and ought the outside of super be flush with outside of hives—plinths, of course, being not counted? How deep would you advise my making roof cover at sides? I should take double the depth advised for the ends to ridge cap. What is meant by the top of roof being "rabetted" at joint? Fig. 4 gives the impression of the 7in. board being slightly bevelled or wedge-shaped. Am I right in supposing that the end of roof cover should not be cut out in a zigzag to receive the 7in. board? I am afraid I am giving much trouble, and hope "Silke" will pardon my ignorance.—INDIAN.

/ [65709.]—**Transparencies.**—Can any of your readers inform me if it is possible to take transparencies for the lantern on gelatine dry-plates, so as to give satisfactory results and clear glass in the high lights such as is required for a map or line engraving or print? I have tried the dry plates of most known makers, but have failed to get good results, the high lights being generally of a dirty brown colour, quite unsuitable for the lantern. A reference to any competent articles on this subject will greatly oblige. Are not Ferrier's well-known slides taken by the wet process?—LUX.

[65710.]—**Electroplating.**—Would some of "ours" kindly tell me of the best method for making gold and silver solutions for electroplating in detail? I have been used to making my gold solution with 1oz. cyanide potassium dissolved in 1 quart of nearly boiling distilled water. I then half-fill a small porous cell with this solution and place it in the bath with the bulk. Into the small porous cell I put a piece of copper connected with the battery by the wire issuing from the zinc pole of battery and the gold anode into the outer bath. The whole of this I place over a spirit lamp and leave until the solution has absorbed 1½ pennyweight of gold. This is the gold solution I have been working, which I got from "Weale's Electro-Metallurgy," published in 1860; but I thought there was now a better and cheaper method of making it. Also I want to know the best battery to use. Sulphate of copper solution in outer cell and dilute sulphuric acid in inner porous cell is what I have had, but have not got the proper proportions.—PERPLEXED.

[65711.]—**Motor.**—TO MR. BOTTONE.—I have just finished motor described April 6th, but cannot get it to work. I have carefully followed the instructions given, but could only get ten sections on armature. Insulation is perfect in magnet and armature cores. I get good sparks at the brushes. I have also tried it as a dynamo, but get no current. I have only used half battery power stated. Will you kindly give any reason?—L. R.

[65712.]—**Disappearance of the Moon.**—I find in Wesley's "Natural Philosophy," Vol. II. p. 143, the following:—"The moon has sometimes disappeared in a cleared sky, so as not to be discoverable by the best glasses. This Kepler observed in the year 1580 and 1583; Hevelius in 1620, as did Ricciolus, and many others at Bologna. Many people throughout Holland observed the same, April 14, 1642. December 23, 1703, there was another total obscuration. A little before it she appeared at Arles of a yellowish brown, at Avignon ruddy and transparent. At Marseilles, one part was ruddy, the other dusky, till she wholly disappeared." Will any reader kindly give a reason for the above phenomenon?—CIRCE.

[65713.]—**Differential Feed-Motion.**—I have discovered an automatic differential feed-motion, and have lately taken out a patent for a drilling machine based upon it. Does the patent protect the principle solely as applied to drilling machines, and is it legal for anybody getting acquainted with it to apply it to other kinds of machines, for instance milling machines?—ONE OF "OURS," Switzerland.

[65714.]—**Type-Writer Ribbons and Inks.**—Will some one kindly say of what materials these ribbons are made in the Caligraph and Remington type-writer, and what is used to ink them for ordinary writing; for writing that is to be copied in letter book; for writing in different colours; for writing that is to be lithograped, and also for multiplying by graph process? How is the ribbon prepared with these? Is there any method of adapting the "Autocopyist" or "Eclipse" copying apparatus to these pattern typers? I have tried special ink sold as effecting this, but it was a total failure.—MACHINE-WRITER.

[65715.]—**Mechanical Problem.**—A circular plate, whose radius is 32in., is movable about its centre in a vertical plane. From two points on its circumference, 90° apart, weights of 36lb. and 48lb. respectively are suspended. Find the distance the lighter weight will be above or below the horizontal line through the centre when the plate is at rest.—P. R.

[65716.]—**Electrical.**—I find it convenient to use some wrought-iron pipes to complete my circuit, but cannot get a good joint. I clean and score with a file, take my wire round the pipe and solder. The joint looks all right, but in a day or two if it gets a knock I find the wire and solder lift off the pipe. Will some practical electrician give me a hint? I have some hundreds of joints to make. The wrought-iron pipes have been boiled in linseed oil.—J. E. S.

[65717.]—**Winding Electro-Magnet.**—Will some one please tell me how to wind the wire on a large horseshoe, 8in. in length and 1in. diam? There is some wire on at present, but not nearly enough, so I wish to add a quantity of No. 16 c.c. near the poles to increase the power. I have tried winding it with my right hand whilst the half-round portion of the magnet was fast in the vice, but I cannot wind it regularly on account of the large size of the wire. Can anyone suggest a winder? At the same time please say the best method of preventing the wire coming loose again after it is wound. Some employ tapes between each layer. Is that the simplest plan? Any help with a suggestion as to the best cell and number of same to develop its powers to the fullest extent will much oblige.—M. S. A.

[65718.]—**Dynamo and Accumulator.**—TO MR. BOTTONE OR OTHERS.—I have castings for small dynamo. F.M.'s 5½in. by 2½in. by ⅞in., poles 2⅞in. by 1⅞in. by ¾in., armature (H) 2⅞in. by 1⅞in. diam. Please say what size and amount of wire I should wind on each, and at what speed I should drive to obtain best results, and what voltage it should give. What is a laminated armature, and could I substitute one in this with advantage? I want to drive it by a model engine at times for a few hours. I am told to wind 8oz. 22 s.c.c. on armature and 1½lb. 24 s.c.c. on fields, when it will light four 5c.p. lamps easily. Is this so? In calculating exposed surface in an accumulator am I not right in supposing same is double the superficial area of the plate? Is tea lead of any use in small accumulators?—MAGNET.

[65719.]—**Boycotted.**—Can any of "ours" who have had any experience in getting plans passed by local boards for starting a small foundry to smelt about 8 or 10cwt. of iron per day? If so, could they give me any advice? The case is as follows:—My premises are close up to a woollen mill, the owner of which is a member of the local board, and I think he has used his influence on the board against my foundry. They have rejected the plans, saying that it would be detrimental to the adjoining property and to the public health. I may say that the owner of the said mill has recently put a rag-grinding place up close to our fence, and at right angles with the mill, so that our yard is bounded on one side with his mill, and the other by the rag-grinding works. Have the board the power to stop me from fixing this foundry up, as I feel sure I can fix it up so that it will neither be a nuisance or dangerous to adjoining preperty?—WM. CLIFFE.

[65720.]—**Palmitic Acid.**—Should esteem it a great favour if some of my fellow subscribers will assist me with a formula I have had some difficulty with—viz., palmitic acid. A few aluminium filings are suggested to be put to palmitic acid whilst hot, you then add zinc. The result being you should get a sherry-like liquid. I have tried all sorts of ways, but the aluminium and the zinc are not in any way affected by the palmitic acid, and all set again. Why is this? Will some one give me a simple recipe? I have also a use for boracic acid, and should like to know what spirit will dissolve this quickly and keep it in a a liquid state.—PALMITIC ACID.

[65721.]—**Dynamo.**—TO MR. BOTTONE.—I have made a dynamo, Pacinotti ring, cog armature. The F.M.'s are cast iron, 8in. high, 2in. thick, pole pieces 8in. high, 3½in. wide, wound with 10lb. c.c. wire, the armature 7½in. diam., 3½in. wide, 1in. thick, in 12 sections, wound with 2½lb. of 18 c.c. wire. I have wound it to your directions in your book. Now I want to drive the dynamo right-handed—that is, when you stand facing the commutator, that it turns to the right with the top brush on the left-hand side, reversed from your article. I have magnetised the F.M.'s by coupling the zinc to the wire wound on the inside, and the carbon to the wire wound on the outside. Now I wish to know that by reversing the brushes will I have to remagnetise the F.M.'s by reversing the poles, and if so, will you kindly tell me, and at what speed to drive it at, and how many 16c.p. lamps it will light, and what volt lamp to use (magnetised with Bunsen cells)?—W. H., Liverpool.

[65722.]—**Ants.**—My orchard house, with trees planted in inside borders and trained upon trellis work, is infested with the above pests. They appear to take up their abode in the brickwork, from the points of which they issue when fruit is ripening, scaling the woodwork of house and trellis, and attacking the fruit even before it reaches maturity. Have tried bagging to no purpose, the fruit stems being too short to admit of stopping every crevice. Will any correspondent kindly suggest a remedy?—ROB. HARRIS.

[65723.]—**Pump.**—TO "T. C., BRISTOL."—I have a pump to a ½H.P. engine that will not work right. It will pump all right when the water is cold, but up it will not pump at all. It is made ju the one described in "Engine Making at you tell me what is the cause of it not pumps stands about 18in. higher than t boiler, which is just level with the firebo valve seats are covered with a leather Liverpool.

[65724.]—**Air-Pump.**—Will any reade me with a sketch of a horizontal air-pum 4in. diam., 4in. stroke, to run at 80 revs for a compound surface condensing launcl vided the pump is large enough, and I hav surface in condenser, can I, with this cla 28in. vacuum? Pump to be as short as show valves in detail.—TARA.

[65725.]—**Formic Acid in Honey** it stated somewhere that there is about formic acid in honey, as taken from the be of which prevents its fermenting. Will any friends say if that is so, and would the a cent. of formic acid to, say, new cider prev ing, and consequently losing its sweetne be at all injurious to anyone drinking course, one would take a much larger qua fruit juices than in honey, or can anyon really reliable anti-ferment that is harr using it?—F. W.

[65726.]—**Non-Conductor.**—I want a substance that will stand contact with a periods, say, half a minute at a time. Can made non-conducting to this extent? If of your readers will kindly inform me stitute?—IGNORANT.

[65727.]—**Magnet.**—Would Mr. Bo correspondent kindly assist me? I have a of soft iron, ½in. diam. The legs are 4in. in space between them is about 2in. What si wire ought I to put on to make a good ele GENS.

[65728.]—**Trash Ashes.**—Contrary practice I carted a quantity of trash ashes pen. I am informed I have injured the some kind reader inform me if it is really t hints will oblige.—S. J. S., Antigua, W.I.

[65729.]—**Solutions of Cane Suga** one kindly tell me how to calculate the nu of cane sugar contained in a solution (of s that weighs 15lb. to the gallon, and what is there when, say, 10lb. of cane sugar is di of water?—F. W.

[65730.]—**Solution.**—Will any reader in what proportions sulphuric acid and c used in the porous pot of a double flu battery, and also the solution used in the ment?—J. C., Newcastle-on-Tyne.

[65731.]—**Dynamo.**—Will some one what sized vertical boiler and engine to d of seven 10c.p. incandescent lamps and Should the boiler be tubular or not?—AN A

[65732.]—**Electric Light Dynamo** reader give me information how I cou dynamo capable of yielding 80c.p. or 100 it could be made by water power? Kind whom the casting and other fittings may be the entire cost would be?—R. PETERS.

[65733.]—**Arachnidæ.**—I have observed on the ground with roundish white bags ab their abdomen attached to the anal extre abdomen, and should much like to inform bags are for, and what are the peculiarities possessing them.—OMICRON.

[65734.]—**Champagne Corks.**—What heads of champagne corks round when in th it with the pressure of the wire, being cros ways, or are the corks shaped before bein few particulars as to how champagne is mad would greatly oblige.—E. M.

[65735.]—**Magic Lantern.**—What is way of inserting a 6½in. circular plate (same a switch camera) in the magic-lantern, so as to discs in proper position on screen? Plate c discs 2½in. diam.—KINGSTOWN.

[65736.]—**Watchmakers' Apprentic** any of our watch-making friends answer t question? A lad apprenticed for six years watch jobbing. What course of instruction master give the lad each year?—ONE THAT T

[65737.]—**Chrome Alum.**—Will some on me how to crystallise out the chrome alum of a solution of a bichromate battery?—GENS.

[65738.]—**Preserving Stonework.**—Wh application is used for this? It has been ap Houses of Parliament and other buildings to a —ANTARES.

[65739.]—**Eyepiece.**—To "F.R.A.S."—How the length of focus of a Huyghenian eyepiece, t the eye and field-lens respectively being known

[65740.]—**Ink Stains.**—Will anything take out of a coloured illustration. It is ther print aniline ink which has been spilt upon—Some

[65741.]—**F. S. Lathe Bed.**—To M sketch of section of your new design wo readers besides—NEW SUB.

[65742.]—**Jewsbury's Back Gear.**— follow working of this. A diagram wo SUB.

[65743.]—**Frosting Watch Pla** watch plates frosted before gilding?—

[65744.]—**Plating Dynamo.**—To M Very many thanks for the reply to my May I trouble once more? How thick to be where it is screwed to core? Is is not shown in Fig. 1)? Must the F.M. shown, as I should like them to form Will it be worth the extra trouble to malleable iron? Please say what rule I ount of iron to put in the F.M.'s of a MC.

llines.—Would some reader kindly tell t the finer varieties of these beautiful om shrivelling up when dried? I have n in turpentine, as well as solutions of without avail, and I am told that the If, however, any of your readers could e upon the subject I should be greatly 'E.

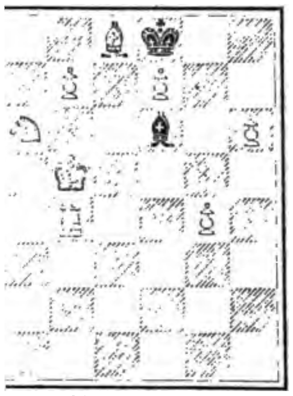
Algebraical Symbols.—I am rystal's work on algebra (the first part , and have come across symbols which I l and which I never met before—viz.. Will some mathematical reader tell me —F. S. S. [Our printers have not d to; but * represents three horizontal a parallel with a vertical line through ts side with a vertical line run through to be no end to the vagaries of mathe- -ED.]

CHESS.

ations for this department must be s EDITOR, ENGLISH MECHANIC, 332,

PROBLEM MCIII.

Black.



White. [8 + 2

play and mate in three moves.

SOLUTION TO 1,101.

Black.

1. K takes Kt (*a*).

ch). 2. Anything.

es.

(*a*) 1. B-Q B 3 (*b*).

&c.

(*b*) 1. B takes Kt (*c*).

(ch), &c.

(*c*) 1. R takes R (*d*).

&c.

(*d*) 1. P moves.

h), &c.

also be solved by 1. R takes Kt. (ch) &c., or 1. Q-B 7 (ch).

ES TO CORRESPONDENTS.

ns to 1,101 by Black Pawn (2), J. G. Han Bryden (3), J. Palmer (2), H. B. Lester almer (too easy), Link, E. W. Barnett, Billington.

olution to 1,100 was previously sent and f in 1,101 $\frac{\text{B takes R}}{\text{B takes R}}$, and how then?

and J. P. Taylor are thanked for pro-

ON.—All in good time. The Problem e to go on for another ten weeks; the is concurrent.

our correspondents' attention to the new d of the problem this week.

ers will have seen with great regret the the sudden death of Dr. Zukertort at the He was probably the finest living chess- the first prizes in the Paris and London 878 and 1881, and although defeated in his Steinitz, we think this was due in a great ate of his health at the time. Those who his celebrated games, in the '83 Tourney are familiar with the extraordinary depth Zukertort's play. He was also one of rs who have the wonderful faculty of al games simultaneously without seeing lay involves far more than an astonishing this must be the principal power at work. s the author of several works, but none, e of, on chess.

aily American, and *Tri-Weekly Jamaica* with thanks.

RNE will probably make a tour of the the autumn of this year. He has had to cross the Atlantic, and America is ortion of the civilised world in which he vanquished the doughtiest champion of —*Star.*

RNE was the "man of the day" and sub- ed cartoon in *Vanity Fair* of June 2.

nd Solution Tourney are announced in *ekerist*. Composers may send one of each and four-movers—up to Aug. 1.

ANSWERS TO CORRESPONDENTS.

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*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand*, *W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to Hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, June 27, and unacknowledged elsewhere :—

BRIGHTLINGSEA GAS CO.—An Old Welded Boiler Maker.—Vooght.—A Working Man.—H. H. E., Electrician, Torquay.—Stud.Inst.C.E.—Stoko.—A. W. M. B.—Frank Caws.—Potter.—J. H. Thomas.—Jo.—E. W. Bussell.—P. Harvey.—E. T.—Lincoln—Principia.—C. Andrew.—V. J. B.—S. Bottone.—H. M. Ward.—T. B. S., Devizes.—Weird.

J. S. (It appears to us from your description that you have a coil which was never intended for the purpose you imagine. It is a simple induction coil. You appear to want a "medical coil," as it is termed. See indices, or if you wish to make one, p. 53, Vol. XLIV.)—PAXES. (Your belt is apparently worn out as the copper wires are oxidised. Try with the "tongue" test; perhaps your galvanometer is out of order, for it ought to show a current if one exists.)—R. D. (We do not remember. Are you sure it was given? Parson's revolving steam-engine was illustrated and described some time ago, but not Rigg's, so far as we can recollect. Where did you find any mention of it?)—CONSTANT READER, F.C. (Procure a list of books published by Messrs. Spon, 125, Strand. There is no practical information in book form, if that is what you want.)—ONE IN A FIX. (Not an easy matter, but try a weak solution of chloride of lime, or expose to the fumes of a burning sulphur match.)—CURIOSITY. (You will best answer your first question by referring to the book asked for in your second, which may be "Astronomy," by Rev. R. Main, published by Crosby Lockwood and Son at 2s. 3. We really could not answer such a question. You must consult the booksellers' catalogues, and choose for yourself.)—TO AN INQUIRER, E. W. (See indices, or consult any cheap manual on house painting. We do not know what you mean by "graining colour," but the ordinary method is simple enough, and they mix it for you where you buy the materials.)—STEPHEN SIBLEY. (Discussion about furred kettles in last volume, and several recipes in back volumes. Make hot and tap gently.)—SIMPLETON. (The "consequence" will be nothing at all; but no one could answer the question about infringement without making rather laborious searches at the Patent Office. If for your own private use, no one will interfere if you do infringe; and if you combine various improvements you may perhaps be able to invent something that will be worth patenting.)—STACCATO. (If you went into one of the large music-dealers in your city, they would show you the works they have in stock, and no doubt give good advice.)—INCUBATOR. (How can anyone say how many eggs can be hatched at once in an incubator, unless the dimensions of that apparatus are known? Besides, see Hints No. 4, above. You can find all the information you require by turning up the back volumes.)—DERBY. (You will find it illustrated in a back number. We suppose you mean "without" legs or feet, although you write "with." Nothing gives us greater pleasure this hot weather than searching up illustrations of subjects that have been almost forgotten by our readers.)—W. H. (We do not think so; because the method of taking portraits and making enlargements by the light of paraffin lamps have been frequently described in our columns.)—ROGER. (Preparations are sold for the purpose, and there are many recipes in back volumes. Dried flour mixed with red-lead and a little pounded sugar has been recommended—so have hedgehogs.)—CYCLO. (We have frequently stated that there is no known method of dissolving vulcanised rubber or of repairing articles made from it. The old stuff is sent to the mills to be worked up.)—TYNE. (Your question is rather incomprehensible. What instructions do you want? However, whatever they are, you will find them in back volumes. Try p. 432, No. 903, Vol. XXXV., and look on pp. 338, 386, 409, 504, same volume.)—BRAZIER. (Why make an engine of that antiquated type? Several diagrams of the firing ports of gas-engines have been given recently. See p. 46, this volume.)—WOODBINE. (You can make carbonic-acid gas by pouring hydrochloric acid on marble chips, or sulphuric acid on chalk or whiting. As to a pump, what is the purpose? See the catalogue issued by Barnett and Foster, 25C, Eagle Wharf-road, New North-road, London.)—CIRCE. (It is naphthaline—frequently described in our columns. The formula is $C_{10} H_8$.)—H. G. P. (See indices. You should say what the boiler is for, and at what pressure you require to work.)—GEORGE BLENT. (1. Yes. 2 answered by 1. 3. We have not time to make the calculation; but roughly, that would be about it. 4 answered by 3. 5. The water in the dock would probably be denser than that in the open sea, unless the sea water in it were frequently renewed. Not much between oceans; but the water of the Dead Sea is much denser than that of the Red Sea.)—MORE LIGHT. (Your legal question will be replied to by Mr. Wetherfield in the *Weekly Times and Echo*.)—STATICS. (Query shall appear next week, as you send it a second time; but we cannot as a rule spare space for half the mathematical questions which reach us. We know of no other handbook than the one you mention. Possibly the secretary of the Society of Arts may.)—M. (Better consult Dr. Allinson in the *Weekly Times and Echo*, though grinding the teeth in sleep is a symptom of many things—of worms, for instance. Other query next week.)

Every Man or Woman suffering from any form of nervous derangement, loss of power, debility, or functional disorder, should send at once for "Electropathy; or, Harness's Guide to Health" (copiously illustrated). It will cost you nothing, and if, after perusal of the astounding facts it will bring to your notice, you should be persuaded to stop physicking and try rational treatment, you will assuredly be numbered among the ever-increasing multitude who daily express their gratitude for the priceless benefits derived from mild, continuous currents of electricity generated by wearing Harness's Electropathic Belt. Don't hesitate a moment, but sit down at once, lest you forget it, and write for the treatise, which will be sent you free by post.—Address, Mr. C. B. Harness, Consulting Electrician, the Medical Battery Company, Limited, 52, Oxford-street, London, W. (corner of Rathbone-place).

USEFUL AND SCIENTIFIC NOTES.

◆◆◆

Preservation of Meat.—The *Petit Journal de la Santé* has published a special report recently addressed to the Minister of Agriculture, in which the advantages of sugar as an agent for the preservation of meat are set forth. The writer remarks that salt absorbs a portion of the nutritive substances and of the agreeable taste of the meat. When an analysis is made of the solution of the salt dissolved by the liquid contained in the meat, one finds in it albuminoid and extractive substances, potash, and phosphoric acid. The salt deprives the meat of these substances, in proportion as it penetrates into the tissues and the length of time it is allowed to act. It then happens that the meat, withdrawn from the saline solution, has lost nutritive elements of real importance. Sugar in powder, on the contrary, being more soluble, produces less liquid. It forms around the meat a sort of solid crust, which borrows from it very little water, and does not in any way alter the taste. Thus preserved, it is sufficient to dip the meat in water to wash off the sugar before using it. If this treatment of meat is a little more costly than its preservation with salt, the final result and the loss avoided should be taken into account, as these would be greater than the difference of price between the two agents of preservation.

Photography Made Easy.—Mr. Stanley, of Railway-approach, London Bridge, has just issued the tenth edition of his manual for beginners, which is known under the above title. It is a cheap and trustworthy work, and certainly the "beginner" needs no more than he can find in this neatly-printed and well-illustrated work.

ACCORDING to *La Metallurgie*, an alloy useful when metals are to be soldered together at a low temperature can be made as follows: Copper in a fine state of division is obtained by precipitation with zinc from a solution of sulphate of copper. From twenty to thirty parts of this, according to the hardness required, are mixed in a cast-iron or porcelain mortar with concentrated sulphuric acid, to which is finally added seventy parts of mercury, and the whole triturated with the pestle. The amalgam thus formed is thoroughly washed with water to remove the sulphuric acid, after which it is left untouched for from ten to twelve hours, at the end of which it is hard enough to scratch lead. To use the alloy for soldering it is warmed till it has about the consistency of wax, and in this state it is applied to the joint, to which it adheres very firmly on cooling.

W. KOHLRAUSCH (*Electrotechnische Zeitschrift*, March, 1888) has estimated the current and quantity of electricity in a lightning-flash. He calculates that it will take 9,200 ampères to melt a copper rod of 2·5 centimètres diameter. Preece's constant (*Proc. R.S.*, March, 1888) makes it 10,244. Such a current concentrated in a flash would contain from 52 to 270 coulombs, which would decompose from 5 to 25 milligrammes of water, and from 9 to 47 cubic centimètres of explosive gas. If this energy were stored up and distributed for electric lighting, it would require from 7 to 35 such flashes to keep one glow-lamp alight for an hour.

NITRE is sometimes used to take away the turnip taste from milk. A case was tried some time ago in the West of Scotland, where nitre was supposed to have been added to milk. The dairyman pleaded not guilty to using nitre, but said he gave his cows rock-salt. The magistrate found the man not guilty of using nitre, but guilty of adulterating his milk, inasmuch as by giving cows rock-salt they were thirsty and drank more water, and thus the milk was diluted by an extra quantity of water.

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*** It must be borne in mind that no Displayed advertisements can appear in the "Sixpenny Sale Column." All advertisements must be prepaid; no reduction is made on repeated insertions, and in cases where the amount sent exceeds One Shilling, the Publisher would be grateful if a P.O.O. could be sent, and not stamps. Stamps, however (preferably halfpenny stamps), may be sent where it is inconvenient to obtain P.O.O.'s.

The address is included as part of the advertisement, and charged for.

Advertisements must reach the office by 1 p.m. on Wednesday to insure insertion in the following Friday's number.

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5s. 6d. for Six Months and 11s. for Twelve Months, Post Free to any part of the United Kingdom. For the United States, 13s., or 3 dol. 25c. gold; to France or Belgium, 13s., or 16f. 50c.; to India (via Brindisi), 15s. 2d.; to New Zealand, the Cape, the West Indies, Canada, Nova Scotia, Natal, or any of the Australian Colonies, 13s.

The remittance should be made by Post-office Order. Back numbers cannot be sent out of the United Kingdom by the ordinary newspaper post, but must be remitted for at the rate of 4d. each to cover extra postage.

Messrs. JAMES W. QUEEN and Co., of 924, Chestnut-street, Philadelphia, are authorised to receive subscriptions for the United States for the ENGLISH MECHANIC, at the rate of 3 dols. 25c. gold, or Thirteen Shillings per annum, post free. The copies will be forwarded direct by mail from the publishing office in London. All subscriptions will commence with the number first issued after the receipt of the subscription. If back numbers are required to complete volumes, they must be paid for at the rate of 3d. each copy, to cover extra postage.

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All the other bound volumes are out of print. Subscribers would do well to order volumes as soon as possible after the conclusion of each half-yearly volume in February and August, as only a limited number are bound up, and these soon run out of print. Most of our back numbers can be had singly, price 2d. each, through any bookseller or newsagent, or 2½d. each, post free from the office (except index numbers, which are 3d. each, or post free, 3½d.).

Indexes for Vols. VI., VII., and IX., 2d. each. Post free 2½d. each. Indexes to Vol. XL., and to subsequent vols., 3d. each, or post free, 3½d. Cases for binding, 1s. 6d. each.

NOTICE TO SUBSCRIBERS.

Subscribers receiving their copies direct from the office are requested to observe that the last number of the term for which their subscription is paid will be forwarded to them in a PINK Wrapper, as an intimation that a fresh remittance is necessary, if it is desired to continue the Subscription.

Holloway's Pills.—Easy Digestion.—These admirable Pills cannot be too highly appreciated for the wholesome power they exert over all disorders of the stomach, liver, bowels, and kidneys. They instantaneously relieve and steadily work out a thorough cure, and in its course dispel headache, biliousness, flatulence, and depression of spirits.

OUR EXCHANGE COLUMN.

The charge for Exchange Notices is 3d. for the first 24 words, and 3d. for every succeeding 8 words.

Good Value Offered (cash or instruments) for all kinds of Scientific Appliances.—CAPLATZI, Science Depot, Chenies-street, near British Museum. Estab. 1862.

Wanted, a Collection of Postage Stamps, if possible collected before 1880. Exchange offers.—J. W., 28, High-street, Ipswich.

Photographic Apparatus wanted in exchange for **Sewing Machine** or 52in. nearly new Bicycle. State makers name and condition of apparatus.—DEER, 100, Houndsditch, London.

Bench **Drilling Machine,** with sliding head and holding jaws, with vertical and transverse adjustments. What offers? Amateur's portable Forge preferred.—R. A., 41, Athol-road, Manningham, Bradford, Yorkshire.

Wanted, set of Weston's **Blocks and Falls,** small size. Will give good exchange.—ALFRED BRYANT, 37, Camberwell New-road.

Planing Machine, to plane 13ft. by 3ft. 6in. square, two tool boxes, and set of Basses governors, perfect. Exchange good machinery.—RIGBY SMITH.

Lathe, 18in. centres, 36ft. bed, two saddles and rests, screw-cutting complete; shaping machine, 14in. stroke, two tables, equal new. Exchange.—RIGBY D. SMITH.

Slotting Machine, 14in. stroke, self-acting in all cuts. Macles and March steam pump, 4in. ram, complete.—RIGBY SMITH, 107, Granby-row, Manchester.

Strong 7in. **Lathe,** traversing mandrel, 4ft. bed, two dozen chucks, &c., cost £25. Exchange ½-horse Gas Engine or offers.—2, Grosvenor-place, Leeds.

Exchange, Compound **Slide-Rest,** 22 long, suit 8 or 9 lathe, for Safety Bicycle or good Tricycle, value £5, new.—BAKER, Robin-lane, Pudsey.

Exchange **Root's Blower,** for either 1 or 2 fires, new, for either Safety Bicycle or good Tricycle, value £5.—BAKER, Robin-lane, Pudsey.

Diamond Drills for china, glass, dental purposes, &c., from 1-32 to ⅛. Exchange offers. Stamp reply.—C. BLANCHARD, 26, Little North-street, Grove-road, London.

Silver-plated B flat **Cornet,** good condition, equal to new, value 4 guineas (retiring from playing). Will exchange for good Bicycle, ball bearings, 54in.—FRED AUSTIN, The Field, Church-lane, Marple, Cheshire.

Grand Model Tank **Locomotive,** 37½in. long, 5½in. gauge, 1½in. bore, cylinders 2½in. stroke, six wheels coupled, steel link reversing motion, steel connecting rods, fitted with brasses, steel riveted and stayed boiler, 5 tubes, 1½in. diameter, copper, internal firebox made to burn coal, spring buffers and steel working springs, strong and powerful, cost £60 secondhand. Photo. sent. Part exchange. Genuine bargain.—W. DOWNING, 295, St. Philip's-road, Sheffield.

Nearly ½-horse horizontal **Model Engine,** good workmanship, strong and powerful, will work lathe; also iron Vertical Boiler for same, with furnace and fittings. No use for them. £8, part exchange. Genuine bargain.—W. DOWNING, 295, St. Philip's-road, Sheffield.

Wanted, 1½ or 2H.P. Boiler (vertical), in exchange for ½-plate CAMERA, cost £6, and Burnishers for burnishing up to 12in. wide (steel rollers), also wanted 1 or 1½H.P. Vertical Launch Engine in exchange.—A. W. NURSE, 38, High-street, Lewes, Sussex.

Wanted, Youth's Tricycle. Exchange Virtue and Co.'s "Hume and Smollet's History of England." 4 Vols., just bound in half-calf, new and perfect, cost £5.—H. T., 127, Hatherton-street, Walsall.

Exchange 6-cell **Carbon and Zinc Battery,** cells 8in. by 6in., with lifting arrangements and electric motor, King, Mandon, and Co., Bristol, maker. Jewellery or offers.—TAYLOR, 40, Bentinck-street, Ashton-under-Lyne.

What offers in Photo. Goods for **Microscope,** by Negretti and Zambra, 3 powers, 9 doz. slides.—11, Godwin-road, Margate.

"**English Mechanic,**" numbers 556 to 581, 641 to 699, and 20 others; 2½in. Electric Bell. Offers.—COYN, 6, Albert Villas, Clifton-road, South Norwood.

12in. **Circular Saw,** spindle and pulley, equal new, Drilling Machine, nearly finished. Exchange Drawing or Painting Materials.—PERCY CLARK, Stamford.

5in. **Lathe.** (makers, Britannia Co.), equal to new, slide-rest and tools. Exchange for piano.—PERCY CLARK, Stamford.

Lamb Knitting Machine, perfect working order, cost £12. Exchange £4 value.—F. KIRK, 26, Cranbrook-street, Barnsley.

ENGLISH MECHANIC wanted, **Vol. XXXIX.,** in exchange for ELECTRICAL INSTRUMENTS.—MC., 28, Percival-street, Clerkenwell, E.C.

Cartridges.—A few 12-bore brass and salmon, and conical bullet mould. 1½oz. Exchange Chemical Apparatus. See after 7.30.—BROWN, 20, Johnson-street, Westminster.

Wanted, Gem Air Gun, good as new. Exchange ELECTRICAL APPARATUS.—E. THORNTON, 37, Stafford-street, Barrow-in-Furness.

Symon's "**Monthly Meteorological Magazine**" for 1884, 1885, 1886, in exchange for No. 18 cotton-covered Copper Wire or offers.—JAMES, 72, Cambridge-street, Birmingham.

Chuck. 6in. Universal 3 jaw, and 6in. Compound slide-rest. Exchange offer.—16, Riley-street, Bermondsey.

Indiarubber **Water Bed,** 4 by 6ft., quite perfect, for Aneroid Barometer or Silver Watch value £2.—F., care of C. MCKELVIE, Sliddery, Lamlash, N.B.

Wanted, Chuck (Universal), suitable for 6in. lathe; also Screw-cutting Lathe. Exchange SAFETY BICYCLE and cash.—30, Howson-road, Brockley, S.E.

"**Student's English Literature.**" "Ganot's Natural Philosophy," Globe Translation "Horace," "Routledge's Italian Dictionary," "Civil Service Report," 5s., nearly new. Offers wanted.—ROBERT SMITH, East Wall, Londonderry.

Organ Pipes.—I have Lieblich Flute, CC to B, 61 pipes, quite new, cost £3 10s. Offers equal value.—J. RILEY, 8, Grant-street, Accrington.

Good hand **Sewing Machine** for sale, or exchange for good Opera Glasses or offers.—CLARKE, Applegate-street, Leicester.

Splendid double **Engine Model** and copper boiler quite new; also several sets of Model Boiler Fittings.—Particulars, J. BLACKBURNE, 130, St. Stephen's-road, Bradford.

Limelight Apparatus showing 6 different coloured lights, all complete, cost £12. What offers in exchange?—SWIGG, 101, Southwark Park-road, Bermondsey.

What offers for 1 **Morse Printer,** 2 new Medical coils, 8 switches, 9 doz. photographic dry plates?—PERCY HUDDLESTON, 97, High-street, Woolwich.

3 **Electric Bells,** in case, 2 batteries, 3 pushes, and wire, also 4 number pendulum indicator.—H., 42, Charteris-road, Tollington Park, London, N.

Wanted, good ¼ or ½-plate Camera, Lens, &c., complete, in exchange 52in. BICYCLE, No. 2 Rudge, worth £4, cost £12.—TAYLOR, Tannery, Marple.

Organ, bellows, chests, odd pipes, an excellent 12 tune Organette, and about 200ft. choice Rosewood and Mahogany Veneers.—JOHNSON, 12, Moxley, Wednesbury.

Pair **Wheels,** new, suit builder's tip cart, 4 by 3 high, 2½ by ⅝ tyres, very cheap. Exchange.—10, Pitlake Bridge, Croydon.

Wanted, Zither, exchange **Batteries,** Coil, tubes, motor, &c.; also will give Saloon Rifle for Lady's Silver Albert.—RICHARDSON, West Vale, Thornhill-road, Dewsbury.

Wanted, half-horse Gas or Petroleum Engine and small Dynamo for lighting (must be cheap) in exchange for half-plate CAMERA, by Shew, Eastman's Roller Slide, and cash.—119, High-road, Kilburn.

Slide-valve horizontal **Engine and Boiler,** 1in. bore, fitted with pump, water gauge, and taps, very handsome model, value 10 guineas. Exchange Rover Bicycle.—Apply by letter, 51, Vassall-road, Brixton.

Will exchange double-cylinder **Engine,** 2in. bore, 3in. stroke, for part cash and anything useful.—H. B., 81, Midland-road, Wellingborough.

Electrical Instruments, great bargains. Bichromate battery, six 3 pint cells, carbons 7½ by 3½, pots 8 by 5, lifting arrangement, enclosed in wood box; another bichromate battery, mahogany frame, case, lifting arrangement, six cells, 3 by 2 by 1½, glass, quite perfect with lamp.

Galvanometer, high and low resistance, brass dial, brass frames, mahogany case, perfect; horse-shoe electro magnet, core ⅝th, 6in. long, 2 terminals, 2 small motors, fit for drilling purposes, one suitable for boat with reversing switch. Perfect.

Spark Coil, ½in., commutator, and perfect, 6 vacuum tubes large size, perfect; medical coil same size with ½ spark full on; another medical coil 1½ long, ¾ dia., a splendid little instrument, guaranteed, 2 sections, 40 wire, vacuum tube, rotator on round base; perfect condition. Offers for the above electrics.

4in. **Spark Coil,** unfinished, all complete, in parts, base and primary core and commutator finished, about 6lb of wire already wound. Offers. Stamp reply.—P. SMITH, 53, Charrington-street, London, N.W.

Wanted, Emery Grinding Machine. Exchange pair of well-made HEADSTOCK REST, Double Crank, and few Tools.—Address, 75, Foregate-street, Chester.

Humber **Bicycle,** 58in., in exchange for 52in. Bicy
—H. BUTLER, Somersham, Hunts.

Good Templar's Grand Lodge **Regalia,** used on
cost £2 15s. Lodge deputy's badge in laurel wreath, 10s. 6d.
parallel vice, tools.—POST, Peat Inn, Fife.

Sawbench, vertical, 11cwt. weight, for power, s
in Manchester. Want good Tricycle or offers.—THOMAS
SCREEN, Bilston-road, Wolverhampton.

Grand model brass and steel **Horizontal Engi**
fitted with reversing motion, 2in. bore cylinder, and all comp
also iron riveted Boiler, strong, all fittings, furnace, and ready
work. Will exchange to value of £5. A bargain.—W. DOWN
295, St. Philip's-road, Sheffield.

½-horse **Inverted Engine,** vertical copper bo
complete. Exchange Foot Lathe or Tools to value. Send the
A. B., care of Mr. Damant, Framlingham, Suffolk.

Table Piano, 4ft. 3in. by 19, 7½ deep, a little o
order. Exchange anything useful.—P. MUCKLE, Abbeygate
John's-green, Colchester.

Vertical **Engine and Boiler,** together or separ
cylinder 1in. by 1½in., boiler 7in. by 14in. Wanted, larger Boil
offers.—LEA, King-street, Melksham.

THE SIXPENNY SALE COLUM

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Fretwork.—Catalogue of every requisite, with
illustrations, free for 6 stamps.—HARGER BROS., Settle, Yorks.

New Illustrated Price List of **Screws, Bolts, a**
NUTS for Model Work, drawn to actual size, sent on receip
stamp.—MORRIS COHEN, 132, Kirkgate, Leeds.

Billiards or Bagatelle, or Requisites for ditto,
Billiard Work.—HENNIG BROS., High-street, London, W.C.

Woollen Cloths for men's and boys' suits, dir
from the manufacturer, thus saving intermediate profits.

Woollen Cloths.—Patterns of new season's goo
fancy coatings, trouserings, hair lines, &c., post free on applicat

Woollen Cloths.—Any length cut. Write f
patterns to CHARLES ARROW, Woollen Manufacturer, Piece Ha
Halifax.

Carbon Plates, best quality, cut and moulde
and capped; quality cannot be surpassed.—GEO. G. BLACKWELL.

Pebble Carbon.—Graphite for Leclanche cells
splendid conductor; price very low.—GEO. G. BLACKWELL.

Manganese Oxide specially prepared for Leclanche
batteries; high strength and purity, greater E.M.F., steady
action; been in use 15 years with immense satisfaction; 7, 14, and
28lb. packets. Prices on application.—GEO. G. BLACKWELL,
Chapel-street, Liverpool.

Wheel-Cutting and Dividing to 12 inches dia-
meter, in brass only.—CLEGG, Belinda-street, Hunslet, Leeds.

Planing to 12in. by 8in. Boring, Turning, Screw-
cutting, Slide-rests, &c.—CLEGG, as above.

Write for **King, Mendham, and Co.'s** (Bristol)
new ILLUSTRATED CATALOGUE, 4½d. Acknowledged
valuable to amateurs.

Clearance sale of soiled and second-hand Magic
LANTERNS, dissolving views, slides, photographic lenses.—
Lists Free. Inspection invited.—D. NOAKES
ON, Inventors, Patentees, and Makers, 9, Billingsgate
Greenwich.

Milnes's Lathes are now on view at 17,
Farringdon-street, E.C. Inspection invited.

Microscopic Mounting or **Histology** Lessons
Large selection slides. Send stamp.—COLE, 27, Chancery-lane, W.C.

Turning Woods.—Ebony, Rosewood, Lignum
Vitæ, Cocus, Botany Bay Oak. Parcels, 5s. and 10s.—
BROTHERS, Settle.

Batteries.—200 No. 2 Leclanche cells (new
merate type), complete with zincs and glass jars, very
1s. each.—ERNEST J. GILLETT, 26, Red Lion-square, W.C.

Wire.—Large quantity No. 18 double cotton-covered
for winding dynamos, motors, electro-magnets, &c., 1s.
GILLETT.

Wire.—Quantity of No. 36 and 38 silk-covered
good condition, 3s. 6d. per lb.—GILLETT.

Wire.—Quantity of No. 34 cotton covered, good,
able for winding telephones, bells, induction coils, &c., half
price, 2s. 6d. per lb.

Bells.—30 2½in. Electric Bells, in polished mahogany
plated domes, really good, 3s. each.—ERNEST J. GILLETT,
Lion-square, W.C.

Engineering and Architectural Designs
Drawings and Tracings executed with despatch
by practical draughtsman.—MYLES BROWNE,
Villas, Plum-lane, Plumstead, S.E.

Brass Name Plate, 9 by 4½, free 4s.
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Malleable Castings by our improved
Sharp, sound, and strong as steel.—DRONFIELD
Sheffield.

Astronomical Telescope.—App
made to order.—A. CLARKSON, 28, Bartlett's B
Circus, London.

Astronomical Eyepieces, any p
any telescope, 15s. each.—CLARKSON.

Astronomical Telescope, by Sir H
3in. aperture, on equatorial and divided circle
CLARKSON.

Equatorial Mounting only, to
scope, by Sir Howard Grubb, separately, £6 10s.

Astronomical Telescope, 3½
equatorial, and driving clock, and iron colum

Astronomical Driving Clock
scope, or the equatorial can be had separately

Astronomical silver-on-glass **Tele**
ings made for these, also flats, finders, rack
CLARKSON.

Astronomical Telescope, b
Simms, 3½in. aperture, on equatorial, £ 0.—C

Astronomical Telescope,
speculum, by With, and mounting by Brown

Astronomical Refracting T
second-hand by best makers.—CLARKSON,
Holborn Circus, London.

pot form), No. 1, 26°; No. 2, 45°; No. 3, 60°, the deflection on the intensity coils being, of course, about the same for all sizes.

After the wiring of a building has been completed, and the pushes, bells, and battery fixed in their places, the wire from one of the poles of the battery should be disconnected, and the detector (using the intensity coils) inserted in the circuit in order to see if there is any leakage; for although any great leakage would probably manifest itself by causing the bell to ring, yet there might be a slight continual leakage which, though it apparently does not affect the working of the apparatus, means a constant waste of battery power. Should a deflection be obtained when the detector is put into the circuit, the fault must be traced and removed, otherwise surprise may subsequently be expressed at the short life of the battery.

Faults.

The length of time that the electric bells in a building will run without a "fault" may generally be taken as a pretty good proof as to the quality of the workmanship and apparatus. If good apparatus has been employed, and the wiring done in a thoroughly substantial manner, the bells should run for a year to eighteen months without the slightest attention, and the only expense then should be a few pence for recharging the battery. But if with a view to cheapness inferior apparatus and badly-insulated wire is used, there will be a continual occurrence of faults throughout the entire building, and the bells will be nothing but an intolerable nuisance.

When a fitter is called to a fault in any building, he should touch nothing until he is pretty sure what is the cause of or in what direction the fault lies. More especially should this be attended to in regard to the wires. He should not touch the wires until he is perfectly sure that the fault is in the wiring, for if the wires are cut here and there, as may be necessary when tracing a fault, it is seldom that the bare places, when bound up, will show the same insulation that they did before. He should first gain all information as to how and when the bells ceased to ring, or whatever the fault may be. If the bell rings and the indicator does not work, he should not necessarily conclude that the fault lies with the indicator, and forthwith fiercely attack the indicator with screwdriver and pliers, only to find, after he has taken the thing to pieces, that it was all right, and that the fault was really in the battery, which was nearly exhausted. The most frequent cause of the bells not ringing is from the battery having run down. When a fitter is called to a fault, and is told that none of the bells will ring, he may generally suspect the battery of being exhausted. He should first inspect the battery, joining up the cells to the quantity coils of his detector and comparing the deflection with that obtained from a good cell, and should it be found exhausted it must be recharged, directions for which were given in article V., on the Leclanché battery. A break in the main wire close to the battery would cause a similar fault, and if the battery is found all right, this wire should be inspected. If the bell rings feebly while the battery is in good condition, a bad joint may be suspected in one of the wires. Faults occur in the pushes, and especially if the springs are not fitted with platinum contacts, and should the bell ring at one time while it does not at another, dirty contacts will generally be found in the push; but if push seems all right the fault may be in the bell—though, as a rule, the bells seldom give any trouble unless the workmanship is very bad. If the bells ring continuously, a contact between two wires may be suspected, or the push spring may have stuck. Pulls, and especially the one at the tradesmen's entrance, are very likely to cause the bell to ring continuously, as the spiral spring loses its set, and after a time does not move the disc (see Fig. 16, Article II.) back clear of the springs, thus keeping the circuit closed. Indicators will often frequently require adjustment, though the pendulum movements are better in this respect than those with a mechanical or electrical replacement.

As a parting word to electric bell fitters, and all who have anything to do with electric bells, I say, *Be thorough.* Do not leave a piece of work with the words, "Oh! that will do," as nothing is so fatal to success in electrical work as apparatus erected in a manner that will just *do.* If a fault occurs, put it right at once, and put it right thoroughly, not merely patching it up thinking to put it right at some future time. If you are screwing up the adjusting screw of a bell, remember you are working at a bell; and if you are adjusting an indicator, remember you are at work on an indicator, and not a 100H.P. Galloway engine. **F. C. A.**

GENERATING ELECTRICITY BY HEAT.

AMONGST recent inventions in thermo-electricity, we note those of Mr. E. G. Acheson, of Pittsburg, Pennsylvania, which have been lately patented in this country, the object of his device being the conversion of heat energy directly into electric energy or the "current." Many attempts have been made to produce electricity by the direct conversion of heat, as in what are known as thermo-electric piles, pyro-magnetic generators, and the like, but this invention differs from all those both in principle and construction, and in order to embody it in practical form the patentee has constructed various mechanisms, designated "calelectric generators." The invention is based primarily upon the discovery that if what is known to those skilled in the art as the "magnetic whirl" is produced in or about an electric conductor which is traversed by currents of heat, which tend to escape by radiation or otherwise from the conductor at such points as may be below the temperature of the point at which the heat is introduced, an electric current will be generated in the conductor at each establishment and disestablishment of such "magnetic whirl" cutting the conductor. The patentee has also discovered that electric currents may be produced in such a conductor in such a manner that they may be utilised as power for all purposes for which electricity is applicable. In experiments leading up to and in demonstrating and applying this discovery, he has used various means for producing these electric whirls in or about a conductor into which heat has been introduced, and through which heat was caused to pass, and, without attempting to describe all the various ways in which this can be done, we refer to the accompanying drawings, which clearly describe several simple ways serving to illustrate the principle of the discovery.

Fig. 1 represents a very simple form of apparatus, which may be operated in accordance with the new principle, and in which 1 is a bar or other electric conductor having apparently high conductivity for lines of magnetic force, while 2 is a bar or other electric conductor having comparatively low conductivity for lines of magnetic force. These two conductors are joined, as at 3, and their other extremities are closed, as by a conductor 4, which is arranged in inductive relation to an electric circuit 5, in which an intermittent, alternating, or vibrating current of electricity may be produced. Heat is applied to one of the conductors 2 by any suitable means, as a burner 6. The heat entering the conductor 2 has a tendency to flow through and radiate from conductor 1 at all points that are of a lower temperature than the point at which the heat enters. When the electric current in circuit 5 is established, disestablished, or varied, an induced current is set up in the circuit 1, 2, 4, producing under well known laws "magnetic whirls" in or about the conductors forming said circuit. In conductor 1 the magnetic whirls will be more completely retained within the conductor than in conductor 2, owing to their relatively different specific conductivity for lines of magnetic force. Under these circumstances i
that the current produced in the circ
gives a greater indication upon a
located in said circuit, as, for instan
vanometer 7, than is due to the ord
ductive current produced in the circ
heat is not applied to the conductors,
augmented current is due to the di

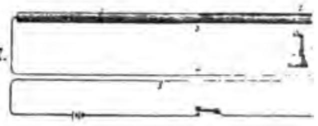

Fig.1.

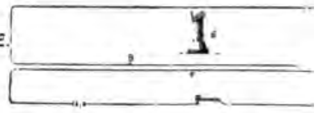

Fig.2.

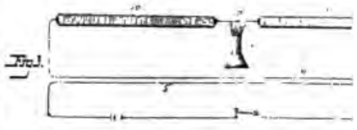

Fig.3.

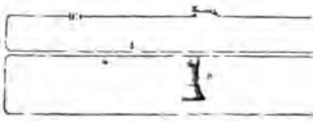

Fig.4.

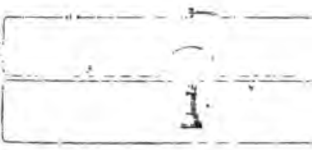

Fig.5.

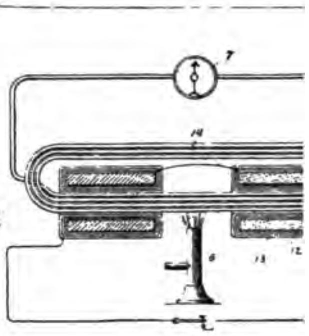

Fig.6.

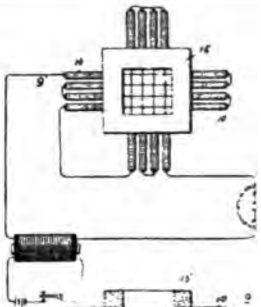

Fig.7.

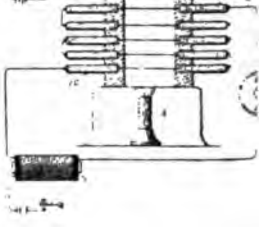

Fig.8.

version of heat energy into electric
In Figs. 2, 8 is a conductor having c
tively high conductivity for lines of m
force, which conductivity may be al
varied by the application of heat. Th
ductor is arranged in inductive relati
circuit 5, similar to that of Fig. 1. an
the application of heat to a part of th
ductor 8, the heat tends to travers
radiate from the conductor at all points
a lower temperature than the part at w
enters, and the current produced in th
ductor 8, upon varying the current i
circuit 5, as indicated upon the galvan

anslator, is found to be greater ctive action due to the ordinary nt when the heat is not employed. is a conductor of comparatively vity for lines of magnetic force, hich, as at 10, 11, are surrounded having comparatively high con- lines of magnetic force, as a spiral e for instance, and when this nged as set forth above, in con- another circuit, the same results

s shown arrangement of circuits t shown in Fig. 2, excepting that pplied to a point of the conductor ductive field so that the magnetic oduced on either side of the point heat is applied, but as in this case plied to both circuits, the patentee range the circuits as shown in hich the primary circuit 5 looped tion of the generating circuit is heat.

embody this principle in a work- , in Fig. 6 is shown an arrange- n is a cylindrical core 12, of some terial, wound with a series of con- of insulated wire, the terminals of onnected to the primary circuits, s for supplying alternating, inter- vibratory currents of electricity. s coil is passed the conductor or 4 forming the generating or con- the terminals of which are con- working circuit, and means are heating these coils as before. If tric current is closed through the 13, and magnetic whirls are pro- about the conductors 14, and if at e heat is applied to the conductors fluence of the whirls, an electric be generated in the conductors at hment and disestablishment of the g the heat lines, and a conversion energy into electric energy takes conductor. The patentee prefers two magnetic whirls around the ith the direction of the lines of osition, and by locating the source ween the whirls so that the heat rom a central point in opposite s shown in the drawing, the direc- ines of force of the whirls with re- direction of the heat will be such e or convert the heat into electric the same direction. It will be that the cores 12 are not necessary, olutions themselves will produce

and 8 is shown another means for e principles of the invention, in a stack, tube, or other device of ing and refractory material, having opening, resting upon a suitable pplied with a source of heat. Pass- the walls and crossing the opening k is a continuous conductor 9, of ly low conductivity for lines of rce, and the exterior loops of this re surrounded by a material 10 of ly high conductivity for lines of rce, similar to that shown in Fig. 3. ings the stack is shown rectangular s as extending upon the four sides t it is evident that the stack may e and the loops may extend in any ctions, and the portions within the ng the opening may be arranged in e way that may be found best for the heat passing through the stack. the illustrations thus far given is inductorium for causing the ener- nt to flow through the converting it will be understood that this cur- e produced in any known manner, nce, a direct current generator may 1 by means of suitable commutators. may be made to flow through and converting coils at intervals, and e intervals the same commutator ed to close the converting coils working circuit.

GEARING.—XVIII.

Miscellaneous Gears.

tilated gears comprise a large and eable class, their purpose being the of altered and intermittent motions

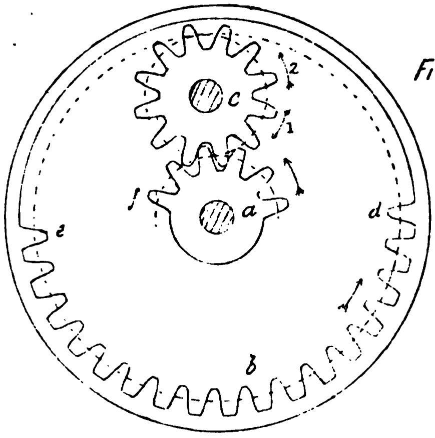

Fig. 121

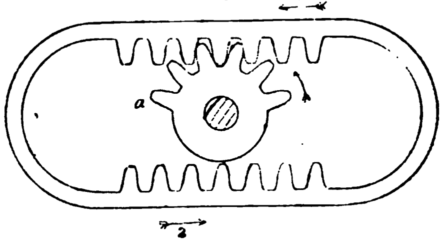

Fig. 123

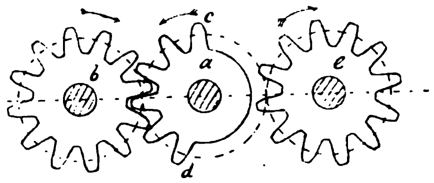

Fig. 122

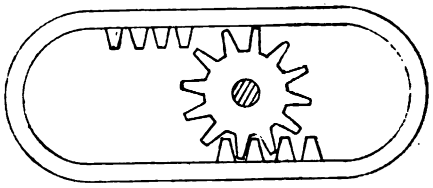

Fig. 124

Fig. 121 shows a gear adapted for producing an intermittent and quick return: *a* is a mutilated pinion, *b* a mutilated internal ring of teeth, the teeth being so arranged that they shall commence or quit contact with the teeth of the entire wheel *c*, just as the teeth on *a* quit or commence gear. *a* and *b* are fixed on the same shaft, *a* then drives *c* slowly in the direction of the arrow 1, until the tooth *d* on the internal ring comes round and enters into gear with the teeth of *c*, when the direction of the motion of *c* is immediately reversed (arrow 2), and it is driven at a quicker speed, corresponding with the difference in radii of *a* and *b*. As the last tooth *e* of wheel *b* quits contact, tooth *f* is ready to enter into gear, driving *c* slowly again.

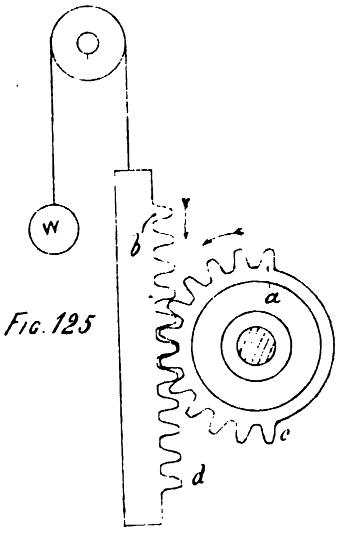

Fig. 125

Fig. 122 shows a gear for driving two shafts in the same direction but alternately. The mutilated wheel *a* is the driver, and revolving in the direction of its arrow, and, being in gear with *b*, drives that as shown by its arrow. Immediately the last tooth *c* leaves contact, tooth *d* gears with wheel *e*, and drives that in the direction shown by its arrow, in the same direction as *b*, which motion continues until *c* quits contact with wheel *e*, and *d* begins to gear with wheel *b*.

Fig. 123 shows a mutilated pinion giving alternate reciprocal motion to a frame. The pinion moving in the direction of its arrow, the frame will be driven in the direction of the arrow 1. Immediately tooth *a* commences gear with the teeth below, the frame will be driven in the direction of the arrow 2.

In Fig. 124 the operation is the reverse. In this, two mutilated racks drive an entire pinion alternately in opposite directions with an interval of rest, the lengths of the periods of revolution depending on the number of teeth in the rack lengths, and the periods of rest on the lengths of the mutilated spaces. There may also be more than one range of teeth, and more than one mutilation on each side, to give more than one alternation in speed.

Fig. 126.

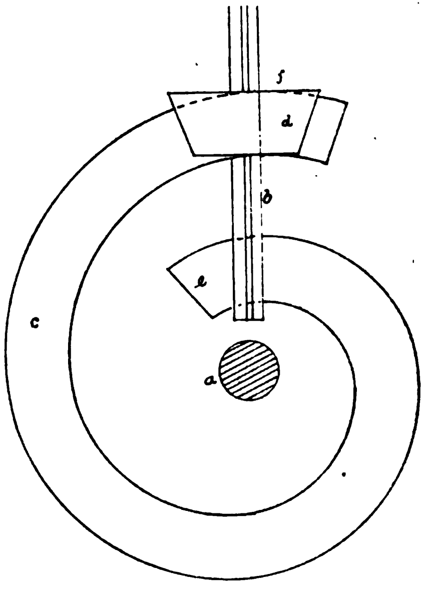

Fig. 125 shows an arrangement for depressing a rack slowly, and with power, and for lifting it again sharply. The mutilated pinion *a* drives the rack *b* in the direction of the arrow until the teeth *a* and *b* leave contact, when the weight W immediately lifts the rack to its original height in readiness to be de-

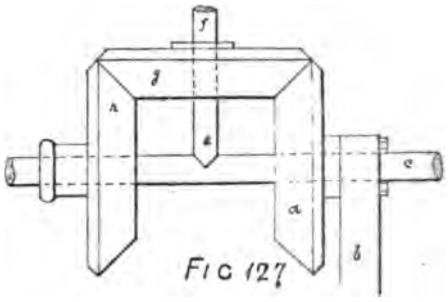

Fig. 127

pressed again as the revolution of the pinion brings teeth c and d into gear.

Fig. 126 represents a device for transmitting a gradually increasing motion from one shaft a to another b, situated at right or other angles therewith. The scroll bevel c on shaft a actuates the ordinary bevel d on shaft b. The latter is free to move on a feather on its shaft b, in order that as the wheel c drives it from its starting point e at the smallest radius of the scroll to f, the largest radius, it is forced gradually backwards, gearing the whole of the time.

Fig. 127 represents an epicyclic train of mitre wheels, designed to produce a double, or a half-speed. The wheel a is fixed to a standard b so that it cannot revolve, the shaft cd running freely through it. The offset shaft ef is an integral portion of cd; wheel g runs freely on ef, and wheel h runs on cd. If the shaft cd is rotated, evidently ef must revolve along with it, and the wheel g will be carried round cd, and, gearing with a, will of necessity revolve at the same time around ef. Hence the result will be that the speed of rotation of the shaft cd, plus that of the bevel g on ef, will be transmitted to h. In other words, h will revolve twice as fast as the shaft cd, and in the same direction. On the other hand, let h be the driver, the effect on the shaft cd will be precisely the reverse; for cd will then revolve at only one-half the speed of h. This is clear, because h will drive g around ef, and also around cd, and, the wheels being equal, half of the rotation of h will be absorbed in each revolution. The relative speeds of cd and h may be altered by substituting bevels of different ratios for the mitre wheels in the figure.

Epicyclic trains of spur-wheels may be designed, and are of interest, because the celebrated sun-and-planet motion of James Watt is one example of such trains. This is a case of the simplest kind in which two wheels only gearing together, the axis of one rotates around the fixed axis of the other. Combinations of three or more wheels may also be used, and combinations also of spur and bevel wheels.

J. H.

PROTECTION OF BUILDINGS FROM LIGHTNING.*—II.

By Prof. OLIVER J. LODGE, D.Sc., F.R.S.

(*Continued from page* 387.)

TWO important matters to be thought of in connection with the conductor are—that it shall not corrode away in places, and shall not be stolen. Another point that must not be overlooked in fixing up any length of conductor is that it is liable to expand and contract. An allowance must be left for this. When it is remembered that it is liable to be exposed to the full glare of the sun, backed up sometimes by a kitchen chimney behind, and then again at another time exposed to the coldest nights, a range of 100° Centigrade is not excessive.

I once rigged up some copper rod battery conductors of substantial thickness between two walls, and one morning after a frost found one snapped clean in half by the contraction. This would be a bad thing to happen to a lightning conductor; so either bends must be left in the rope when put up, or else special compensators must be introduced at intervals.

The allowance for copper is 1 in 500; say an inch in every 40ft. The best place for a compensator is just above a holdfast, so that it will have to support no weight. A bight or bend in a flexible rope answers every purpose; but bends should not be made too sharp, or the discharge will jump across instead of going round. That is a thing to be remembered. Flexible conductors are very convenient, but their convenience must not be abused. Always take them as straight as possible. Lightning has no time to go round circles—it will jump across sooner. Why should it not be let to jump across? Well, because it burns the conductor. That is the real objection to bad joints—the extra heat; a sort of arc produced there, and the liability to fusing and destruction of the conductor at these parts. There is, moreover, some danger from fire.

Now about the earth end. We have had examples of good earth already. Here is a cheap one advocated by Dr. Mann: wire rope opened out into a brush, and the two ends of another short bit, similarly treated, spliced across the first. Two of the fuzzed-out ends make contact with deep soil, one with the surface soil, so that one or other is pretty sure to reach moisture.

The whole conductor introduced into the Cape by Dr. Mann is simple, cheap, and admirable for cottage purposes and for emigrants. Squatters in the States, or Canada, or at the Cape, are far more liable to thunderstorms than we are in this country, and they should certainly rig up one of these homely things. A bit of iron fencing rope will do, with both ends fuzzed out, one supported by a tube fixed to the chimney, the other sunk deep into moist ground, or swamp if available.

In towns, where there are water or gas-mains anywhere near the terminus of a lightning-conductor, they should always be connected to it; and this mainly for their own protection. For if they are not connected, the lightning will not scruple to still make use of them if it chooses, and having to jump across a yard or two of bad conductor on the way, it can easily knock a hole in them or melt them, instead of getting to them quietly.

It must be understood that what I say of the mains underground does not apply to the pipes in a house. To connect lead water-pipes with a lightning-conductor might possibly lead to their being melted; but to connect the house gas-pipe with a conductor is a most dangerous proceeding. The neighbourhood of gas-pipes in a house must be scrupulously avoided. The more it is connected to the mains underground the better, but one does not want lightning rushing along compo-pipes, picking out all the bad joints, and lighting all the gas there. In so far as a house contains escaping gas, or weak gas-pipes, it must be treated like a powder magazine, and great care be taken. A ridiculously minute spark may ignite gas without being noticed, the hole in the pipe may quietly enlarge, and the house be burnt down. A considerable amount of damage has been done in this way. So soon as Swan lamps are in universal use, lightning may occasionally play havoc with their filaments and fuse a few cut-outs, but it will not find the leads easily combustible or capable of burning the house down.

Hitherto I have spoken of the orthodox system of protection, the gather-up-and-carry-away system. But, as you know, there is another system suggested by Clerk Maxwell, the birdcage or meat-safe principle. In a banker's strong room you are absolutely safe. Even if it were struck nothing could get at you. In a birdcage, or in armour, you are moderately safe. I should not care to try armour myself, the joints might get unpleasantly hot and explosive. And even the birdcage, if struck by a big enough flash, might get melted. A melted patch on one's protective armour would be extremely disagreeable. Sometimes one is told to get thoroughly wet through instead of seeking shelter in a thunderstorm; but it is a question whether a stroke is more unpleasant than rheumatic fever.

However, a sufficiently stout and closely-meshed cage or netting all over a house will undoubtedly make all inside perfectly safe. Only, if that is all the defence, you must not step outside, or touch the netting while outside, for fear of a shock. It would be unpleasant, when you reached home out of a storm, to find it so highly charged as to knock you down directly you tried to go in. An earth connection is necessary as well. A wire netting all over the house; a good earth connection to it at several points, and a plentiful supply of that barbed wire which serves so abominably well for fences, stuck all over the roof, and you have an admirable system of defence.

Now let us see how far most people agree, and where they begin to branch out and differ. The old and amusing political controversy between knobs and points has disappeared. Points to the sky are recognised as correct; only I wish to advocate more of them, any number of them, rows of them, like barbed wire—not necessarily at all prominent—along ridges and eaves. For a point has not a very great discharging capacity. It takes several points to discharge readily all the electricity set in motion by a moderately-sized Voss or Wimshurst machine; hence, if you want to neutralise a thunder cloud, 3 points are not so effective as 3,000.

No need, however, for great spikes and ugly tridents, so painful to the architect. Let the lightning come to you, do not go to meet it. Protect all your ridges and pinnacles, not only the highest, and you will be far safer than if you built yourself a factory chimney to support your conductor upon. At present the immediate neighbourhood of a factory chimney or steeple is not a safeguard, but a source of mild danger.

Next, as to the conductor. Should it be iron or should it be copper? Should it be insulated from the building, or should it be connected with all the metal it contains? These are questions at present in dispute. The lightning-rod conference approves copper, though not putting it specially and strongly before iron. Durability is its main recommendation. Under all circumstances I am not sure whether it is more durable than galvanised iron. Mr. Preece has great experience of wires in chemical and all other districts, and I believe he upholds iron. Franklin and the Americans to this day prefer iron. Certainly it is much c
not so easy to melt.

Nearly everyone condemns insulator
eminent authority, M. Calland, advocat
and circumspection in what things you c
what you do not connect. He points
stance, that if you connect up a balc
conductor, a person standing thereon m
one of its striking terminals. I must
with him. Some there are who advoca
ing *both* ends of a roof gutter, or other
closed contour, and not only one end. I
agree with this also. On this point I ha
no doubt.

As regards the shape of the conducto
rod or ribbon? Many experiments have
notably some by Mr. Preece on the d
Dr. De la Rue's battery through co
various sectional shapes, to see if exte
phery matters. Hitherto the results
negative. We may conclude, I think, t
not matter much as regards liability
flagrated. But theory clearly points
that a bundle of detached wires is
better than a solid rod of the same weig
in every respect except durability. But
is an essential feature. No shape can be
satisfactory which aids corrosion. O
obvious; plenty of surface encourages c
slightly diminishes danger of melting.

Lastly, the "earth" and its testing.
is necessary, or you will have your f
knocked about and your garden plo
A good earth is desirable. A few tons o
the conductor coiled up amongst it is a
and satisfactory plan if the soil be p
damp. A bag of salt might perhaps be
it to keep it damp throughout, or rain-
be led there. Often, however, the m
thunderstorms occur after a spell of fi
and the soil is likely to be dry. It is bes
to run the conductor pretty deep, and t
earth.

It is all very well to connect the co
water-mains if near, but if they are far
existent it is no use; and in no case, in
should they be used as sole earths. Cer
gas mains. In dry weather they are n
at all well, and a strong charge may then
and down them and light somebody el
the most surprising way. It does
happen, but it may happen in sandy soil
weather. Always there should be a
earth—a well if possible, a boring if not
conductor be led down into it. If it like
a disturbance when it has to leave the co
long way down, no one need grumble.
much harm there. There is, of course,
in water, unless it forms a large contin
An isolated puddle in a rock, such as has
before now for a lighthouse, is no earth
thoroughly good earth is really a geolog
tion; and for an important building a
specialist should be consulted.

An occasional test of an earth, in
weather, is no real security as to what m
after a long-continued drought. It woul
to arrange a plan whereby just raising
shall give sufficient information as to t
the earth, without any skilled operator.
end, two earths should be provided, q
pendent of each other (one a water-
instance, the other a ton of coke), and th
be connected, first to each other and th
conductor, by a substantial copper band.
the band connecting the two earths pa
some covered outhouse, and have a wel
ping junction of two flat areas pressed to
a spring, but capable of being raised on
other by pulling at a handle or a rope. A
meter indicator and Leclanché cell, pe
connected so as to send a current betwe
earths directly the handle is raised, will
its deflection the state of conductivity o
earths. Very likely the two earths them
suffice to give the necessary current w
auxiliary battery.

There is this to be said, however. If a
is so situated, either on high sandy gro
impervious rock, that a decent earth is
cult to get, then, at least, the house is not
make a better earth than the conductor.
weak point in the excuse so often made o
an accident to a protected building, that
was not sufficiently good. It can very
shown that the earth, apparently chosen i
ence, was any better: often it was obviou

It is a superstition to place much relia
testing of conductors with a galvano
Wheatstone bridge. A galvanometer and
stone bridge are powerless to answer many
ant questions. A Leclanché cell can no m
out what path lightning will take, than
down a hill-side will fix you the pa
avalanche. The one is turned aside b
trivial obstacle, and really chooses the line
resistance; the other crashes through all o
and practically makes its own path. A flash

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[*] Extracted from the Dr. Mann Lectures before the Society of Arts.

at one corner, rushes apparently part way e conductor, then flashes off sideways to a ter, sends forks down all the spouts, and a lot of bricks out. Another branch bangs a wall in order to run aimlessly along some es, and then out through a window-frame, n a spade or something propped up against to earth. The lightning tester comes with anometer and Leclanché cell, and reports earth of the conductor has 100 ohms re- ; and the accident is therefore accounted ut how much resistance would he have the paths which the lightning seemed to n preference to the 100 ohms? Something ike a 1,000,000, probably. Or, perhaps, a bad joint in the conductor somewhere, s being separated by one-sixteenth of an But why should it prefer to jump several and knock holes in walls and windows, han jump one-sixteenth of an inch? No; vanometer, and Wheatstone's bridge, and aw, and conductivity, are simply not in it. thing has been left out of consideration, ething very important too; and until that ing is fully taken into account, no satis- and really undeniable security can be ceed.

something is inertia—electrical inertia.

se you have a pipe or U-tube full of water, perpetual overflow to a cistern, and you to be equal to all demands. You test it, it perfectly easy to pour the water either oth ends are perfectly open; the pipe is a nductor. Then comes some one and hits nant water in your pipe a tremendous blow ammer, bursts the pipe, and scatters the ll about. This is what lightning does to htning conductor and to the electricity in s no gentle push, it is a terrific blow.

uctivity is not what you want; widening is no remedy. There is a something you here is a remedy. The remedy is elasticity ic "capacity." You must reduce the elec- ertia (or self-induction) of your conductor h as possible, and you must increase its elasticity (or capacity) wherever con-

AWINGS v. PHOTOGRAPHS.*

he present time when, to almost every icroscope a photographic camera is being d, and when photomicrographs, of every of merit, are being produced on all sides, it well to weigh the respective values of the and sunbeam as means of recording the tions of the investigator. The idea of re- ng, by photography, what is seen in the ope is so captivating that it is a matter for rprise that so many undertake the work. emarks do not apply to the photographing arations for the purpose of producing ex- pictures, but bear upon the merits of the thods as auxiliaries to the work-table. e pencil is being unwisely neglected, owing o implicit reliance on photography, is an nate present tendency—especially for the investigator, who loses the training to e observation which the conscientious use pencil brings. But both the photographic and the drawing-prism have their advan- nd the investigator can afford to dispense ither, as, by their judicious employment— nes by their combination—more satisfactory able results are obtained than are possible exclusive adherence to either.

experience in photomicrography, which s a full appreciation of its value and ty, has taught that the most serviceable isfactory field of photography lies at the s of the table of amplification—with very to 70 diam.), and with very high powers 1,500 diam.). What drawing can equal, in of detail, a really good photograph of a specimen taken with a fine low-power re; who can draw fibrillæ of striated muscle, of bacteria, or a delicately-marked diatom petition with photographs? Excellent are made under ordinary magnifications 350 diam.), but in the majority of cases much less cause for congratulation. Under rcumstances, the conscientiously and skil- ed pencil will produce a more valuable and tory record for the investigator than the The reason that *good* photographs, with w or very high powers, are so satisfactory under both conditions suitable lenses re- *all* the planes of tissue necessary for a ble representation of the object; nine n ten this will not be the case with the demanded of the ¼ or ⅛. While it is nable to expect the lens to reproduce more e plane accurately in focus, it is neverthe- that this physical limitation (reduced to a m by the thinnest possible sections) frequently renders photographs, under medium powers, unsatisfactory substitutes for more diagrammatic drawings.

At the present time, the investigator who depends upon photographs for his illustrations finds himself confronted by the pertinent question as to the manner in which his pictures shall serve as journal illustrations. That photography, in its applications to book-making, is yet in its infancy, no one doubts; that really beautiful results are already accomplished by the best methods is equally certain; if, therefore, the liberality of the publisher places one of the unexceptional "processes" at his command, the investigator may feel confident. Let him, however, be cautious as to where he places his hopes when economy is consulted, for there is nothing more annoying to the worker himself, or more unfortunate for the cause of photomicrography, than the dissemination of those monstrosities whose harsh black and white masses, devoid of half-tone and detail, are supposed to "reproduce" a really fine negative.

Frequently, however, the use of the photograph is out of the question, and the investigator, or the artist, must make the necessary substitute; by all means let it be the microscopist himself, for he will then have the guarantee that the feature of the drawing, especially valuable, is appreciated. Under such circumstances, a combination of the camera and pencil, which the writer has employed since the introduction of the Eastman "Bromide Paper," may often be found very satisfactory. Selecting the "B" grade, and marking out all undesired parts of the negative, a somewhat under-exposed print is made and developed until the cardinal parts of the picture are visible; this, when dried, yields a black and white sketch which, after being worked over with Indian ink and hard lead-pencil, presents the appearance of an elaborately finished drawing, and, as such, will be satisfactorily copied by the artist on the block or stone. Where details are very simple, the outlines of the photograph are easily transferred to the drawing-paper by means of the interposed sheet of "graphite" or "carbon" paper and the tracing point.

But, after all, for the busy worker the direct sketch on paper is frequently the most convenient and economical. It is to be regretted that the drawing-prisms in use on the Continent are not more generally used among our own microscopists. An experience embracing all the usual forms has resulted in a settling down to the Abbe apparatus as being the most satisfactory, and, due regard to the inclination of the mirror and the warranted size of the sketch being observed, as leaving little to be desired. After a long observation of struggles with the drawing-prisms usually furnished by American and English makers, it is truly refreshing to see with what ease and accuracy complicated contours are followed with this instrument even at the first attempt.

With any form of drawing attachment, the nice balance between the illumination of the microscopical image and that of the paper is an all-important condition; having had occasion recently to use the Abbe prism to sketch some 1,400 sections, a simple device of great service was found. This consisted of a light stand supporting a small glass plate (10 × 15cm.), two-thirds of which was "matt," being very finely ground, leaving the remaining third as a clear strip extending in the direction of the greatest length of the plate. The section being well lighted and focussed, and the paper adjusted for the drawing, the screen should be interposed between the source of illumination and the microscope mirror when the object becomes illuminated by a soft diffuse light, very favourable for the rapid and accurate sketching of details. Slight lateral movements of the screen by the left hand soon determine its best position. When a doubt arises as to some detail, a movement of the wrist floods the field with light, enabling an exact observation to be made, while a second change restores the mellow illumination so favourable for drawing. All this can be done without moving the eye from the tube or taking the pencil from the paper. The position of the screen between the light and mirror is more effective than when the ground glass is mounted as part of the substage apparatus. Those who have never used this simple contrivance in drawing will find it a material aid in many cases. Its frequent usefulness on other occasions, as a light-moderator for low power examinations, will insure it a permanent place on the work-table.

A NEW DEVELOPER—HYDROXYLAMINE AND PYRO.*

WITHIN the past few months considerable attention has been directed in photographic circles to hydroxylamine, a new chemical, and claimant for a position in the ranks of the developing agents. Attention was first called to it by Prof. Eder, in *Dingler's Journal* for 1887, p. 225, who recommends the following method for its use:—(A) Hydroxylamine chloride 1 part, dissolved in alcohol 15 parts. (B) Caustic soda 1 part, dissolved in water 8 parts. For use, mix 3 to 5 parts of A and 5 parts of B with 60 parts of water. This formula, however, when tested by other observers has been found to be very unsatisfactory, the powerful action of the caustic soda causing blistering and reticulation of the gelatine film of the photographic plate; while, if a weaker alkaline combination is used, such as the carbonate, no image can be evolved.

In the January number of *The American Journal of Photography*, Mr. J. G. Cassebaum, a member of this Society, called attention to the value of hydroxylamine in combination with pyro. as a developer, not only for negative plates, but also for transparencies and lantern slides, claiming that it produced a wonderful clearness in the shadows and brilliancy in the higher lights, and gave a beautiful bluish-black tone, rich in gradations, and soft and pleasing to the eye. The addition of hydroxylamine to the developer also acted as a preservative, keeping the pyro. solution clear and active for a long time. Mr. Cassebaum's results have been corroborated by Mr. H. G. Stebbins, of New York, in a paper published in Anthony's *Photographic Bulletin*, p. 141, 1888. While I, therefore, cannot claim anything particularly new for the subject I propose to discuss this evening, I desire, briefly, to show what can be done with this new agent, and to offer a few suggestions for its proper use. Before going into further details, however, let us look for a moment at the chemistry of hydroxylamine.

Hydroxylamine, represented by the formula OH, NH_2, is a combination of hydroxyl (OH) the radical of water, and the univalent radical amidogen (NH_2). It was discovered by Lossing in 1865. It is a very volatile and easily decomposible base, and can be obtained only in solution. It is formed when ethyl nitrite is acted upon by tin and hydrochloric acid, or by the action of hydrochloric acid on tin and ammonium nitrate; also by the action of sodium bisulphite and nitrite of sodium with solution of potassium chloride. Hydroxylamine is really an ammonia in which hydroxyl (OH) has been substituted for one atom of hydrogen.

$$N\begin{cases}H\\H\\H\end{cases}\qquad\qquad N\begin{cases}OH\\H\\H\end{cases}$$

It forms definite salts with the acids, and its combination with hydrochloric acid, hydroxylamine chloride, is the salt which has been used in recent experimentation.

Hydroxylamine chloride is found in commerce in the form of beautiful, colourless, transparent tables, very much resembling nitrate of silver crystals, only possessing rather a more waxy appearance. It is quite soluble in water, moderately so in alcohol, and although more stable than its base, is still gradually decomposed by the action of light and air, and hence should be kept in a closely-stoppered bottle and excluded from the light. Its photographic value resides in its avidity for oxygen, it breaking up again into water (OH_2) and hydrochloric acid. It is a great reducing agent, and hence is especially valuable for photographic work. There are several makes of hydroxylamine chloride at present in the market, some of which are much discoloured and impure. I am indebted to Mr. F. H. Rosengarten, of Rosengarten and Son, for that which I have used in my experiments, and have found it to be very pure, and of excellent quality.

When combined with pyrogallol, hydroxylamine chloride exerts a double action: first, by its absorptive capacity for oxygen it serves to partially protect the pyrogallol from decomposition; and, secondly, when mixed with the alkalies or their carbonates in the process of development, a certain quantity of chlorine is liberated, which combines with a certain proportion of the alkali to form an alkaline chloride, which salt exerts the same retarding influence on the development as do the alkaline bromide salts. It is even probable that its action may be better than that of the bromides for preserving detail and keeping the shadows clear, as the quantity of the salt formed is quite small; its action takes place gradually and progressively, and the chloride formed is in a nascent condition when its modifying influence is exerted.

During the past two months I have made a quite extensive use of this combination of pyrogallol and hydroxylamine chloride, not only as a developer for negatives, but also for developing transparencies and lantern slides, and I can fully corroborate the excellent results which have been obtained by the gentlemen previously mentioned. As an "all-round" developer it excels anything I have ever used, and is equally good for negatives or positives. It works with sufficient slowness to admit of the finest detail being obtained, and gives the most beautiful, clear shadows, and brilliant high-lights. It seems almost impossible to fog a plate in development when this mixture is used, and I have carried on development for a half-hour, and until the back of the plate was almost as dark as the

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Dr. GEORGE PIERSOL, in the *American Monthly* *pical Journal*

* By Dr. CH. L. MITCHELL. A Paper read before the Philadelphia Photographic Society.

front, and yet, after washing and fixing, the negative or positive would be very dense, of course, but still very clear and brilliant.

The formula I have used is a slight modification of that recommended by Mr. Cassebaum, and is as follows:—

No. 1.	Hydroxylamine chlorine ...	30	grains
	Pyrogallol........................	240	„
	Water..............................	1	pint
No. 2.	Sodium carbonate, crystals	1½	troy ounces
	Sodium sulphite	4½	„ „
	Water..............................	1	pint

To develop, take of No. 1 from one to two fluid ounces, No. 2, one-half fluid ounce, water four fluid ounces, flow over the plate, and if the image does not appear within 30 to 40 seconds, add more of No. 2 solution, in small portions at a time, until development commences. This is only offered as a general outline of the method of development, for each plate must form a study by itself, according to character of subject, time of exposure, &c., and the above proportions varied accordingly. No ironclad system can be laid down for this.

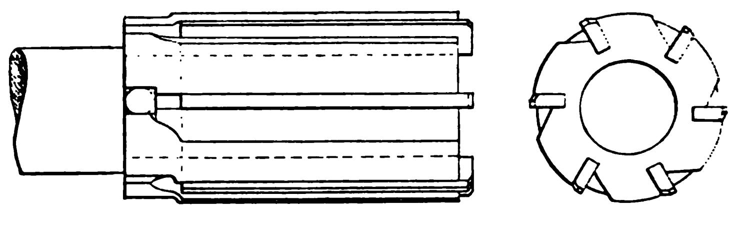
The use of the sodium sulphite in this formula seems to be mainly in preventing the discoloration of the liquid during development. It may also act as a slight retarder of the chemical action, but such action is very slight. It does, however, materially affect the colour of the liquid, for when a solution of the sodium carbonate alone is added to the pyro. mixture, the liquid darkens very rapidly, much more so than when the sulphite is also used. With the latter mixture I have developed a dozen lantern slides, using the same developer for all, and after the last plate was finished the developer was but of a moderately light orange colour. The mixture of the pyro. and hydroxylamine chloride seems to possess remarkable keeping qualities. This bottle which I now show you contains a mixture made up two months ago, and, as you see, it is not as yet very dark, although it has been exposed to a strong light, and is, as I found out by testing it to-day, fully as active as when it was first made up. I am inclined to think, although as yet I have not had the opportunity of practically testing it, that the mixture will keep still better if the sodium sulphate is mixed with the pyro. and hydroxylamine salt, instead of being added to the sodium carbonate. I shall try this combination shortly, and report its results to the Society at some future time. A point here which I wish to make in regard to keeping not only this but all other pyro. mixtures, is the use of amber glass bottles and rubber corks, instead of the ordinary white flint bottle with a wooden cork. The amber glass prevents the actinic rays of light from penetrating to the contents of the bottle, and the rubber stopper is much superior to the woody cork, which soon blackens, rots, and contaminates the liquid which it confines.

A few months ago I had the pleasure of calling the attention of the members of this Society to a method of silver printing on plain paper, by which very beautiful results could be obtained. To attain the best results, a negative is needed which possesses considerable "snap," as it is technically termed, and this pyro. and hydroxylamine developer produces the best negative for making the prints of any developer that I have yet used. The contrasts of light and shade are beautifully brought out, and while perfectly clear are still soft and pleasing.

SOMETHING ABOUT REAMERS.*

THE article (on p. 346) on the subject of "Reamers," by Mr. Richards, has certainly introduced a subject we have not a very extended knowledge of, but one thing I think we are all agreed on is, that it is a practical impossibility to maintain sizes of holes within a small fraction, in ordinary cast iron, with a solid or unadjustable reamer; at least, we have found it so. I have, in consequence, been forced to try and find some way to keep our sizes more nearly uniform than we were able to with solid reamers, and the only perfectly satisfactory way I have so far found for producing a 1in. hole 1¼in. deep in a light piece of cast iron is to bore and ream the hole about ·002in. under size, then place on mandrel and finish outside, roughing off the ends; then to grind the hole with a small emery wheel in our Brown and Sharpe Universal Grinder to a solid gauge, and then to square off the ends to length in the lathe; this is our most exacting job, however.

We have a number of pieces requiring a 1⅛in. hole about 3in. deep, going through the piece, and after a very limited use of our solid reamer we were unable to use it longer because of its excessive wear. To get the last of the holes to the size of the first ones near enough for this work we resorted to the expedient of shimming up with a stick and pieces of tissue paper, and so managed to get out some 25 or 30 pieces. This is a very short life for a solid reamer, but we did not allow ·001in. variation in size. We then purchased some adjustable reamers covering the sizes most used—viz., 1⅛in., 1in., ¾in., but we were unable to do anything with them; the holes they made would vary two or three thousandths, the amount of variation depending on the amount of stock to be removed; and because of the spring of their cutters, you must of necessity take a heavy cut, or none. In the mean time, our smaller sizes had been wearing so that we could not get our work together, and I got out of all further patience with the solid reamers. And so we made some spring reamers for sizes under ¾in.; they are the same in general design as used in some sewing-machine work, and for our use (that is, keeping sizes to gauge) they so far give good satisfaction. For our 1⅛in. holes we now have a reamer made on the plan of one shown me at the works of Brown and Sharpe, which is to all intents and purposes a solid reamer, with an adjustment for wear, and seems to us the best of anything we have found for its particular use.



For holes of 2in., 2¼in., and 2½in., I, the other day, made some cast-iron shell reamers with inserted cutters, which work very well, and are practically solid reamers, with the means of retaining size and edge. The 2in. size is shown in sketch herewith, and may be described thus: The body of cast iron is 3½in. long, and bored with a 1in. hole for the shank (which fits all three sizes); it is in diameter $\frac{1}{32}$in. smaller than the size of hole it is intended to make. It is then grooved with a ⅛in. slotting saw for six cutters, the grooves being so placed as to bring the cutting faces of the cutters radial. These grooves are milled on a taper of ¾in. to the foot, the deepest at the entering end of reamer. The cutters are of ¼in. by ⅛in. bar steel, worked off on the emery wheel to a thickness that will go in the grooves, then cut to lengths, planed to taper required, and hardened as hard as we could make them; if they spring in hardening only a little, no matter. We then lapped the inner edges up straight, and after liberally easing the sharp corners left by lapping, drove the cutters solidly into place, leaving the entering ends projecting as shown. Then mounting the complete shell reamer on our milling cutter grinder, we ground it to size, as you would any long mill. When it gets dull or loses size, by forcing each cutter slightly further in and regrinding, you have a new reamer again.

The holes this tool makes do not look like a gun barrel, but they are as good as are commonly made. In grinding one of these reamers you may have the unexpected happen, and very unexpectedly, too. All at once the wheel will apparently jump into the cutter, and the temper is drawn, both in the cutter and yourself; the cutter will be found to have pulled out of the shell. When you get the cutter out to reharden, the nice, straight-lapped back will be found quite rounding. I resolved to straighten it when rehardening, got it heated, looked for bend, it was all straight again of itself. Just why these bends stay and leave as they do, or, in fact, why they come as they do, I cannot as y satisfactorily explain; but this is our experience.

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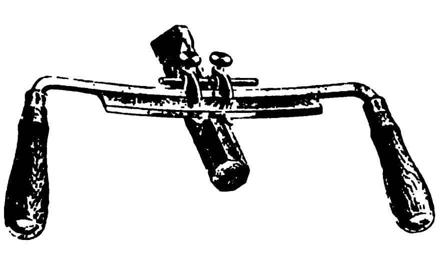
* By C. S. Beach, in *American Machinist*.

PERKINS' DRAW-KNIFE CHAMFER GAUGE.

THIS tool, which is made by H. H. Perkins, Kewanee, Illinois, prevents the knife from drawing into the work and spoiling it. It can be set to any width of chamfer in a moment, and makes every chamfer alike, a point which all carpenters and wood-workers will appreciate at once. With this tool there is no need of gauges, and hence there will be no gauge-marks on the work to be planed out.



The manufacturer of this tool claims that with a little practice a corner of any size can perfection and five times as fast as the It is made in two sizes and styles.

NEW AUTOMATIC FIRE-AL

A NEW automatic fire-alarm, based expansion of air, is being introduc "Patented Appliances Company," and in the adjoining cut (Fig. 1). It consists

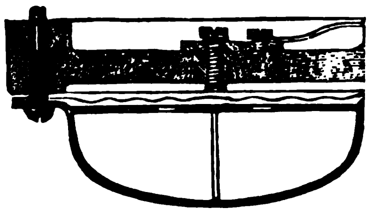


Fig. 1.

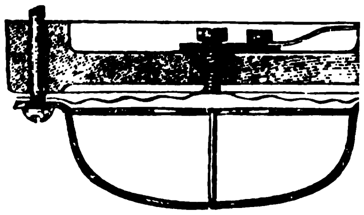


Fig. 2.

chamber hermetically closed by a corruga plate, similar to that used for an aneroid b When the temperature rises to a certain expansion of the contained air brings th plate in contact with screw, as shown This closes an electric circuit, which ri and operates an indicator in the usual *The Electrician*.

A Trick with Figures.—The follow metical trick, from *La Nature*, althoug may be revived for the benefit of tho unacquainted with it. It never fails t those who do not understand it. Tell select any even number of figures, an letting you see them, to write them dow place under them the same figures in re Thus, for example:—

943518
815349

This done, ask him to add the two num give you the sum, less any figure wh choose to reject, and the space occupie must be left blank or shown by a hy example, 17588-7. Putting on an inspi now assert that the figure omitted is prefer, you can let the person subtract from the other, and then tell him t figure with the same ease. The trick and the explanation of it can be under boy who has studied arithmetic. Th number and the same number reversed i of 11, and their difference is a multiple in multiples of 11, the sum of the eve equal to that of the odd ones. Applyi to our example, 17588-7, and repre unknown figure by x, we have $x + 8 +$ $+ 5 + 8 = 21$. A simple mental gives $x = 6$. Where the number of fi product is an even one, the sum of the first three will equal the sum of the last three, and so on. Proceeding with ence, which is a multiple of 9, the figures must itself be a multiple of 9. example, 1-8169, and adding the figures, 25, but as this is not a multiple of 9, add 2 to obtain the multiple, and th figure rejected.

A MARITIME canal across Italy is bei to connect the Adriatic with the Med shores. The canal would start from F Adriatic, and would greatly benefit between the eastern and western coasts.

X [illegible]

SCIENTIFIC NEWS.

appears that the small planet announced as a discovery by M. Borrelly on May 13 is tical with Sirona (No. 116), discovered by f. C. H. F. Peters in 1871. Dr. Palisa's st planetoid will therefore be No. 278 r all.

he annual meeting of the Marine Biological ciation was held last week, Prof. Flower g in the chair. The report of the Council d that the laboratory at Plymouth (opened Saturday) is practically complete, with s stocked, a good library, and Messrs. Cun- ham and Weldon already doing useful —the one investigating the life-history of food fishes, the other studying the crus- a of Plymouth Sound. It is hoped that n the importance of the laboratory is re- ised the income of the association will be iderably increased, and, in particular, sub- tions are desired to purchase a small steam el. Dr. John Evans proposed, and Mr. F. p seconded, a vote of thanks to Prof. Ray- kester, for his assiduous labours in con- ion with the association. The Marine ogical Laboratory at Plymouth was form- opened on Saturday last. It has been ted at a cost of £12,000. The Government a subsidy of £500, and the total annual me of the establishment is about £900.

e Geologists' Association propose an in- sting excursion for the month of August, ng about a week. The starting point will loucester, whence the party will visit the st of Dean coal-fields, the Rhætic beds at tbury-on-Severn, and the Silurian rocks of Hill. The Valley of the Wye between ond's Yat and Chepstow will be explored, then starting from Cardiff, the coal-field South Wales will be examined, with the tic beds at Penarth, and the Silurian rict round Usk. Altogether, an instructive enjoyable trip.

e plague of caterpillars on the oak-trees not seem to be confined to this country, gh the larvæ are rather capricious in their ks. Dr. Emil Deckert says that the fine in the Thiergarten of Berlin have been st completely stripped of their leaves, e, strange to say, those of the Zoological len close by have been left comparatively uched.

rious statements are made about the ograph in the daily papers, not the least ous being the delusion that it is a piece lectrical apparatus. It is stated "on ority" that several instruments will reach country in a few weeks, and that they will laced at the disposal of the Press first, and be handed over to the scientific and ed societies. It is not easy to understand the phonograph can be a commercially essful or even useful apparatus, for written munications must be of more value than a ogram in wax, which requires a special ratus to reproduce the communication ssed on its surface.

ith reference to the Dr. Mann Lectures on Protection of Buildings from Lightning," ered by Prof. Oliver J. Lodge before the ety of Arts, many of our readers will be to learn that the lectures will shortly be ished (with additional matter) in book , by Messrs. Whittaker and Co., of White -street, Paternoster-square, E.C. The work be published with the approval of the ety of Arts.

onversazione of the Royal Geographical ty was held last week, when photographs ictures illustrating the people and scenery ferent parts of the world, portraits of all ast presidents of the society, and curiosi- weapons, and ornaments of various savage were on exhibition during the evening. I. O. Forbes, the New Guinea explorer, ited by the aid of the limelight a number ews taken by himself in New Guinea. Mr. Mackinder, of Oxford, exhibited a series out 60 types of scenery, with maps and ams, and Mr. Freshfield showed a series of of the Caucasus taken by himself last mn.

. A. W. Stokes, the public analyst for Pad- on, Bethnal-green, St. Luke's, &c., calls attention to the fact that several samples of the so-called "imitation Indian muslin" which have been submitted to him were found to be highly charged (for such articles) with arsenic. Mr. Stokes says "that the presence of this poison is injurious, even when apparently well fixed in the fabric, is shown by the fact that one sample was brought to me because some six or eight work-girls at a milliner's were all taken ill with the well-marked symptoms of arsenical poisoning. These workers are especially liable to suffer, as the work must be brought close to their mouths in warm rooms, where occasionally hot irons are used to press the material. Even when sent home to the purchaser there is great danger from such material used as dress or curtains. The Legislature should prohibit, as is done in some foreign countries, the use of poisonous colours. Meanwhile, the drapers should demand a warranty from the manufacturer that colours such as those produced from arsenic are not sold to them. The general public rarely care to go to the trouble and expense of an analysis until some mischief comes home to the individual."

Mr. W. Noel Hartley, F.C.S., has communicated to the Chemical Society an interesting note on the synthesis of salicylic acid. Specimens prepared by Kolbe's process and from oil of winter-green were carefully recrystallised and examined by means of the spectrum. They were found to give identical series of photographs, and the same curve. It may therefore be presumed that they possess similar properties, and that they would give the same results.

Naphthaline, the source of so much trouble to gas companies, has already been extensively used for many purposes; but it seems now that it is a valuable drug in treating cases of dysentery. It has been employed for some time in treating the summer diarrhœa of children, and other intestinal disorders depending for their causation probably on the presence of microbes; but according to a Russian doctor, he has found injections of the drug very useful in cases of dysentery amongst adults.

For many years it has been stated that an electric current would be found useful in "ageing" whisky and maturing wine, and the fact has been established by trial. An Italian savant, Signor Mengarini, has published the results of his experiments in the maturing of various samples of Italian wines by passing a current equal to about four ampères through them. Probably the passage of the current destroys the Mycoderma aceti, for although some acetic acid was found, a bouquet was imparted to the wine, and rapid maturation was brought about.

The famous series of water-colour drawings of shells known to conchologists as "Gibsone's conches" will probably be purchased and presented to some suitable institution in Newcastle-on-Tyne, as the Mayor and Archdeacon Martin have taken the matter in hand. Mr. G. Gibsone was an architect who erected and managed the first iron furnaces on the Tyne—those at Lemington—and he devoted his leisure to the study of shells. The drawings are on nearly 2,000 separate sheets, and contain considerably over 7,000 delineations of 3,025 varieties of the *Testaceæ*.

What can be done by the gentle pressure of a little competition is just now being shown in the railway world. The Continental service of the L.C. and D.R. is now being done at a saving of twenty minutes, owing to the opening of a new bridge at Boulogne, which reduces the distance between Calais and Paris. The Flying Scotchman commenced this week to run between London and Edinburgh in eight and a half hours, and on the first day ran well within time. The booked speed is about 49·6 miles per hour for the whole journey, the fastest bit on the East Coast route being from York to Newcastle, 83½ miles in 97 minutes. A little more competition between the lines running south of London would be to the advantage of the public, and probably also to the ultimate advantage of the companies which show the most enterprise.

Sugar refiners are, it seems, in the habit of using ultramarine to destroy the faint yellow tinge in the crystallised product, a fact brought out by M. Barnouvin, by his endeavours to discover the reason why syrup of ether, after standing for a long time, deposits an intensely blue precipitate.

It may interest some of our readers to know that we illustrated the Watkins range-finder in No. 651, so long ago as Sept. 14, 1877. The Government officials have only recently discovered its merits.

Saccharin is now recognised in France, and the Council of Hygiene and Salubrity are considering what is to be done, as the new sweetener is being extensively used, the increasing demand lowering its price on account of the large scale of manufacture.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, *332, Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

*** *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

> "I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

◆◆◆

JUPITER.

[28938.]—REFERRING to the letter of Fred. Wm. Nash in the "E. M." of June 1st, I may mention that with my 3in. achromatic in May last I saw Jupiter in the same field with β Scorpionis, and very near it; and on the next night in the same field, but further off from the star.

It will be interesting to watch Jupiter, after retrogression, on its return to the star, which will happen about 10 Sept., according to *Whitaker*, page 47. The proximity could be found more closely in the *Nautical Almanac.* Mars will also be then in the same neighbourhood.

Charles North.

Rougham, Norfolk, June 30.

ON THE DIAMETER OF THE FIXED STARS.

[28939.]—I WISH to thank "A Fellow of the Royal Astronomical Society," who answered my query respecting the above. As there appears to be no method known of obtaining the diameter of the fixed stars, the way is open for my suggestion, which I submit for the opinion of practical astronomers. I think I am right in theory, but the difficulties in the way of its accomplishment may be too great. The rays of light which come to us from the fixed stars must be regarded as parallel. The stars have no apparent diameter in consequence of their remoteness, therefore angular measurement is not possible. We can imagine the existence in space surrounding every star, countless bundles or cylinders of parallel rays of light. Our aim in attempting to measure the diameter of a star must be to find the thickness of one of these bundles or cylinders, which found will obviously correspond with the diameter of the star. The way I would suggest to do this is to utilise the motion of the earth in its orbit round the sun. A long tube or telescope must be pointed in the direction of the star whose diameter we want to measure, and must be kept parallel by suitable mechanism with its first position. I suppose it would have to be kept in this position for some weeks or months according to the size of the star, which will very likely be something within the diameter of the earth's orbit, judging from the size of our own sun. If this can be absolutely accurately accomplished, then when the earth arrives at one certain point in its orbit the star will leave the field of vision. The point in the earth's orbit where observation commenced, and the direction in relation to some fixed line from earth to sun must be noted, also the point where the star leaves the field of vision. Then the distance between the parallel lines from the star passing through these two points will be the diameter of the star. **Capella.**

THE FATAL THIRTEEN.

[28940.]—IN the '50's, or somewhere between 40 and 30 years ago, there dined together, on *four consecutive* Christmas Days, thirteen persons, consisting of the following individuals:—Grandmother (an octogenarian), father, mother, their six children, and four orphan cousins (one consumptive). Of these there are *now living* ten out of the thirteen—viz., the mother (now an octogenarian), the six children, of whom I myself at 56 am one, and three of the cousins—the deceased being the grandmother, the consumptive cousin, and the father at the ripe age of 77.

So much for the ridiculous superstition about a fatal thirteen. **F. G. L.**

GENESIS AND ITS MEANING.

[28941.]—"SATINE" (letter 28871) is wrong in assuming that I intended to express myself as a believer in original sin. I meant only to define the term to the best of my knowledge, according to the doctrine of the Church. Perhaps I should have been a little more correct had I called it by another and equally familiar name—the Fall of Man. However, the two doctrines are, if not exactly the same, intimately associated.

And now for a few words in reply to "E. L. G.'s" remarkable letter (No. 28914). The writer asks whether many Englishmen have a chance of reading the Bible in a common-sense way? I should say most certainly they have, just as any person fairly educated can read a history of other (not necessarily sacred) supernatural events, provided it, like the Bible, is printed in English. I am not now touching on those difficult questions, the Divinity of the Bible and the accuracy of our English translation. If "no scholar will honestly" allow me to "assume that Genesis is quite 'fairly translated,'" then the best thing for me, and thousands like me (who have read the Bible carefully, but have no knowledge of Hebrew), is to put the book aside as untrustworthy, at least in many important parts. Still, your correspondent must admit that men acquainted with Hebrew, conscientious men, and men of no little learning, were employed on the translation of the early portion of the Bible. Why, then, am I to suppose those men wrong in the meanings they gave to words and sentences, and "E. L. G." (or his authorities) right?

More than one of your correspondents blame me for introducing religious doctrines in my letter, regarding the meaning—whether singular or plural—of the name "Adam." However, as "E. L. G."—who, I venture to think, lives in a glass house—now "drags" into the discussion some remarks respecting the seventh day as a day of rest, but which he seems to consider is not yet over, I think I may be allowed to say this much:—The idea of God's ever resting—the word "rest" implying, as it surely does, a state of inactivity, if not of actual weariness—appears to me quite as incompatible with our human conceptions of the Deity as the Ruler of the universe, as does the Mosaic account of man's fall and the curse which followed it with our conception of God's perfect justice.

In conclusion, permit me to state that, although I cannot agree with a large number of thinking men, many of whom, no doubt, have given more attention to the Bible narrative than I have, as to the correct interpretation of much of the book of Genesis, I am no scoffer at the opinions of those who differ with me when I believe their opinions to be honest and sincere.

Charing. **J. B. C.**

A PROTEST.

[28942.]—IS there any reason why Churchmen who do believe the supernatural truths which they profess to believe are not allowed to enjoy your news of mechanical art and physical science without being annoyed week after week with sneers at their religious convictions?

I venture respectfully to submit that the provinces of natural and supernatural knowledge are at present wholly distinct, and that your columns should not be made a medium for shallow attempts to discuss the bearings of shallow science and shallow theology upon one another, still less for little onslaughts on revealed religion.

B. Compton
(late Vicar of All Saints', Margaret-street).
10, Mansfield-street, W.

A STARTLER.

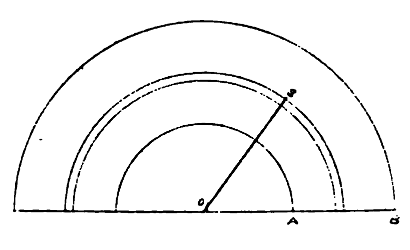
[28943.—A SCIENTIFIC paper, June 8, printed some remarks that may perhaps interest and startle the unmathematical readers of the "E. M." The question was asked, "How much further does the outer handle of one of the carriages of an 'inner circle' train travel in one journey than the inner handle, the circumference of the circle being 18½ miles, and the handles being 9ft. apart?"—and the reply given was, "A little reflection shows that the circumference of the circles has nothing to do with the problem (unless they are several thousand miles in diameter); the difference will always be the circumference of a circle whose radius is 9ft."

If the earth were a plane there would be no occasion for the qualifying clause in parentheses. For the difference between the circumferences of any two circles is invariably equal to the circumference of a third circle whose radius equals the difference between their radii. Owing, however, to the globular form of the earth, the difference between the radii of the two concentric circles would not equal the distance between the handles, if the circles were very large. As an example of circles we may take any two circles (or "parallels") of latitude. Near the poles, where they are very small, their distance apart is very nearly equal to the difference between their radii. But suppose it were possible for a train to travel round the world exactly on the Equator, the two handles would then travel exactly the same distance. **F. S. S.**

PROBLEM IN MAXIMA AND MINIMA.

[28944.]—IN answer to "M.I.C.E., Bath," I send my solution of the problem he proposed in letter 28876.

The figure is a half-plan of the Circus, O B and O A being R and r respectively. The concentric circles passing s inclose a circular element of area.



Take Os = x, so that the breadth of this element is $\triangle x$. Thus the area of the whole circular element = $2\pi x \triangle x$. Now the intensity of light varies inversely as the square of the distance, and directly as the sine of the angle of incidence.

Thus $\frac{C}{h^2 + x^2} \cdot \frac{h}{\sqrt{(x^2 + h^2)}}$ represents the quantity of light falling on each superficial unit in the ring element. The constant C connects the intensity with the actual quantity of light falling upon a unit of area; but with the value of C, however, we are not at present concerned.

Hence the measure of light falling upon the ring element is $2\pi C h \frac{x \triangle x}{(h^2 + x^2)^{\frac{3}{2}}}$

Integrating this last to include whole surface of road, we have

$$2\pi C h \int_r^R \frac{x\,dx}{(h^2 + x^2)^{\frac{3}{2}}} = 2\pi C h \left\{ \frac{1}{\sqrt{(h^2 + r^2)}} - \frac{1}{\sqrt{(h^2 + R^2)}} \right\}$$

The indefinite integral is $-(h^2 + x^2)^{-\frac{1}{2}}$.

The quantity h, which has hitherto been considered constant, now becomes a variable, and we require to know what value of h makes the above integral a maximum. That value of h by the principles of the differential calculus is to be found from the equation

$$\frac{d}{dh}\left\{ \frac{h}{\sqrt{(h^2 + r^2)}} - \frac{h}{\sqrt{(h^2 + R^2)}} \right\} = 0.$$

$$\frac{1}{(h^2 + r^2)^{\frac{1}{2}}} - \frac{h^2}{(h^2 + r^2)^{\frac{3}{2}}} = \frac{1}{(h^2 + R^2)^{\frac{1}{2}}} - \frac{h^2}{(h^2 + R^2)^{\frac{3}{2}}}$$

$$\frac{r^2}{(h^2 + r^2)^{\frac{3}{2}}} = \frac{R^2}{(h^2 + R^2)^{\frac{3}{2}}}$$

$$r^4 (h^2 + R^2)^3 = R^4 (h^2 + r^2)^3$$

Take cube root—

$$r^{\frac{4}{3}} h^2 + r^{\frac{4}{3}} R^2 = R^{\frac{4}{3}} h^2 + R^{\frac{4}{3}} r^2$$

Whence

$$h^2 = \frac{R^2 r^{\frac{4}{3}} - R^{\frac{4}{3}} r^2}{R^{\frac{4}{3}} - r^{\frac{4}{3}}} = \frac{(Rr)^{\frac{4}{3}} (R^{\frac{2}{3}} - r^{\frac{2}{3}})}{R^{\frac{4}{3}} - r^{\frac{4}{3}}}$$

$$= \frac{(Rr)^{\frac{4}{3}}}{R^{\frac{2}{3}} + r^{\frac{2}{3}}}$$

Thus the required height is

$$\frac{(Rr)^{\frac{2}{3}}}{\sqrt{(R^{\frac{2}{3}} + r^{\frac{2}{3}})}}$$

Portsmouth. **A. M.**

[28945.]—AS "M.I.C.E.," letter 28876, has asked for an opinion as to his result, I offer as follows:—Let M P be the height of the pole upon which the light is suspended. P R and P r the lines drawn from P to the sides of the road, as in his figure. Then the quantity of light received by the road varies as the angle R P r, and is a maximum when this is so. The instruction, therefore, is: Describe a circle passing through R and r, and t pole. The point of contact will be th required.

This he will easily see without the calculus, by means of the propositio angles in the same segment of a circl For, by help of this, it is evident that from any other point in the pole wi less angle than do those drawn from t contact.

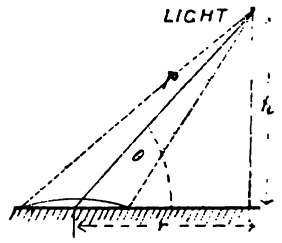
Also, since M P touches the circle, cuts it, the square of M P is equal to tl M R Mr. (Euclid III. 36, which give of M P.)

There is certainly a fallacy in the that $\sqrt{-4} = 2$ (letter 28878), as the pects. These quantities are undoubte them, fourth roots of 16, and the reaso letter implies that because they are so therefore be equal. $+a$ and $-a$ are b roots of a^2; but they are not therefore

I hope presently to have a few wor subject to which "M.I.C.E." invites a page 376.

[28946.]—REFERRING to the "Maxima and Minima" (28876, p. 37 that your correspondent "M.I.C.E." call A somewhat similar case occurs in W "Diff. Calculus."

If θ be the angle which one of t



light makes with the centre of the roa the degree of illumination will vary

sin. θ and inversely as p^2; but sin. θ

$= h^2 + r^2$, ∴ sin. $\theta = \frac{h}{\sqrt{h^2 + r^2}}$, ∴

must be a max., or taking the log., tl log. $h - \frac{3}{2}$ log. $(h^2 + r^2)$ must be a

$u =$ log. $h - \frac{3}{2}$ log. $(h^2 + r^2)$, the

$- \frac{3h}{r^2 + h^2} = \frac{r^2 - 2h^2}{h(r^2 + h^2)}$, wh. $= \theta$, wh

and as $\frac{du}{dh}$ passes through $+ o -$ the v function is then a max., which is what How would this do? **Stud. I**

Aberdour, Fife, June 25th.

MATHEMATICAL PUZZLES A PYRAMIDS.

[28947.]—OUT of the six expressions gives, on p. 371 as being equivalent, o three are so. $\sqrt{-4} = (-4)^{\frac{1}{2}} = (-$ pressible by $2\sqrt{-1}$; but by no means into $4\sqrt{(-4)^2}$, nor into $4\sqrt{16}$, which over, is = 16, not as he says = 2. Th "puzzle," therefore, is a mare's nest. about a mistake, either mine or the p p. 272. The two acute angles of triangle were meant—one having its t cosine equal, the other its sine and cota

This problem of inclosing a complet the minimum slope lines was not near likely to be attempted, "M.I.C.E." n that of inclosing a hemisphere tomb (Buddhists call a "Dagoba") by a pyr minimum solidity, and also minium su pyramid to do this was half a regular like half a crystal of alum, all whos equilateral, and the angle of every edg that the slope of a face to the horiz half this, or 54° 44′. This was in my p. 353, misprinted 50° 44′. There seem Grimthorpe said, no approximation in pyramid, to this 50° 44′; indeed, only within 2° or 3° of it—namely, th "M.I.C.E." quotes from Fergusson as slope of the two-storied Dashoor pyr the builders everywhere showed abil accurate, even to single minutes, and though right enough in this one a original authority; nor, I must warn at all trustworthy elsewhere. More correspondent has mistaken this py second at Dashoor, for the one I referred as "the great," and (p. 331) "the largest place; also the second of all pyramids of base, though third only in mass.

authorities to be taken (instead of for all pyramid dimensions are reat work (1840) and Flinders Petrie hich show admirable agreement. All s seem to have used identical cubits, tandard as perhaps the most accurate intries could to-day. All slopes were very simple numbers for base and ar, but such that the hypotenuse was a ot in the single case of the great ramid, whose base width was 420 cubits, and therefore slope 290 *exact*, Perring the angle as 43° 36′ 11″, which corre- hose commensurable sides to a single esides being the only slope that showed ce with Euclid's 47th proposition, this is actual slope, the only one approximately I think intended to be identical), being one of the neighbouring two-storied at "M.I.C.E." has quoted from Fer- 5°, which is certainly wrong.

other extreme, the steepest slope in roper (or those built in level courses) izontal to two vertical (or 63° 26′) in the brick pyramids of Hawara; the only on inundated or cultivable ground, were doubtless the two Herodotus with hugely exaggerated dimensions) as a lake Mœris, bearing statues of the d his wife. When "M.I.C.E." mentions on pyramid as steeper, he goes from ramids to those now called "Mastaba built by a nest of enclosing walls, all e same uniform batter as the tombs staba—namely, one horizontal to four approximately 76°. Nothing is within rees of his 70° 32′, the edge-angle of a rahedron, or supplement to that of the

puzzle of "four-dimensional space," I e it was suggested to me long before it in mathematics, by a passage heard in at church (Eph. iii. 18). Of course, it l "depth and height" were in St. Paul's s well as ours, only one dimension differ- ed, but he would not have used the four to express or remind us that the Creator ed in Himself or in anything He may create by limits He has placed in our lsewhere the same author calls length h "creatures," which was anticipating e "puzzle." When the first creatures Genesis are, as some translate, "the ff and the earth-stuff," or, as I would ly, "that which is the two skies, and is the earth," both of these, which were at, are claimed as creatures. Space, no atter, is a "stuff" or creature, and any of the number of dimensions its creator He might as easily have willed the pace, or this visible universe of our e, to be of *n* dimensions as He might an have *n* limbs, or red light to have as lations per inch as blue has, or bodies fall *n* feet the first second instead of 16. Oliphant, in his "Scientific Religion," wedenborg, he has been shown a world e is "neither space nor time, but there rance of both." While human geometry , then, is of three dimensions, geometry ract must be of *n* dimensions.

E. L. G.

EATH FROM OLD AGE.

—IN reply to a question asked in letter e 29, by "Weird," as to the theory of old age as taught to medical students, y that biologists (those who study the life, and I am speaking for myself as ese) believe the human body, and all l vegetable bodies, to be made up of a number of very small living units, or these cells live, increase, die, and do f the whole body, as men live, die, and k of a nation. We find that they in- ize, and divide into several smaller pieces elves, which also grow and divide again, and that this process is always going on. gh many of these cells are continually being killed, they are replaced by others. unction of some groups of them to mul- supply loss more than in other groups, other groups have various other func- rform for the good of the whole.

goes, this power of continued multipli- ens, and as old age comes on we find it lost. Thus, when, through injury, nt of food, &c., some groups die, then thing to replace them, and the work that done no more. This leads to a failure roups which depended upon the dead eir living, and more and more die and placed. At last the wants of the re- are so little, and the regenerative dividing up into more cells is so lost, rest die quickly, and the body is dead

ot make them go on dividing more than their natural number of times until you fertilise one of them (by sexual reproduction); then this one will begin dividing again, and go on and form a fresh body—a child. You can make them last out a bit by being careful, that is all.

This is only a very rough sketch indeed, and I apologise for it, and for my haste in writing.

Harold G. Dixon.

NO MORE DEATH.

[28949.]—YOUR correspondent, "W. A. W." (letter 28890), may, or may not, know that the external use of acetic acid for the purpose of eliminating waste matter through the pores of the skin was first practised to any extent by Mr. Francis Coutts, of Glasgow, in 1850. In the hands of the late lamented Dr. Dirk, of Edinburgh (author of that invaluable series of "Papers on Health"), as also in those of his successor, Mr. Newbigging, at the Seamill Sanatorium, many marvellous cures have been effected. The principle of the acid treatment is this, that acetic acid, when applied to the skin over a diseased joint or unhealthy part of the body, converts the waste organic matter into a bad-smelling gas, which readily escapes through the pores in considerable quantity, and soon makes itself evident through the medium of the olfactory nerves, whilst the action on the living and healthy tissue surrounding or covering the diseased part is most beneficial, causing increased local circulation and vitality, which is evidenced by the healthy glow that soon makes its appearance.

Although I am undergoing the acid treatment myself at the above mentioned sanatorium for a neglected sprain, with very satisfactory results, I sincerely hope that it will not have the effect of causing me to live on for ever, at least in this unhappy world. Acetopathy is as yet only in its childhood; but from what I have personally seen of its effects upon disease, I think I may safely prophesy that its use will be very much extended during the next few years, especially if, as "W. A. W." expects, it proves to be the long-sought-for "Elixir of Life."

June 25. **F. W. J.**

[28950.]—"W. A. W.'s" conclusions are based upon such obviously unsound premises that I read them with a smile, but never supposed any readers of "Ours" would be taken in by them. As, however, "Edelweiss" seems to think there is something in them, I may tell him that acetic acid used daily, as directed by "W. A. W.," only dissolves the cuticle, and is in no way superior to ordinary ablutions as practised by most people who have a regard for their health, and is very much inferior to an occasional Turkish bath. The skin is a very important breathing organ, and the fatal results of extensive burns or scalds, and the experimental effects of coating animals with varnish, show that its action is essential to life. Hence the importance of keeping it in a clean, healthy condition, and the man who does so will, *cæteris paribus*, live longer than his neighbour who does not.

In reply to "Weird," physiologists teach that in the life of the animal body there are three periods. The first, the period of growth, in which repair exceeds waste; the second, commonly called the prime of life, in which repair and waste are equal; and the third, old age, in which waste exceeds repair.

"W. A. W.'s" theory presupposes what is not the fact, that the skin is the only excretory organ of the body. The lungs, liver, and kidneys are equally important, and the fatal results of the loss of any of the three, to which "W. A. W." cannot apply acetic acid, is quite sufficient to demolish his theory. Each excretes its own peculiar waste product, and if that product is not excreted the animal forthwith dies; but in any case it must die eventually, when repair ceases to bear a sufficient ratio to waste to maintain life.

The reason the acetic acid removed the warts from "Weird's" hands was because of its power of dissolving cuticle, and warts are only little masses of cuticle which have grown faster than their neighbours. Perhaps it may help him if I explain that the skin is formed of a mass of cells. The deeper and younger ones, which are constantly being renewed, are globular in shape; as the growth of new ones below pushes the older ones to the surface they get flatter and denser, until at the surface itself they become quite horny, and so serve as a protecting covering to the delicate structures, nerves, blood-vessels, &c., below, and are eventually rubbed off by the friction of the clothes, by washing, and especially by the Turkish bath; but under no circumstances could they accumulate in the body so as to make it grow larger.

Doctor Med.

LATHE MATTERS.

[28951.]—I SHOULD like to say to "J. L. D." that if 3½in. is the diameter of his smallest pulley on the crank-shaft, it is no wonder he finds the band slip. It is sure to do so unless he tightens it till it squeezes out the oil of the bearings or pulls the hooks off. The conclusion we seemed to come to when we debated this subject was that 7in. was about the smallest size of pulley on crank shaft to transmit all the power of the tread; 5in. might be adopted with a band of V-section. In any case the grooves should be of an acute angle, less than 60°, and they will hold better still if as deep as 45°. I think the description he gives of his way of changing to hand work is the same way as I proposed for the "E.M." lathe.

Mr. Carre may not have noticed that we have referred to two kinds of internal back gear. There is, first, the true internal, which, as he says, is described in Holtzapffel, and it is also described still better in Vol. XI., and commended by "J. K. P." There is also Jewsbury's differential gear, very well described in the "E.M." I have already stated where, and cannot now refer, as I am away from home.

F. A. M.

[28952.]—I SEE on p. 393, in letter 28910, that "J. L. D." wants to know something about Messrs. Pfeil's screw-cutting arrangement. Well, I may perhaps be able to help him a little towards understanding it, though I was a good while myself before I made it out, and am not sure even now that I fathom it.

Firstly, the leading screw has 6 threads to an inch, and in the whole list of threads, 28 in number, headed "Whitworth's Gauge," ranging from 60 threads to 3½ threads to an inch, the driving wheel is in every case No. 36. The right-hand column is headed "Metrical Gauge," and in every case, 30 in number, from ·3mm. up to 7·2mm. pitch, the wheel on the mandrel is 34 instead of 36. In dealing with millimètres, the usual rule, and a very near one too, is to consider 127 millimètres to be the same measure (I see in a letter in a recent number of "E. M." a measurement called a "measure") as 125 twenty-fifths of an inch, or 5in., or, putting it another way, $\frac{1}{25}$in. : 1mm. : : 127 : 125. Messrs. Pfeil, without going to that degree of approximation, take twenty-fourths of an inch, and estimate $\frac{1}{24}$in. : 1mm. : : 18 : 17, or 18mm. = $\frac{17}{24}$in.

According to my notes on the subject, 1 mètre = 39·37079in. If we suppose that 18mm. = $\frac{17}{24}$in. or, decimally, ·70833, then 1·8 mètre, which should be 70·867in., comes out as 70·833, giving an error of $\frac{1}{32}$in. in 6ft., deficient. This seems a considerable quantity; but I may mention incidentally that as lately as 28th June I obtained from a professional divider his measurement of what was believed to be a very good screw, belonging to a small self-acting screwing lathe, and it turns out to be $\frac{1}{30}$in. short in 2ft. (not yards), although for that distance it is remarkably even, and finishes with a good piece of 3in. at the end where it is never used. This is a new lathe, not one that has been bullied for a decade by a lot of boys in a jobbing shop. Of course, it is impossible to cut "any number of threads from 3½in. to 60in. with only nine gears." Obviously the meaning intended is, any of the threads that Whitworth uses in his bolts. Messrs. Pfeil, moreover, advertise that they supply "spare sets of wheels for other gauges at moderate charges." The list they give for their "Unique" lathe is as follows—viz., 12, 16, 20, 21, 24, 27, 30, 33, 40, 72, 80; but some of these are used for millimètres only. If you reckon 127 millimètres = 5in., you get 914·4mm. to a yard English. If you say 18 millimètres = $\frac{17}{24}$in., then you get 914 $\frac{14}{17}$ = 914·82mm. to a yard, the difference being about ·4 millimètre = $\frac{2}{125}$in., or, say, $\frac{1}{64}$ of an inch in a yard.

J. K. P.

FRONT SLIDE LATHE BEDS.

[28953.] — THOUGH the discussion on Mr. Price's lathe bed is closed, I may say to "H. F.C.," who apparently cannot understand my method of calculating the life of a bed, and therefore, I presume, cannot agree with my conclusion, that in comparing the life of a top slide with a front slide lathe, the first thing to be considered is the surface on which the wear takes place.

Take an ordinary self-acting lathe, whose top bearing surface is 2in. wide—i.e., each flat is 1in. wide. Add to this the back V of, say, ¾in. wide, and you have a total of 2¾in. for the saddle to bear on.

Now let this same bed be converted into a front slide in the simplest way possible, altering nothing, but simply turning it on its side, and setting the heads on what was the back of the lathe. Of course, this is only by way of illustration and for comparison. Is it not evident that now what was the back V has to take the whole wear, for the front of the bed has all pressure removed from it? The wear must, therefore, be in proportion to the surfaces. Supposing the saddle to have the same length, the wear will, therefore, in this front slide lathe be as 2¾ to ¾, or about 4 to 1 for surface alone.

But, in addition to this, in order to turn the full [illegible] the line will [illegible] of the [illegible] the weight of [illegible] the power [illegible] of four [illegible] The power [illegible] the weight of [illegible] The leverage [illegible] four times as great [illegible] four times [illegible] leverage [illegible] when [illegible] then the power is applied at the short end of the lever and the resistance at the long end, and therefore it is comparatively harmless.

I trust "H. F. C." will now see how I arrived at my conclusion; but I was wrong in that I took the whole top of the bed, including the opening for the heads, as wearing surface.

My question as to what was the advantage of "canting" the heads has been made [illegible] by its being printed "[illegible]." [illegible] the F.H.L. [illegible] everything should be done to relieve the [illegible] of all unnecessary pressure.

To "New Sub.," who asks me to send sections of my improved design for F.H. [illegible], I may say that I sent sections to the Editor some time ago; but he did not think it worth anything, so it has not appeared. Others have thought differently of it. "J. L. D." asks me would it not be worth while to make my own pattern and have it cast? That is what I purpose doing, though I have got several estimates for it.

I do not think that pattern-making is an overwhelming job. There are very few parts of a Lathe I have not made patterns for; but I like to make my patterns well, and I know it not only takes a good deal of time, but skill and knowledge. I wished to spend as little of the first as possible; but as I have decided now to have a straight bed, the pattern is greatly simplified, I should say.

If "New Sub." wishes to write to me direct, I will send him a sketch of my new bed.

Fredk. Carre.

P.S.—That my letter ([illegible]) may not be misunderstood, it was written before "F. A. M.'s" second letter on internal gear was written, and, of course, my remark refers not to that, but to his previous letter.—F. C.

June 30.

THE HAYDON CUTTER-BAR.

[28954.]—WILL anyone who has had some lengthened experience with this cutter-bar give his candid opinion as to its utility? I cannot say that its performance comes at all up to what I was led to expect from it in the way of convenience and good work. I find the cutters difficult to get to stand, and they do not do anything like the amount of work a solid, properly formed and sharpened tool will do for a sharpening. It may be my cutters are of too small section of steel, $\frac{5}{16}$in. The steel itself is good, yet they stand a very short time.

"J. K. P." gave long ago a series of illustrations of the different forms of cutters used with it; but they were to me rather hard to understand, and it may be I am not forming the cutters rightly. At any rate, I cannot get "D. H. G.'s" theory to work, for when one edge is parallel with axis I find it chatters, and leaves bad surface. The simple diamond *point* formed by a top slope of 45° I find works perhaps the best. I have failed to get the face angle of 120° to work at all satisfactorily.

Is it not a mistake to cut off the shaving at a great slope—I mean of a great width in proportion to the depth of cut? I find it is more than I can do to take a $\frac{1}{16}$in. deep, 90 to the inch feed. About half this is as much as is comfortable. What is a fair cut for a foot lathe? **Fredk. Carre.**

SAFETY LAMPS.

[28955.]—THE letter on p. 391, signed G. R. Postlethwaite (which seems to have been sent round to several other papers), has evidently been written without much knowledge of what has been said in these columns. The "constant recurrence of these fearful accidents"; the "prices of petroleum oils will certainly be very much lower"; there "can be no such thing as a safety lamp without a safety burner"—are all statements for which Mr. Postlethwaite can give no substantial reason or good evidence. "The whole catalogue of disasters arises from no other cause than the overheating of the oil in the reservoir." Will Mr. G. R. P. oblige with one well-authenticated case of a [illegible] explosion? It will be [illegible] [illegible] I am quite sure that [illegible]

[illegible]

THE ORGAN OF THE FUTURE.

[illegible]

[illegible]

[illegible]

[illegible] classification of the stops into Diapasons, Flutes, Reeds. By Diapasons I mean all stops from the open diapason upwards of this family of open metal pipes; by Flutes those of the stopped diapason tribe, with all stops either of wood or metal partaking of this character of tone. The Reeds will be readily understood.

Now the old models of Bernard Schmidt, Renatus Harris, and their contemporaries present a uniform colouring of a negative rather than a positive tint of the Diapason type. They are extremely musical, but their capacity for effect is limited to a narrow sphere. The requirements of modern times carries an organist beyond these limits, which present insurmountable difficulties to him, and so it has happened that in despairing haste, and often with reckless hand, the old work has been swept away to be replaced by that which, though less musical to the refined ear, has had the merit of being much more smart and of wider service. But this acquirement of a brilliant chorus at the expense of refinement of detail, if it has served to help the organist in his dilemma, does not satisfy the requirement of art with which I have here to deal.

We are indebted to the skill of Edmund Schulze, whose work has been so widely copied but so little understood from an artistic point of view, for the revelation that the utmost brilliancy is not incompatible with refinement in detail; but, on the contrary, that it is enhanced by its presence; that a positive colouring may be exquisitely musical, and that the finest effects are the outcome of a blending of opposites. We have not yet learned the full value and variety of the "flute" family, which he was the first to introduce into this country, and certainly we are but just beginning to appreciate the development of that beautiful family, the "Gambas," or, as I shall term them, "Strings," of which he was in a great degree the originator. In fact, Schulze pointed out the path to artistic tonal colouring in organ stops. If to this variety we add the distinctive and splendid family of "reeds" presented by Henry Willis, we have all the colours wherewith to paint a fine picture.

How are these colours to be used to the best advantage? Common practice is to rely for effect upon a multitude of unison stops of more or less negative colouring, and to make the harmonic series as positive as possible. If two open diapasons of "positive" colouring be combined, a wide interval of scale being made between each, they will produce greater effect than three diapasons of equal scale and character similarly combined. Hence it may be assumed that combinations of few stops of positive colouring will be more effective and obviously more useful than the duplication of tones which are of negative colouring. I can show proof of this in practice to any who may be interested, to judge for themselves.

I cannot speak of Messrs. Roosevelt's modern work in detail; but in general design I miss, in [illegible] to those points already [illegible] "Flutes" which I had [illegible] the absence of definition, [illegible] multiplied.

Here is a sketch model for a co [illegible] manuals, with one for an inst [illegible] of very ordinary dimen [illegible] of interest. The [illegible] will be sufficient for analys [illegible] speaking stops only, the sm [illegible] I fancy—only 28 stops. [illegible] are there to be found [illegible] except, of course [illegible] of the organ related to their [illegible] "positive" in character.

Before analysing this organ, I [illegible] wind pressure emp [illegible] imply, as some pers [illegible] tone; but [illegible] certain stops whic [illegible] by such aid. It [illegible] shall be pu [illegible] as perfect as art can make in

[illegible] SCHEME (Four Manuals an

GREAT ORGAN

[illegible] C. 61 Notes—First

(On 4in. wind).

1. [illegible] Major ....(
2. [illegible] Diapason..............................
3. [illegible] ....
4. [illegible] ....(
5. Stopped [illegible] ....(wood
6. [illegible] Octave ....

[illegible] Coupler on 1 to 6. Th [illegible] placed i [illegible] organ.

7. [illegible] Harmonique..............................
8. [illegible] ....
9. Super Octave ....
10. [illegible] Mixture (metal) ....
11. [illegible] ....
12. Trumpet ....
13. [illegible] ....

[illegible] transferable, with indepe [illegible] Swell [illegible] pneumatic comb [illegible] these stops.

These Stops [illegible] wind, inc [illegible] swell-box.)

CHOIR ORGAN.

[illegible] Notes—Second

(On [illegible] wind).

1. [illegible] Gedact ....
2. [illegible] (imitative) .....
3. [illegible] Stopped Harm
[illegible] Coupler acting on
[illegible] Open Soundboard pl [illegible] Great Organ at lower le
4. [illegible] ....
5. Concert Flute ....
6. [illegible] ....
7. [illegible] harmonic ....
8. [illegible] Mixture ....
9. Vox Humana ....

[illegible] be inclosed in [illegible] Four pneumatic combination [illegible] organ.

SWELL ORGAN.

C C to C, 61 notes—Third M

Swell Proper 5in. wind, with Octave Coupler.	Swell Great Transferred 7in. wind
1.	[illegible]
2. Geigen Prin[illegible]	[illegible]
3.	[illegible]
4.	[illegible]
5.	[illegible]
6. Hohl Flote....................	[illegible]
7. Oct. Geigen....................	[illegible]
8.	Great Flute ......
9.	Octave [illegible]
10.	Super Octave .....
11. Flautina	[illegible]
12.	Great Mixture [illegible] (3, 4 & 5 ranks)
13. Mix., 3 ranks....................	
14.	Trombone
15. Cont. Fagotto....................	[illegible]
16.	Trumpet
17. Tromba	[illegible]
18. Oboe	[illegible]
19.	[illegible]
20.	Clarion.....

Six pneumatic combination [illegible] stops.

SOLO ORGAN

C C to C, 61 Notes—[illegible]

1. Contra Bass (imitative) [illegible]
2. Harmonic Flute Major [illegible]
3. Viole d'Orchestre (imit[illegible]
4. Viole Celeste .... [illegible]
5. Clarionet and Bassoon [illegible]

(1 to 5 on 5in. wind, an[illegible]

ve coupler on these stops, which are to Swell manuals with independent

'osaune	16ft.
	8
arion	4

on open soundboard over 14in. wind. nation pistons control the stops of this

PEDAL ORGAN.

CCC to F, 30 Notes.

ass		32ft.
ass		16
	(metal)	16
n Bass	(metal)	16
lute		8
	(metal)	8
Amour		8
Bombard		32
d		16

n 5in. wind, 8 and 9 on 14in. wind.

all acting on pedals supplied with h off and on, except Sub and Super aced on draw-stops attached to their organs; the tremulants to be on draw-overned by one pedal.

PEDAL COUPLERS.

'edals.	1. Tremulant to Solo.
Pedals.	2. Tremulant to Swell.
Pedals.	3. Tremulant to Choir.
Pedals.	Pedal affecting such as are drawn.

MANUAL COUPLERS.

reat.	5. Solo 1 to 5, Super.
Great.	6. Swell proper, Super.
Great.	7. Choir 1 and 2, Sub.
Choir.	

. Solo 1 to 5 to Swell.
. Great Chorus to Swell.
. Ditto on Great.
. Solo 1 to 5 on Solo.
. Sostenuto Great.
. Fortissimo Great and Pedal with Opened Louvres.

vhen released, leaves any combination viously drawn undisturbed.

shutters to be vertical and working in ngs governed by balanced pedals within ither foot.

No. 2 (Small Model) Three Manuals.

GREAT ORGAN.

to C, 61 Notes.—First Manual.
(On 3½in. wind.)

1	16ft.
'pen Diapason	8
	8
	4

nd, standing on open soundboard in an. Super Coupler on these Stops only.

ic Flute	4ft.
Quint	2⅔
ctave	4
	2, 3, and 4 ranks
Posaune	16
	8

ops on 7in. wind inclosed in a 3in. and transferable by one movement, ndent use to Swell manual.

CHOIR.

o C, 61 Notes.—Second Manual.
(On 3½in. wind.)

Gedact		8ft.
ourdine	(imitative)	8
Flöte		4

(Stopped Harmonic.)

ps on open soundboard placed in front gan.

Oct. Coupler on these Stops only.)
(1 to 3.)

öte	metal	8ft.
rn		4
t		8
		2

Inclosed in a Swell-box.

SWELL ORGAN.

SWELL PROPER.

t. Coupler		16ft.
Principal		8
Traverso		8
Orchestre	(imitative)	8
leste		8
Geigen		4
Harmonic Flute.		4
Quint Octave.		2⅔
Super Octave.		2
xture		2 ranks
Mixture.		4 ranks
Contra Posaune.		16
		8
		8

per Oct. on transferred Swell.)

PEDAL ORGAN.

CCC TO F, 30 Notes.

1. Great Bass	16ft.	wood.
2. Dolce	16	metal.
3. Great Flute	8	wood.
4. Flute d'Amour	8	metal.
(On 5in. wind.)		
5. Bombard	16	metal.
(On 7in. wind.)		

COUPLERS ON PEDALS.

(On and off with spring catch.)

1. Swell to Pedals.
2. Choir to Pedals.
3. Great to Pedals.
4. Tremulant Swell and Choir.
5. Sostenuto Great.
6. Super Work to Great.
7. Great Super to Swell.
8. Fortissimo Great with couplers and open louvres, leaving any combination drawn unaffected.

Four pneumatic piston combinations to Great Organ, acting on Pedal Organ.

Four	Ditto	to Swell.
Three	Ditto	to Choir.

Vertical Swell shutters in gun-metal bearings governed by balanced Swell pedals.

In No. 1 scheme are four organs, each perfectly balanced, and absolutely distinct in tonal colouring. They may be entirely separated, as in Roosevelt's grand scheme, or placed in two cases, the Great and Choir organs being together, and the Swell and Solo; the Pedal Organ being subdivided.

The flauto major of 16ft. in the Great Organ possesses the characteristics of "wood" with a dash of "metallic" colouring; it is preferable for blending purposes, either to the double open or to the bourdon, both of which it represents. The principal diapason is of large scale with a broad mouth; it is of ready speech and of immense volume of tone, all the harmonic series of this manual having this stop for the root.

The small open diapason is seven pipes smaller in scale than the large one, it is provided with a mouth of different proportion, and is of distinct "colouring." The lighter organ music of modern composers needs such a diapason as this, with super work to match, for proper effect; it is here provided for this and many other useful purposes. The claribel—a lovely stop if properly treated, but apparently displaced by Messrs. Roosevelt in favour of the German "Doppel Flöte"—is here of more positive character than is usual. Here, then, with the quint, is the foundation of the organ proper; it is of immense breadth of tone and of manifold service. With the first stop of the harmonic series it stands in the front of the instrument on an open soundboard. An octave coupler acts upon these stops for special effects. The whole of the super work of the great organ is inclosed in a 3in. swell box of peculiar construction, and is under perfect control for any degree of intensity. In order to preserve the "attack," so essential to the Great Organ, this portion of the organ is placed over a heavy wind. These stops are transferable by a single pneumatic movement to the swell manuals, where they act entirely independently. A pedal is attached to this organ, giving instantly the fortissimo, with full Pedal Organ and open louvres; but not affecting any combinations which may be drawn, which remain as drawn, on the pedal being released from the spring catch which holds it.

There are five combination pistons to this organ, acting also on the pedal organ.

In the Choir Organ is presented a charming combination of delicate stops. The lieblich gedact and viole sourdine stand on an open soundboard, and are placed in the front of the Great Organ at a slightly lower level; they speak into the very faces of an audience. The second of these two stops, as its name implies, partakes of the character of a muted string. In service it is intended to displace the colourless dulciana. The remaining stops of the choir serve the double purpose of an echo organ, and are under control for degrees of intensity.

The Swell Proper is a feature of absolute novelty; it is a very small but complete organ, consisting of one 16ft., four 8ft., a 4ft., a 2ft., and a mixture, with octave coupler. To this can be added at pleasure all the super work of the Great Organ, together with five stops in the Solo Organ, which can be used as one immense swell of 20 stops, or in three separate portions, either of which may be intensified as required. If we add that this huge swell can be coupled to the Choir manual, it will be understood what extraordinary effects are possible, not only in startling intensity, but in dissolving tone effects. This organ is supplied with six combination pistons.

The Solo Organ also presents distinctive features. Here is the complete family of orchestral viols, together with the wood wind of the orchestre—an invaluable addition, these stops being all under control for expression; and as a topping to the whole organ will be found 16, 8, and 4ft. reeds on a heavy wind, standing on an open soundboard. Four combination pistons govern the stops of this organ. The Pedal Organ is complete, and will commend itself. There is one point, however, upon which I invite the consideration of experts. I consider no Pedal Organ complete which does not contain a large and powerful 8ft. wood flute—for it is the link which unites the unison of the Pedal Organ to that of the manuals, for which no substitute can be found on the manuals, and it binds the whole Pedal Organ together in a solid form as no other stop will do. In every Pedal Organ, therefore, consisting of more than two stops, I should insist upon this stop as the next addition.

The whole of the couplers except those of the sub and super couplers I should propose to govern by pedals in preference to draw stops, made to lock by a simple spring catch, the release of which throws off the action. This action will be found of more easy management than the French ventil pedal with sliding movement. The swell louvres are to be vertical, working in metal bearings, and governed by balanced pedals accessible to either foot.

I have thus attempted to sketch out a scheme more complete than that of Messrs. Roosevelt, while it has the merit of being only a third of its size. The cost of this instrument would be less than that of our large concert organs, and its capacity for effect would exceed that of any organ yet built!

The smaller model presents some interest. Organists will be surprised if they study the variety of effects of which it would be capable.

Discussion has waxed warm lately (perhaps I should write "warmed waxy") on the merits of tubular pneumatic work. I have no wish to reopen an argument which has failed to arrive at any practical issue—*Parturiunt montes, nascetur ridiculus mus*—but only to state that from my standpoint no action, whether pneumatic or otherwise, is perfect which does not *respond instantly to the finger*—repetition, *per se*, is an insufficient test, my condition is more difficult to fulfil, but it is essential in every case.

Is it not significant that not one correspondent has thought the subject of Tone Production worth mentioning! **Carlton C. Michell.**

20, Torrington-square.

ORGANS.

[28957.]—THERE is much truth in what Mr. Lawrence says with regard to the American organ the specification of which was published a fortnight ago; but surely we are working backwards when we condemn mechanical accessories in modern church organs. An organ, I think, is a machine by means of which the resources of an orchestra can be brought under the control of one player; if this be granted, surely the more completely it is brought under individual control the better. What we want is not to do away with "mechanical contrivances," but to bring those mechanical contrivances more under control. Is there any organist who would object to composition pedals, on the ground that they were not in use when the great masters composed for the organ?

The musician and the mechanic should work hand-in-hand. The mechanical portion of an organ-action, &c., is certainly, I think, a necessary evil, but at the same time, very necessary, and not to be despised by the musician. I have lately seen and played upon several Italian organs, and there the mechanic's art is sadly conspicuous by its absence. One instance I can quote at Milan where all the stops are arranged on the right hand of the organist, and at a distance of about 18in. from the manuals; and the stops do not draw forward, but sideways, and are held in position by a catch. This arrangement is met with in several Italian organs—even the fine modern one in Como Cathedral. Surely in such a case the mechanic's aid might have been called in with advantage? The only organs I found in Italy with our ordinary draw-stop action were two in the Basilica of St. John Lateran, in Rome, built by a Perugian builder. In a large organ, what effect is produced by drawing one or two stops? Surely very little, therefore, while we build large organs, let us try to help our organists to play them. Another instance of the evil of keeping mechanism in the background is, I think, the system of placing an organist almost entirely *under* his organ; in how many organs do not the front pipes *overhang* the organ stool? I have frequently gone to churches to hear organs, and have been told by the organist to go to the other end of the church in order to judge of the effect. Now, it cannot be right that an organist should not be able to know what effect he is producing, and by the help of mechanics this undesirable arrangement can be remedied. They have given us the tubular pneumatic and the electric pneumatic actions, by means of which the organist and his console can be removed to almost any distance from his instrument and really hear what he is playing. I may say, in conclusion, that I am putting up a large organ of four manuals and about 45 speaking stops, to be built by Mess

Wordsworth and Co., of Leeds. I intend to place the organ upon a gallery at the west end of the church, and to play it from the chancel, where I shall sit with my choir. I hope to have a good many mechanical accessories, electrical and otherwise, and I shall be glad if any of your anti-mechanical correspondents will come and try the organ, which I hope will be ready by next autumn. The organ will be blown by an electric motor. This subject opens a further field for the enterprise of the modern organ-builder.

A. W. M. B.

[28958.]—MR EDITOR, when are we readers of the ENGLISH MECHANIC to have a continuation of Mr. Audsley's Notes on Concert-room Organs? It is a long time since the last appeared, and I am sure that everyone who has read them must agree that his notes on chamber, church, and concert-room organs are about the best that ever have been published. He writes with a full practical knowledge of his subject, having built the most perfect chamber-organ in London, its tone and workmanship being of the very best. The articles and letters about organs given in the "E.M." are far better than those given in most papers, and I for one read them with great pleasure and addition to my knowledge of the king of instruments. The Belgian organ, given a short time back, was an interesting instrument. Its reversed keyboard is now common on the Continent, and when the organ has to be played from the choir stalls most convenient. Its semicircle of stops on each side of the keys is a modern arrangement, and its pedal, to which some take exception, is one that Silbermann used to use, is used by Cavaille-Col, and Mr. Hopkins gives it in one of his schemes for organs. I do not care much for the elaborate American organ; there is too much patent this and patent that in it. Father Smith took out no patents for his organs, and the great makers of violins did not protect themselves with patents; but they used their brains as well as their hands, and turned out the best they could, and their work is hard to beat even now. With respect to the proposed organ in Cologne Cathedral, I expect that it will be a long time before it is erected. Some years ago, when I was in Cologne, I made inquiries about it, and as far as I could learn it was very doubtful when it would be built. A musical paper, published, if I recollect right, in Berlin, gave a very full account of what was proposed to be done; but the quarrel between Berlin and the Vatican was a lion in the path. As to the cathedral having a new organ, it is wanted, as the old one is not good or large enough for the noble cathedral in which it stands.

J. N.

WHITEWASH—TO "SATINE."

[28959.]—OF course yellow wash is frequently preferable to whitewash, and of course two coats are usually better than one. Nevertheless, my remarks on the subject were strictly correct. It is quite certain that the intention of those who add the black is to modify the tint, just as blue is used in the laundry, and manganese in glass-works, and it is not possible, as you suggest in letter 28871, that a tablespoonful or so of black could give body to a pail of whitewash, so as to make one coat have the effect of two, but it very obviously affects the tint. Two or more coats are generally advisable; but I was not writing a receipt, but suggesting an omission in some that had been given. Neither did I advise whitewashing anything, but merely advised those who wanted whitewash not to start by dirtying it on purpose.

W. A. S. B.

TURRET CLOCK.

[28960.]—MR. F. CARRE asks where is Meanwood Church? It is about three miles from the centre, and in the borough of Leeds. The clock there is not now a very good one, having been altered from its original arrangement by Mr. Beckett Denison.

The A frame is a very strong model, and is admirable for a going train; but it requires a leg down the middle, and should be made like a king-post roof principal. The going train is placed on the vertical leg with the escape-wheel at the bottom and the barrel on one of the sloping members. The king-post shape will also do, though it is scarcely the best one, for a combined going and striking train. In that case the going train may be placed up one slope and the striking train up the other slope, as was done by my friend, Mr. Moore, of Leeds, who made for me, for Mr. George Salt, of Saltaire, and for one or two others, the best regulator clocks that have yet been made in England. There is almost no doubt that large movements, with pallets 14in. or so long, and the double three-legged escapement are not necessary for moderate-sized turret-clocks. The small four-legged escapement with pallets about 9in. long, used by Mr. Moore in his regulators, will do the work efficiently. My own four-legged clock has never tripped in twelve years' service, and cannot be made to trip. About eight years ago it had an additional arbor made for it, and it now goes for seven weeks with two lines to the 70lb. weight. This, and all Mr. Moore's clocks, have the sun and planet winding motion, which allows the winder to take unlimited time over his work, and which answer admirably, though Mr. Denison made some (to me) incomprehensible objections to it in his book. They have also lantern pinions throughout, and jewels to the two fastest arbors, and cut gun-metal wheels, and they cost about half the sum asked by a London clockmaker for an article nothing like so well made or designed. The four-legged escapement seems to be practically unknown to the London trade—at all events, it is hardly ever to be seen in the shops. If Mr. Carre wishes for it, I will send him the principal dimensions of my clock when I return to my own house, in about a fortnight's time. The locking plate motion is much more satisfactory for a striking train than the English rack motion.

T. S. Kennedy.

47, Lennox-gardens, S.W., June 29.

METHYLATED SPIRIT: A CAUTION—ARACHNIDÆ—PROBLEM FOR THE SEASIDE.

[28961.]—"T. C." (letter 28935, page 397) seems very angry with poor Mr. Higson! I have not the honour of the last named gentleman's acquaintance; but, in common fairness, must express my opinion that it would be well if the public had more servants as zealous as he. I do not remember what query 6,500 was about, but I recollect a correspondent asking the question how to get rid of the taste and smell of methylated spirit. If this be the same, I heartily wish that Mr. Higson could capture the querist. Does "T. C." realise what would be the result of the discovery of a cheap process for obtaining pure alcohol from methylated spirit? First, I should say, wholesale defrauding of the revenue, and secondly, a widespread increase of drunkenness. Thirdly, perhaps the prohibition of the sale of methylated spirit, which would mean the immediate paralysis of several trades, and inconvenience to all chemists and users of spirit lamps. Unless "T. C." be an Irishman of the improved breed, and considers that all breakers and evaders of law are to be helped to escape punishment, I do not see why he should have thought it necessary to lecture a zealous servant of the public who is doing his duty.

"Arachnidæ" (query 65773).—The rounded white bags are egg bags, in which the female spider carries her numerous progeny. If "Omicron" opens one he will probably set free a vast multitude of microscopic spiders. But it is a cruel experiment, for maternal love is very strongly developed in these creatures. A more pleasing experiment is to catch the spider, put her on a large sheet of paper, remove the bag, and place it at a distance from her. She will run about the paper in a most distracted manner until she chances to discover her precious charge, when she will dart upon it with an evident joy which shows that, even amongst spiders, "folks have their feelings."

"Problem for the Seaside" (query 65672). I began solving this problem last week by graphical construction, but found it would require an immense sheet of paper, so I tackled it mathematically, but was too late to send my solution. I solved it by a somewhat different method from that of Frank Caws (p. 400), taking into account only the properties of similar right-angled triangles.

Let d = distance from middle point of windows to middle point of steamer's course.

$\therefore x$ = speed of steamer per second.

$$\therefore (1)\quad d + 6 = 200x$$

$$(2)\quad \frac{26 + d}{46\frac{1}{2}x} = \frac{26}{6}$$

Solving these simultaneous equations we obtain—

$$x = 13\tfrac{1}{4}\text{ft. per second}$$

$$d = 2{,}660\tfrac{2}{3}\text{ft.}$$

These results agree pretty well with those of Mr. Caws, though I think "knots," in his answer, should read miles. I do not see why there should be even the small discrepancy which exists between our calculations, unless he neglected some figures after the decimal point in his solution, which I have not time to verify. Lest any reader should fail to see whence the above equations are derived, he will find out at once by erecting a figure and noting the ratios below—

$$(1)\quad d - 6 : 200x :: 6 : 6$$

$$(2)\quad 26 + d : 46\tfrac{1}{2}x :: 26 : 6.$$

T. Preston Battersby, Capt. R.A., F.R.A.S.

[28962.]—"T. C." (28935, p. 397) appears to have formed such a bad opinion of me as to think it necessary to hold me up as an object for reprobation. Why? If the readers of the "E. M." will refer to the query, they will see that "T. C." asked for advice as to how he could best perform an illegal act; and because I directed his attention to the Act of Parliament which creates the offence, he calls for your readers to censure me; but at the same time he misstates the facts.

Judging from his action in this case, I suppose "T. C." would think that I have no right to tell your correspondent "Confectioner," query 65499, that he will require a license under Act 9 and 10 Vic., c. 90, &c., before he can use a still or retort for distilling amylic ethers; but such is the fact, and probably "Confectioner" does not know it.

W. Higson,
Supervisor H.M. Inland Revenue.

June 30th.

PATENT TELESCOPES.

[28963.]—OPTICAL instruments, though not so patent ridden as electrical ones are—probably because less understood—are still occasionally met with, and, as a rule, possess some merit. A small patent telescope lately came into my hands such as I had never seen before. I should be glad if some kind reader could tell me why it has not become more popular? At present, judging from its merits, I can only conceive that its privileged construction and consequent enhanced price must have stopped its way. If that were the case, all patent rights must now have expired, and its construction be open to anyone. I, therefore, give a short outline, by which it can be copied.

It was patented by C. Rands, made by Watkins in St. James's-street, London. Its 3ft. mahogany tube contains a good 2in. o.g. and draw-tube, with the usual erector and Huyghenian eyepiece. Round the focus of the eye-lens the brass tube is enlarged into a drum. In its focus are two fixed parallel wires, past these on a slide move two other wires. The slide is actuated by a milled-headed screw on one side of the drum, and terminates in a graduated scale sliding along a vernier of the other. A reading lens hinged in front of the scale enables the observer to read off the divisions in $\frac{1}{10}$th and $\frac{1}{100}$th, and to compute, with a printed table on the body of the tube, the distances apart of the objects observed in seconds, minutes, and degrees.

Such eyepieces might evidently be adapted to any telescopes. They are simple and compact, the outside dimensions of the above one, reading lens included, not exceeding 2in. by 2in.

A. Caplatzi.

EVOLUTION.

[28964.]—IT is to be regretted that time should be occupied in useless controversy with those who accept the Bible as an absolutely true statement of the world's creation and history. For these, taking no heed of scientific facts, can never be convinced. The scientists and believers in evolution have no cause to seek converts by a tedious argument on scientific facts, addressed to those who, from their position, are totally unwilling to believe in them, and probably incapable of all such instruction.

The Bible had best be left to its exponents to make their interpretation of what should be taken only in its literal sense.

The scientific observer is so absolutely bound by the immutable laws and properties of matter that it is difficult to give any statement of origin except as a mere visionary idea that, according to the known laws by which he is bound, could not find acceptance. For example, all actions and material things are influenced by three infinitesimal conditions which have neither beginning nor end—viz., time, space, and matter. The first can never cease. Space has no boundary, for if supposed to be limited by something, what is there beyond that? and if matter which pervades all space be reduced even to the gaseous form, and this assumed to consist of finite molecules, still this is not the commencement. As all our surroundings appear to us to be bounded and limited by something, the mind is incapable of grasping and realising the idea of infinity. Yet these three conditions are inseparably connected, for matter must occupy space, and in accordance with the laws of motion and force, it must also have time to move in that space.

In this discussion it is remarkable that the opponents of the doctrine derived from evolution should have taken up the incongruous account of Noah's ark and the Deluge for a theme. As to the Ark itself, the requirements would have necessitated a construction of a size so enormous that it would take all the shipwrights of this country many years to build, and then be without strength to stand even a moderate gale. To build one of our old wooden frigates forty acres of well-timbered oak forest was required, and here a vessel of many hundred times the capacity is said to have been constructed in a short-wooded country, and floated in a vast landless ocean that would be subject to terrific storm-waves. All these things must now be considered from our present standpoint and knowledge of facts, which cannot be altered by quotations such as those in the miserably-bigoted and sinister letter of "E. L. G." as to what one or another pastor has chosen to say in his sermons.

Unquestionably there is evidence that even some of the highest mountains have been submerged for centuries, or thousands of years together, and have formed part of the bed of the ocean, as proved by water-worn pebbles and fossil shells. In the very country where the Mosaic account of the deluge was compiled I have seen ranges of hills composed almost entirely of the shells of the common oyster. All these were brought to the surface by vast upheavals of the earth's crust before it had acquired a state of equilibrium, long prior to the existence of man. It was probably the otherwise unaccountable appearance of these fossils that gave rise to the legend of the Universal Deluge. In those times it was supposed by the writers that the earth was a flat plane inclosed in a canopy or firmament, with water above. In this case it was easy to conceive that a deluge might occur, and there would then be no difficulty in imagining that the waters subsided by drainage, and returned to the source from whence they came.

It was a grand intellect that, without precedent or instrumental aid, alone decided that the sun was stationary and the earth a sphere revolving on its own axis in space. In this case the disappearance of a delnge could only be accounted for by an evaporation that would envelop the globe with a vapour, which, according to the laws of attraction, could never leave it, and which to this day would enshroud the humid and sunless earth beneath in utter darkness.

It may be asked by the Bible-readers who endeavour to form a consistent religion from what they find therein, "You who are adopting a doctrine from evolution, and say that our written text is 'not to be depended upon,' and that our religion is but a remnant of polytheism, giving character and human form and passions to deified beings, and as we say that our ultimate reward is to be everlasting bliss, to what end does your own doctrine lead you?" The answer will be precisely the same as yours, "We shall not be affected by a belief for which we have no control, for the mind of man is formed by his surroundings." Without them he would have but little consciousness or knowledge of existence; every phenomenon and every material in creation responds to his inquiry and contributes to his uses, informing us that I am this or that element, and in all my conditions, ramifications, or combinations, I obey a true and rigid law. Mind and matter become associates, and appear to be intimately connected, as if the intellect with which our race is endowed were derived from the same superior source as its cause, for even the most ardent amongst those who adopt evolution as a basis in their creed will not admit that all nature could be as an incomprehensible blank without a purpose, or the presence of intelligence or mind derived from and ruled by a First Great Cause. The very existence and proof of all things appears to rest in a knowledge of their existence.

F. H. W.

A LAUGHING PLANT.

[28965.]—CANNABIS SATIVA (or "Wild Hemp") is found as a rank weed in three-quarters of the globe, where it is consumed in various crude forms as a narcotic and intoxicant to a great extent; even the Hottentot smokes it under the local name of *Dukha*, and so in India; besides the beverages, conserves, and compounds, alike used by the unsophisticated villager and the crafty criminal with different objects. But in mountainous countries, where thickets of this noxious plant attain gigantic growth, a resin exudes of concentrated powers, which is collected and sold in the low country under the Oriental name of *Churrus*, possessing such awful properties that special surveillance is exercised in our Eastern islands over the possible smuggling of this much-sought drug, the pains and penalties being very severe. As might be expected, heavy adulteration with wax, and other bulky substances commences from the time it leaves the local gatherer till it reaches the *habitué*—happily so for civilisation. I obtained mine direct from Central Asia, pure and potent, through a friend on his travels. It is also to be purchased in Nepaul, but the heavy duty levied by our Government at the frontier is quite prohibitive, and it is only by private hand (as in my case) that the *pure, genuine* product, possessing the virtues I ascribe to it, is procurable. I have many and great objections to publishing all I know on the subject; but must refer our medical botanists to Professor W. O'Shaughnessy's "Indian Materia Medica," containing his valuable clinical experiments. This work, published in '42, is now very scarce; but in more modern times, Dr. Waring, medical officer at the Court of Travancore (and long retired from active practice), has produced a very good book on the indigenous Pharmacopœia of Hindostan.

Here is a very wonderful fact. All the carnivorous animals, and adult man, are easily intoxicated, while herbivorous and frugivorous creatures are proof to the narcotism induced by this drug. A European infant of 60 days, suffering from convulsions, took 130 drops of tincture safely, while a strong young Hindoo medical student became cheerfully intoxicated by ten drops. One grain of the solid resin to each of two men labouring under rheumatism produced profound trance, or catalepsy.

More than thirty years ago I made some small experiments on my own person. They all ended in profound sleep, with a voracious appetite on awaking. I should always hesitate to administer *Churrus* to an adult, except as the last solace, or to soothe infants in a convulsive condition (as I have done), or in the spasmodic stage of Asiatic cholera at all ages.

I end with the well-expressed words of O'Shaughnessy—"Next to cure, the physician will perhaps esteem the means which enable him to strew the path of the tomb with flowers, and to divest of its specific terrors the most dreadful malady to which mankind is exposed" (rabies).

Eos.

SOME LITTLE-KNOWN PLANTS OF THE FLORA MEDICA — AURANTIACEÆ, GENUS CITRUS.

[28966.]—ORANGES, lemons, limes, shaddocks, &c., in their numerous varieties form a lengthy botanical catalogue, the chief of which are only found growing in tropical or juxta-tropical regions. The East Indies are said to be indebted to the early Jesuit missionaries for the bulk of these useful and delicious fruits. To fever-stricken, thirst-abiding lands of the sun no vegetable product ever brought such comfort and health. Notably the "Great Lime" and the "Little Lime" of Hindostan supply the wants of the poorer classes, these two being very plentiful and containing the largest quantity of juice. I will describe them. The first is a spherical fruit with a coarse orange-yellow rind, about as large as a 16lb. shot (occasionally smaller), and when ripe containing the most intensely acid liquid it is possible to imagine. I was repeatedly informed that a needle stuck into this kind of lime will rapidly disappear! Acting on this information, in a remote part of Bengal where spleen largely prevailed among the ill-fed population, I made a crude substitute for citrate of iron. I got iron filings from a village blacksmith, cleaned them, and strewing them thickly in shallow dishes of the above freshly expressed juice, I placed them for a short period in the open air. I cut some of the bitter peel in shreds and added them thereto. I afterwards strained my preparation into glass bottles. I found the disorder rapidly disappear under its administration.

The "Little Lime" (or *Kaqjee neemoo* of Hindostan) is no bigger than an Orleans plum, pale yellow, and replete with fine, sour juice. The trees are very prolific, grow well in most places, and seem to be a good investment to the cultivator, though I have seen the best fruit sold in the markets at 10 to 15 for a farthing; but that was very long ago. Dyers, jewellers, blacksmiths, &c., consume a large quantity in their trades, but the bulk of the fruit is daily used in cooling drinks and vegetable sauces of the most primitive kinds, to flavour the national foods. I have seen this variety growing in gardens in parts of South Africa.

The "lemon," that odoriferous, oblong, juice-yielding fruit of British households, is remarkable for the large amount of essential oil contained in its peel, and which, judging by the infusion of the freshly-stripped rind in the various cooling drinks of the East, has considerable febrifuge qualities. Rapid steam voyages have abolished the dread ordeal of serving out lime-juice "to all hands." I shall never forget the mouldy-tasted abomination (like bad cider) of fifty years ago. We can carry our own lemons nowadays, or buy them *en route*. There are very few constitutions to which the newly-expressed juice is hurtful. I believe the Americans first employed it in rheumatism with great success. In England, Dr. Arthur Farr discovered that the prophylactic virtues of lime-juice and other vegetable acids in curing scurvy depended upon their direct action as food solvents, and since that time he compounded an artificial gastric juice, considering the limejuice to represent the acid portion. Accordingly he mixed this pepsine, and introduced the new medicine to the notice of the profession, with the best results in dyspepsia. Limejuice, with either pepsine or pancreatine, is a very convenient form for prescriptions, and the compound keeps well, without deteriorating. The largest and finest specimens I have ever seen were gathered by me in sacks from trees growing on the grassy islets of the Upper Brahmapootra, formed of a rich alluvium; nearly every fruit was thrice the weight and size of those we get in England. "Uninhabited tracts" of a modern map, they were described to me as once flourishing villages, destroyed by Burmese invaders, and that these beautiful lemon trees were the only marks left to identify the land!

The orange, of all kinds, sizes, and qualities, ranks high as an adjunct in medical practice, especially in eruptive fevers, and the rind contains a bitter and aromatic oil, which gives its stomachic qualities to the famous liqueur, Curaçoa. The "Indian Materia Medica" states that the bitter matter of the unripe orange is a substance named "hesperidin," discovered by Lebreton in 1838. The process of extraction is tedious and delicate. The properties of hesperidin deserve investigation; its bitterness leads us to suppose that it may possess considerable febrifuge powers. The bitter Seville orange is also likely to yield a principle of considerable value in medicine as a tonic and febrifuge remedy.

The chemical constituents of soil exercise remarkable effects on the quality of this fruit. I have seen renowned varieties carried short distances, and carefully tended; yet they failed in similarity. Grafting, too, on an ill-assorted stock has wretched results; a loose rind, a tough and dry pulp, with large seeds, are common signs of this mistake. Some parts of South Africa can rival Asia in oranges—Port Natal especially. When "Prince Alfred the Middy" (as he was then called) was entertained on his landing at some port, a lady colonist gave him so large a fruit, that he wrapped it up "to take to his mamma on his return home," so he said!

Eos.

REPLIES TO QUERIES.

*** In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[64359.]—**Wheatmeal Bread.**—I suppose I ought to apologise for so long a delay in replying to "Hygienist" (p. 129); but there is little harm done, for I could not hope to convince him of the absurdity of his arguments (examine the table he gives), and they certainly will not affect a single individual acquainted with the rudiments of chemistry. I do not see, though, why Liebig should be libelled, and I therefore ask "Hygienist" to give the reference to the passage in which Liebig said that whole wheatmeal contains 60 per cent. more phosphates than meat, and 200 per cent. more than white bread. Verily there are discoveries made in these latter days.

ELEMENTARY CHEMIST.

[65199.]—**Golf Balls.**—The most suitable paint is Charlton white mixed with the best wearing body varnish and a little turps. Charlton white is a patent oxysulphide of zinc; it has a better covering power than white lead, and is whiter in colour. The best body varnish is one of the most elastic and durable of varnishes: it will mix with white without causing any discolouration. If you have any difficulty in obtaining the above articles, advertise address.

T. CLARKE.

[65330.]—**Plating Dynamo.**—TO MR. BOTTONE.—As "H. C. B.," after having read both editions of Thompson's "Dynamo-Electric Machinery," says that he defies anyone to design a dynamo (from either edition) where the electrical dimensions and speed are fixed, I am afraid it will be useless for me to attempt to assist him. I can only say I have designed several hundreds by the very rules therein laid down, and have not had a single failure. Some have been better than others, owing to softer iron in the former case; but by making a preliminary trial of the magnetic permeability of the iron to be used, it is possible to design very closely indeed.

S. BOTTONE.

[65357.]—**Cycle Making.**—I do not think you need trouble to test the ordinary pattern of wheel if your work is sound. When spider wheels came into use, I saw many tested in the way I have described; but I doubt if wheels for racing machines would stand it. I believe there are no joints for the chains you mention. I think Morgan's was the most convenient for repair. I would suggest that a tool such as is sold in tool-shops might be carried in the bag. It consists of a hollow handle, which for cyclists might contain a reamer, screwdriver, one or two bolts as used for uniting end of chain, and a spare link of chain. A small pair of pliers would not add much to weight in bag, and a small saw-file would be handy for taking off end of rivets. I think the whole lot would not weigh more than a pound. For short distances, bolts and link alone might be sufficient, if it were possible to find a smith's shop at hand.

A. M. M. A.

[65386.] — **Hardening Parchment.** — Try steaming the parchment. At the blind school in Norwood the pupils have, instead of note-books, a sheet of parchment stretched on a frame; this they prick with a sharp-pointed instrument, making holes on something the same principle as the telegraph, which punches holes on a strip of paper. When this is filled with this writing, the parchment is taken out of the frame and hung in a chamber through which steam is passing. Aft- half-an-hour's steaming the parchment is ta out and dried; the little pricks become hard, and can be felt by passing the hand over them.

SATINE.

[65387.]—**Duplex Telegraphy.**—For some information on single-needle duplexing, I would refer querist to the *Electrical Review*, Vol. XX., pp. 270, 340, 363. W. PERREN-MAYCOCK.

[65389.]—**Fibre.**—No doubt makers of such machines will give "Glave" the information he requires. The extraction of fibre from pineapple and plantain-leaves is not exactly an extensive business, and is scarcely of much interest to readers of this paper. NUN. DOR.

[65394.]—**Grinding Glass.**—There is no telling what a "Persevering Amateur" can do; he can do almost anything that anybody else can. Glass is roughed out with sharp sand and water as it is held against a revolving iron plate. It is then brought to a state fit for polishing by means of wooden (willow) wheels and emery or crocus.

NUN. DOR.

[65399.]—**Power for Small Lathe.**—Weights are useless for the purpose of driving a lathe, unless you have a heavy weight and a lofty tower. Better trust to the leg, or if power must be had, get an engine of some kind—a turbine or a gas-engine, as gas can be made from one of the light hydrocarbons as required. J. M. C.

[65405.]—**Twist Drills.**—They will hold tight enough in the square if you try them, and drive in hard. If not, file the shanks square to suit the brace. CHIPS.

[65406.]—**Tampico.**—Like another query bearing same signature, this can be of but little interest to readers. Presumably, the fibre is separated by maceration and beating, and no doubt by hand labour. It is not very extensively used, I think, and the only time I have seen it under that name was in connection with a musical instrument. I cannot find any mention of it in the usual works for such information. NUN. DOR.

[65416.]—**Electric Gas-Lighter.**—From what "A. B." says, he has one of the electric gas-lighters in which a battery is used, which were fully described in a back volume. His battery has apparently become exhausted, and he must replenish it—that is, if he thinks it worth while. He will find descriptions of the chloride-of-silver cell in his back numbers. SELIM.

[65426.]—**Drying Stove.**—The air near the ceiling will contain the greater amount of moisture. A. C. L.

[65473.]—**Survival.**—"F.R.A.S.'s" reply, for which I thank him, simply reaffirms my statement that "the survival of the fittest" means the non-dying of those who are not too weak to live, or have not succumbed to violence or accident—a dictum that I should hesitate to enunciate in a village school, lest the children should proclaim that I had been gravely telling them that the people and animals who live are those who don't die! But did Darwin really venture to inform the world that the creatures who live in rarefied air are those that can breathe rarefied air, and that the animals that are caught by beasts of prey are those that can't escape them? If so, and if for this he is honoured by a monument in the Abbey, I think I must request the dean to distinguish myself in a similar way, as I certainly made the like grand discovery, while still in infancy. But surely "F.R.A.S." must be aware that Darwin went beyond that, and taught that the survivors were the fittest to survive because they improved and evolved their several races, and benefited the world generally. "F.R.A.S." has not informed us whether evolution will at last render human and other creatures immortal. If this conclusion is not to be drawn from Darwinism, then neither is the promise of a long life held out in the advertisement of Holloway's pills. I would also remind "F.R.A.S." that the expression "the fittest" implies the existence of "a fitter" and "a fit," and that the doctrine of the survival of the fittest only, consequently implies that the fit, and the still more fit, to survive do not survive. Fishes, that is, live under the surface of water because the "most suited" to do so; but other creatures who are "suited," and even more than ordinarily suited, to exist in such an "environment" cannot exist in it. That there is a considerable "muddle" somewhere here I should be the last to deny. The advice to study Darwin's book comes to me a few years too late. I had it in hand not long after its first appearance, and then perceived that its teaching really is that those who survive are those who are fit (not "fittest") to survive, and that the fit to, are those who can survive and not those who can't—a bit of philosophy that in Athens would have been uttered nowhere outside an Aristophanic play. Of two men, let one descend from a roof by means of a ladder, and the other accidentally fall off it and be killed; then, according to Darwinism, the one has been fit and the other not fit to survive. Gravitation and the pavement will have been what rarefied air will have effected in the case supposed by "F.R.A.S.," only the cranium, instead of the lungs, will have been the part on which the "environments" will have acted. Had the fallen person been a bird, he would have been "fit" to escape death—not "the fittest" of all falling men, for he would not have been a man. If indeed Darwin employed "fittest" in the limited sense attributed to it by "F.R.A.S." to the word, even "fit" would be incorrect; it should be "fitted," and the notable doctrine will then stand, "Those who escape death are those that are fitted out with an ability to do so"; which would be as if a man should say, "The creatures that fly are those that are endowed with power to fly." B.

[65483.]—**Oiling Flute.**—I have no doubt poppy oil would suit your purpose better than linseed oil. Perhaps this would prevent the polish being blown off to some extent, as poppy oil is a much better drying oil. T. CLARKE.

[65517.]—**Fire Prevention.**—For small closed rooms steam has been found admirably adapted to put out fires, and in many establishments pipe connections are made for the purpose, and the jets have proved very satisfactory in many cases. To be successful, however, the steam must be confined, and hence in large spaces, where it can escape, disappointment has been experienced with the method. The steam jets have done very good service in American cotton mills in putting out fires in special departments where the conditions were just right; but their introduction must be governed obviously by the special conditions in every case. Would not automatic sprinklers, which of late years have been so widely used, afford you all the desired protection? Experience in this country speaks very well for them. It seems to me they are worth considering by you.

Jersey City, N.J., U.S.A. ALFRED SPIES.

[65527.]—**Water Power for Lathe.**—I have no doubt that a water motor, as you yourself suggest, would answer your purpose admirably. Water motors are never made, at least in the U.S.A., in such a variety of sizes and styles that they are applicable in a wide field. In some of our cities, where sufficient water pressure is available, they supplant to a great extent gas, hot-air, and small steam-engines, driving organ-blowers, ventilating-fans, grinders, sewing-machines, laundry machinery, and the like.

Jersey City, N.J., U.S.A. ALBERT SPIES.

[65565.]—**Water Power.**—You should remember that it is the weight of the water multiplied by the height through which it falls which gives the power. The symbol Q represents simply the volume of the water in cubic feet, and must be multiplied first by the weight per cubic foot, or about 62·5lb. We then have for the power developed, 62·5 Q h foot-pounds. This divided by 3,3000 foot-pounds, to convert the result into horse-power, will give $\text{H.P.} = \frac{62{\cdot}5\,Q\,h}{33000} = {\cdot}001893\,Q\,h$.

Jersey City, N.J., U.S.A. ALBERT SPIES.

[65568.]—**Oil Varnish for Violins.**—You could not make an oil varnish without proper plant, and not then without plenty of practice. Would it not suit your purpose to steep the violin in linseed oil for a length of time? T. CLARKE.

[65576].—**Casting Silver in Plaster Mould.**—I am at a loss to understand why Captain Battersby has failed to cast silver in a mould of plaster if the mould was dry. I have cast both silver and gold ingots many times in this way. I usually give the inside of the mould a slight coating of oil. SM.

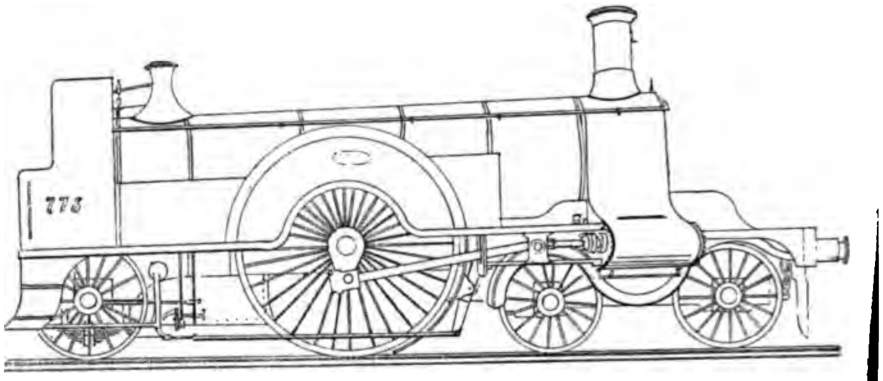
[65589.]—**Hymns and Bands.**—"G. R." says, as many other people do, considering that leading instruments take the treble, bass instruments take the bass, and he may well consider that middle instruments take the inner parts. With a number of instruments the various parts of harmony are repeated in octaves according to the effect required; each instrument has a natural pitch, and a particular quality of tone of its own, which must be greatly considered in arranging music, as particular parts are set to particular instruments, to give an effect in accordance to the composer's desire, which is best done by educated musicians. Before "G. R." attempts to arrange a piece of music, I would recommend him to take lessons on thorough bass, counterpoint, and fugue (books cost only a few shillings), after which he may have a better knowledge respecting the subject.

SOMERSET LAD.

[65595.]—**Valency of Sulphur.**—Sulphur is a bivalent element. SM.

[65627.]—**G.N. Single Bogie Express No. 776.**—I inclose photo. of a drawing of this engine. This type of engine has undergone very little change since it was first designed in 1870. The only important alterations are the following:—The tubes in the boiler have been reduced in number from 217 to 174, and their diameter increased from $1\frac{9}{16}$in. to $1\frac{3}{4}$in., giving a total heating surface of 1,045sq.ft. instead or 1,165sq.ft. The weight of the engine has been somewhat increased, and is now distributed as follows:—On front bogie wheels, 8 tons 2cwt.; on rear do., 9 tons 9cwt.; on driving wheels, 17 tons; on trailing wheels, 10 tons 12cwt.; weight of engine, 45 tons 3cwt.; weight of tender, 33 tons 7cwt., making a total weight in working order of 78 tons 10cwt.

LINCOLN.

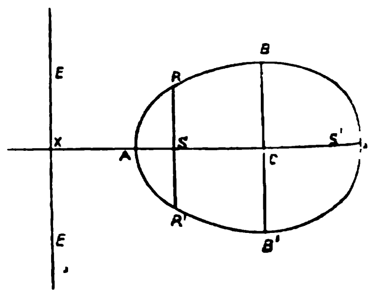


[65643.]—**Cutlery.**—If for fastening handles on table-knives, I think you will find two-thirds Bath-brick, with one-third rosin, crushed fine, do all you require. Fill the handles with the mixture, then heat the tang of the blade over a gas-jet and fix by boring it while hot, into the mixture as if you were using a snig bit. Set to cool in cold water with handles downwards, then scrape off the surplus rosin. W. W. B.

[65644.]—**Paraffin from Cloth.**—Judging by my own misfortunes I do not think the querist will succeed with benzine, hot iron, &c. I found the following quite successful:—Fuller's earth and a little soft soap made into a paste with hot water and applied with a stiff brush. Allow it to dry thoroughly and beat out. R. A.

[65646.]—**Vacuum.**—In such cases it should be remembered that the water or other fluid is not lifted nor raised by the vacuum, but forced by the weight of the outside air into the space left unoccupied. If this were not the case a pump would lift to an indefinite height, and not be dependent on atmospheric pressure. The water in the tube is balanced by the air column, therefore pressure inside tube at bottom is same as atmosphere = 14·7lb., 16ft. up 7·35lb., and at 32ft. *nil*. But a gauge attached outside the tube at a height of 32ft. would register an inside vacuum of 14·7lb., equal to the whole of the atmospheric pressure from outside; at 16ft. this would be reduced by the counter pressure of water in tube to 7·35lb., and at surface of supply water there would be neither vacuum nor pressure registered, for at this point the pressure of air and water exactly balance each other. M. E. J.

[65647.]—**Conics.**—Assuming A A' to be the major, and B B' the minor axis, C the centre, S S' the foci, R R' the latus rectum through S, E E' the



x. and X the foot of the directrix, we have, general property of all conics—

$$SR : SX = SA : AX;$$

the ellipse—

$$\begin{aligned} SA : AX &= CS : CA \\ &= CA : CX. \\ SB : CX &= SA : AX \\ &= CA : CX, \\ SB &= CA, \\ BC^2 &= SB^2 - SC^2 \\ &= AC^2 - SC^2 \\ &= AS . SA'. \end{aligned}$$

$$\begin{aligned} SR^2 : AS . SA' &= BC^2 : AC^2; \\ SR : BC &= BC : AC. \end{aligned}$$

ning this with—

$$SR : SX = SC : AC,$$

ain—

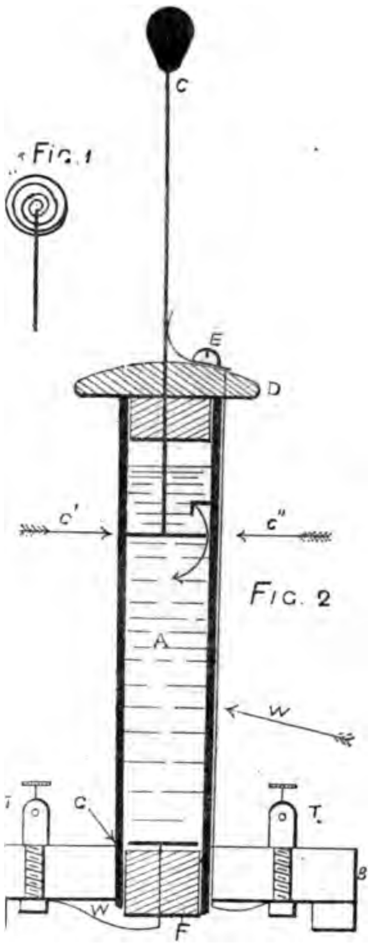
$$\begin{aligned} SX . SC &= SR . AC \\ &= BC^2, \\ SX : CX &= SX . SC : SC : CX \\ &= SX . SC : AC^2 \\ &= BC^2 : AC^2. \end{aligned}$$

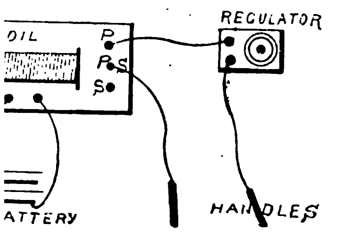
, I believe, the simplest relation between s and the distance of the directrix from the – SX can be written as SA + AX, and CA + AX; also SR : AC may be sub- l for BC² : AC² in the last equation.

V. J. B.

52.]—**Medical Coil.**—To "PRINCIPIA."—se sketches of a water regulator for the y circuit of your coil. Fig. 1 is a piece of wire about 16 B.W.G., coiled up into the f a drawing pin; Fig. 2 is the regulator. a piece of ⅛in. (internal bore) glass tube d fit it into a base (B); the tube to be in. long, and the base about 4in. square. be is to be stopped at the top with a box-pped cork, and at the bottom with an ordinary cork, both well paraffined; D and F represent these. C is a sliding rod (or continuation of wire) with a coiled wire at the end (C'), as in Fig. 1. The idea of having the coiled wire is that it allows the water to freely pass it when it is slid up or down (C''), as shown by the curved arrow; a metal disc may be used if it has a hole punched in it. G is a similar coil in the bottom of the tube; E, a small brass spring to press against rod C, and make contact between it and the terminal through the wire which runs down beside the glass. A is filled with water; the reason being that water is a bad conductor, and the longer the distance of water the current has to pass the greater the resistance, and consequently the weaker the current, so that sliding the rod down it strengthens the current, and *vice versâ*. The knob at the top of C should be made of ivory, ebonite, or other insulator. Fig. 3 is a sketch of the connections, and explains itself. If this description is not clear, will you write again, and I shall be very pleased to help you in anything that lies in my power.

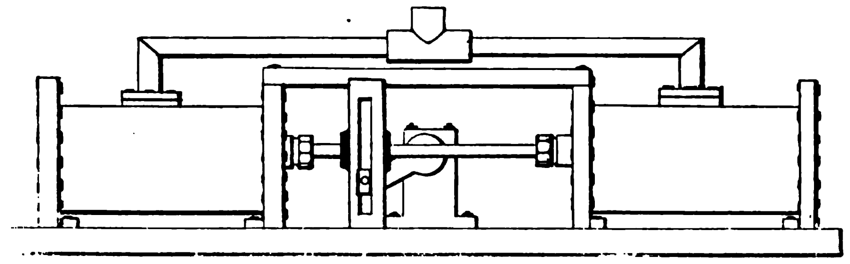
PRINCIPIA.





[60637.]—**Model Engine.**—I send sketch of engine which you could turn out from your two cylinders. It dispenses with connecting rod, but has a slotted link, into which screw the ends of two piston-rods. The crank-pin is fitted with a brass block which works in the slot of the link. Make flywheel 18in. diameter—ought to weigh about 80lb. I presume stroke of engine is 4¾in.

Leamington. C. ANDREW.



[65653.]—**Dipping.**—Clean your brass-work well in boiling potash; then dip the articles; polish afterwards, and then lacquer them with deep gold lacquer.

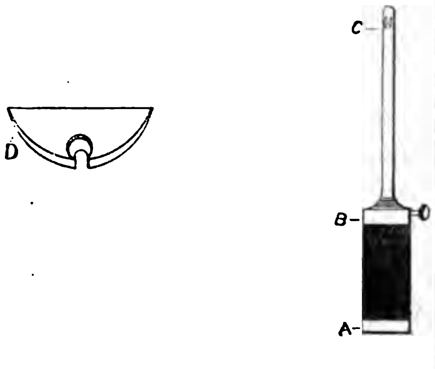
W. W. B.

[65653.]—**Dipping.**—You cannot alter the colour of brass by dipping. The colour is given by lacquers. If the articles are polished, they do not require dipping. Polish, and then lacquer. Pale gold is generally used.

E. T.

[65655.]—**Electric Gas-Lighter (Clarke's).**—You make an error in supposing that these lighters require rubbing. The initial charge of electricity necessary is so very small, that there is always sufficient in the inside cylinder unless the lighter is damp or out of order. A very little moisture affects these, which may easily be proved by taking one in a wet hand or leaving in a place that is at all damp for a short time, when you will fail to obtain a spark. Screw off the bottom of your lighter A and gently slide out the inner cylinder, which place, together with the outer one, in front of a fire to get thoroughly dry (do not get it hot enough to soften the vulcanite). Before putting together, bend each of the collectors at top of inside cylinder outwards, to insure their rubbing the outside one. It requires a little care in screwing the bottom on again, to see that the inner cylinder is in its proper bearings. If this is done in front of a fire with very dry hands, you will most likely now get torrents of sparks with very slight pressure of the button. If it does not now work well, unscrew the top at B and see that the wire which carries the current up the tube is in good contact with a brass washer you see on cylinder. I have known them fail through soot being formed between the wire and the tube at C, which can easily be removed with a pin. These lighters are very simple, and rarely get out of order if kept dry. It is a good plan to keep them inverted on a small bracket with a hole to take the tube bevelled on the upper side as D. If this is fixed on the wall higher up than the gas jet, or near a fire, they will keep in good order for years, and are very easily repaired. They should be used by all who have a number of jets to light or a gas stove, as they soon save their cost in matches and never require recharging.

Devizes. T. B. S.



[65656.]—**Brazing.**— Braze with the proper material (spelter), not brass wire: you will then succeed.

E. T.

[65656.]—**Brazing.** — Why use brass wire? Why not get hard solder? It is cheap, I think—only about 5d. per pound. There are three or four sizes—fine, medium, and coarse. When I was a boy I worked at compass making—I mean drawing instruments. You know the points or legs are brazed into brass. This was delicate work; but after one or two mishaps I never found much trouble. You know what small bow-pens or bow-pencils are: they are small articles. I have often brazed much smaller articles. Well, proceed as follows, and you ought to succeed:—Buy your borax in the powdered state, and get, through some ironmonger, your hard solder; just put about (no strict rule), say, a saltspoonful of solder, do. of borax; mix them up, first having added a little water, just enough to make the mixture as thick as good cream. Have the parts you wish to join bright and free from grease. With any convenient instrument (I used a small piece of sheet brass shaped like a child's toy spoon). Wet the parts to be joined with the mixture, then pick out with your spoon some of the solder, and place it over the joint or connection. Now place the articles on a piece of hot iron, or hold them over a clear fire, but not too near the fire. You will see the borax rise and swell. Be careful, for the rising of the borax has a tendency to throw off the bits of solder. Soon the borax will shrink, and now your solder will hold on to the article. You now want a clear forge fire, the less smoke the better. It is nearly out of the question to take you farther. Watch the solder for the melting point. When you see it run or flow, remove the article from the fire. Never cool it—let it cool. Some articles will not admit of being held in a pair of tongs, so you want some device to hold them. The devices are many. One good one I can commend, more especially if you attempt to braze more things than one at a time. I have often done a dozen compasses at once; but if the things varied in size you would not find it easy to braze more than one or two. Well, about the device. Get a piece of iron, say, $\frac{1}{16}$in. thick, ⅛in. wide, make hot and bend one end like a horse-shoe magnet. Let the long leg be so long as to afford you a handle. On this you can balance your work, and no tongs are wanted. There is no trouble in brazing with soft brass wire, or, indeed, with any rough piece of brass if the thing to be brazed is iron or steel; but where the things to be joined are iron and brass, or all brass, you ought to have the right kind of solder—by some called hard solder, by others, spelter; but for fine work nothing beats silver solder. I will give you the instructions if you wish (for silver).

ARMOURER.

[65658.]—**Lead-Poisoning.**—If some of the dandelion wine be tested by pouring in sulphuric acid, the presence of lead will be shown by a white precipitate of lead sulphate. (The precipitate is perfectly insoluble.)

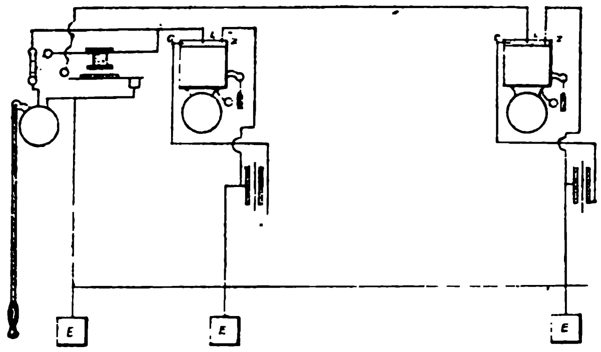
H. R. B.

[65658.] — **Lead - Poisoning.** — Do not be alarmed: it is an utter impossibility for lead to be taken up from the glaze. If lead can be taken up from glaze on earthenware, how is it we don't hear of lead-poisoning through using glass? For the glaze on ware is simply glass applied to the ware in a liquid form, and then fused or fired on.

POTTER.

[65659.]—**Welded Boilers and Tanks.**—These are made without anything inside—the joint simply welded. Very simple when seen, and soon learned by any ordinary smith accustomed to iron work. If you want to go into the business advertise your address in proper column.

AN OLD WELDED-BOILER MAK



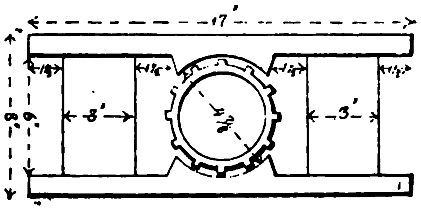
[65665.]—**Bells.**—The mistake is having the two bells in one circuit. Have sent diagrams. As the switch is, only the lodge bell rings.

WEIRD.

[65668.]—**Island of Sumatra.**—This is a Dutch settlement, and tobacco suitable for cigar-making, of high price (if not of fragrance), is largely grown there, as well as in Java, also Dutch. All the produce goes to Amsterdam, and is there sold to the world by auction or tender. 2, 3, and 5 I cannot answer. 4. The labour is native, and the Hollanders have not the best reputation as nigger-drivers. 6. Deli, where the best Sumatra tobacco is grown, is on the north of the island nearly opposite our settlement of Penang in the Malacca Straits. I should not advise our querist to try his fortune there unless he be a Hollander, they being even more exclusive than the Heathen Chinee as to admission of other nationalities (especially English) to their territories. Much better try Ceylon, where very fine tobacco, as well as tea and coffee, are grown.

F. G. L.

[65674.]—**Manchester Dynamo.**—TO MR. BOTTONE.—Below you will find cut giving best proportions to be carried out in a Manchester type dynamo with a 5in. or rather 4⅞in. ring armature. You will see that instead of having the field-magnets 12in. long by 1½in. diameter, they should be 6in. long and 3in. diameter to allow the armature



to come near enough to the pole-pieces, which must run within ⅛in. of the armature. Put on five layers No. 20 d.c.c. for the armature (about 3lb. I get on my twelve cogged rings), put 4lb. No. 15 as the series coil on the F.M.'s, and about 15lb. No. 22 as the shunt coil; will light five 20's at a speed of 1,300.

S. BOTTONE.

[65675.]—**Scene-Painting.**—The colours are used in distemper, with just sufficient glue or other size to bind them. Mix your tints in water just the same as you would in oil, only instead of using white-lead use whiting. Dry colours in fine powder will need no grinding—just simply mixed with waters. Those colours that require grinding are kept in stock, ground in water, at any oil-and-colour shop in the neighbourhood of a theatre. Caution must be observed not to have the size too strong, or it will be liable to chip. Before using, the colour should be tried on paper and dried before the fire, in order to test whether sufficient size has been used, and to prove that the tint is what was required.

T. CLARKE.

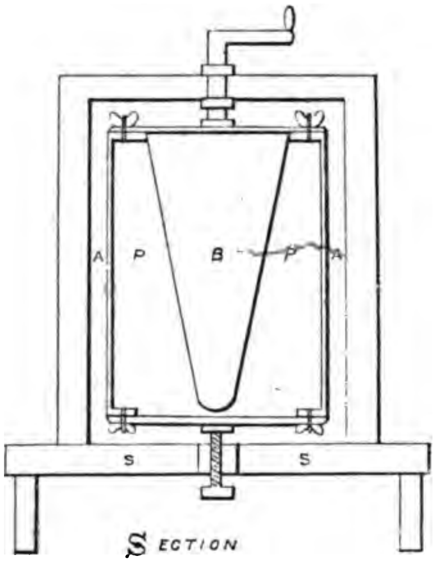
[65675.]—**Scene-Painting.**—In answer to "Dan," on scene-painting, I must say he has been misinformed as to oil colours—to wit, flatting process is used when scenes are required for a long time, for the only colour that is of use is known as body colour—i.e., glue and water are mixed with powder colours. Then, again, the effect of oil-colour in any form is objectionable, as it has no brilliancy, is very heavy, inflammable, difficult to use, poisonous to use; in fact, for scenes especially used by gaslight, oil-painting is most objectionable, although, if "Dan" would like to try it, I will give every detail. Now the cheapest and best colours are obtainable at A. W. Brown, colour merchant, 214, Whitechapel-road, London: azure blue, 2s. per lb., ultramarine, 7d.; zinc-white, 5d.; three chromes, 1s. 6d.; Venetian red, 2d.; orange lead, 3d.; three emerald-tinted greens, 6d.; Dutch pink, 9d.; burnt terra de Sienna and Vandyke brown, ground in water, 1s. 6d.; Indigo, 6s.; brown lake, 6s.; damp lake, 1s. 4d. These are a few of the principal colours, but there are many other items indispensable, but would take up too much room in this valuable paper; so if "Dan" will advertise his address, I will forward particulars of everything. I should say a few pennyworths of each colour will go a very long way. The materials are: Flax sheeting for ordinary scenes and a special gauze for visions and transformation scenes, and the first preparation is made with Cannon's concentrated size, 8d. per lb., and whiting, 2s. per cwt. The only brushes suitable are known as quill tools. I hope the above will be useful to more than one as the winter evenings are coming as fast as ever, and we all like to have something to do to pass away the dreary time when the "winds whistle cold."

E. WARD BUSSELL, A.E.E.

[65676.]—**Crushing Strain on Arches.**—On a 2½ft. voussoir of a semicircular arch of 25ft. radius, allowing heavily for parapet and rolling loads, &c., the crushing strain would not exceed 10 tons per square foot. Cement of best Portland, well mixed 1 to 4 with good aggregate, when three months set, will crush at about 100 tons; and when nine months set, at about 160 tons per foot. Leave your centres in not less than three months, and as much longer as you can up to nine months.

Sunderland. FRANK CAWS.

[65677.]—**Cheap Freezing Refrigerator.**—In a metal cylinder A, a hollow cone B of thin metal plate is so fixed as to divide the interior of A into two parts; the cone B open at the top, and the ring-shaped space P surrounding it, open at the bottom. The substance to be frozen is placed in B to about ⅓ its height; and a cover is then placed on and screwed down tight. B being thus closed, the space P is about half-filled with ammonium nitrate, and water added until the space is nearly full. P having been closed by a cover similar to that of B, only screwed to the bottom instead of the top of the cylinder, the cylinder is then placed in a stand, and is rotated for eight or ten minutes. In the sketch I have sent, which I hope you will understand, I have put a table, S, which makes the apparatus more finished, and won't need holding while being rotated. It has four legs, and is square or round, whichever is preferred. I find upon looking at the prices of chemicals, that ammonium nitrate runs about 2s. per pound.



H. M. WARD.

[65686.]—**Battery.**—This question is very easy. By Ohm's well known law—

$$E = C \times R$$
$$E = 10 \times (7{\cdot}3 + 12{\cdot}7)$$
$$E = 10 \times 20 = 200.$$

Answer = 200 volts. PORTHOS.

[65688.]—**Arithmetical.**—The walls two ends each $h \times b$ and two sides, each

No. of square feet required $= 2h(l + b)$

$$\cdot \left(\frac{355}{12}\right) = \frac{35855}{72}\text{sq.ft.} = \frac{35855}{648}\text{sq.yards}$$

comes to between 55 and 56. H

[65688.]—**Arithmetical.**—In the trac calculated by duodecimals—

17ft. × 12ft. 7 × 8ft. 5.

17
12 7

29 7
2

59 2 = circuit of room
by 8 5 height

473 4
24 7 10

497 11′ 10″ sq.ft., or 55¼sq.yds. nearl

[65689.]—**Algebraical.**—The suppose is wrong. The following is the solution—

$$- 3a - [b + (2a - b) - (a - b)]$$
$$= - 3a - [b^* + 2a - b^* - a + b]$$
$$= - 3a - 2a + a - b = - 4$$

* Erased letters.

H.

[65690.]—**Lemon-Juice.**—I think t will keep if you put it in a screw-stopper (one of Barrett's beer-bottles). This, and it in a cool place, would probably prevent deteriorating. H.

[65690.]—**Lemon-Juice.**—All fruit-ju be preserved for any length of time by one of the plans of the ancients, who, tracting the juice of the grape and othe evaporated some of the water by boiling un cient water was not left to enable the syru times it was made very thick) to ferment. juice, I suppose, would need pure suga When required for use, simply add water, have unfermented wine. N

[65692.]—**Negative Varnish.**—P white shellac, 1oz.; methylated spirit, 6oz. continually until dissolved, set aside for hours until precipitate curdles, then filter.

[65692.]—**Negative Varnish.**—The f is recommended as tough, hard, and Shellac, 1¼oz.; mastic, ¼oz.; oil of turpenti sandarach, 1¼oz.; Venice turpentine, ¼oz.; c 10 grains, and alcohol 20fl.oz. PRINC

[65692.]—**Negative Varnish.**— Sandarac, 4oz.; alcohol, 28oz.; oil of laven chloroform, 5 drachms. No. 2.—Whi varnish, 15oz.; methylated alcohol, 25o latter is not very durable. Unless quant made, it is cheaper to buy a pint of Ma Swan's, or some other good maker.

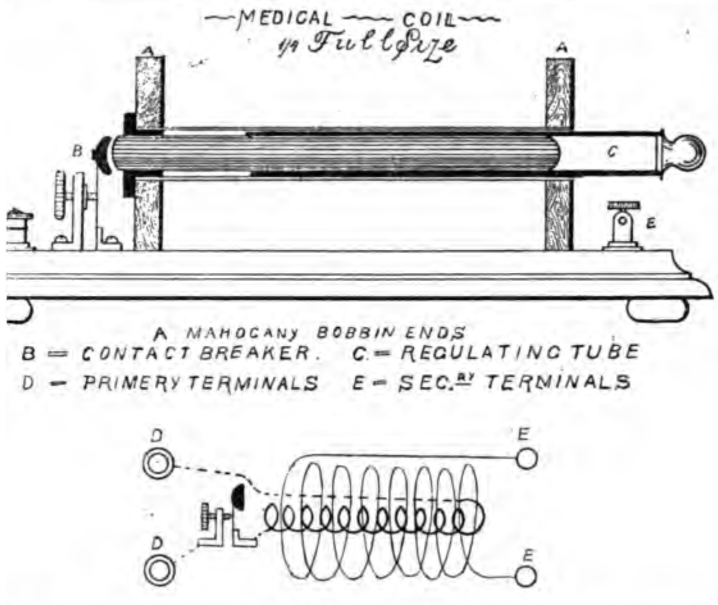
Plymouth.

[65692.]—**Negative Varnish.**— "white hard" varnish, diluted with abo its bulk of methylated spirit, makes serviceable varnish; but sometimes it is too soft. In that case, the addition of "brown hard" varnish would probably im Ordinary plain collodion protects gelatin from damp better than any varnish.

URSA M

[65692.]—**Negative Varnish.**—I f gum-arabic an excellent protective var gelatine negatives. It has two great meri it can be run on the plate while it is wet, plate dries once for all. Secondly, no ma hot a sun it is exposed to, it never stic paper. But the paper must be fairly dry. varnish which merits attention is the o given in the *Photographische Archiv*, wh follows:—Dissolve 8 parts of borax and t of carbonate of soda in 160 parts of hot w dissolve in this 32 parts of bleached shellac up small. When this is dissolved, add glycerine dissolved in 160 parts of water. deposit forms after a few days, filter off. T can be used on the wet film. A very go varnish can be made by thinning do French polish with methylated spirit straw-colour. S. BOT

[65685.]—**Coil.**—"F. W. W." did what sort of a coil he requires. I su means a medical; if so, use 1in. paper ⅙ soft iron wire core about No. 22 gauge brass tube made to slide over it 1/16in. th regulator; 4in. square mahogany ends. sectional drawing and diagram of con which explain themselves. Wind the pri with four rows of No. 24 d.c.c. wire. with paraffin wax and cover with layer of


—MEDICAL — COIL—
1/4 Full Size
A
A
B
C
E
A MAHOGANY BOBBIN ENDS
B = CONTACT BREAKER. C = REGULATING TUBE
D — PRIMERY TERMINALS E — SEC.RY TERMINALS
D
E
D
E

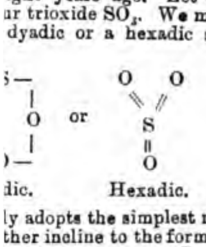
nd the secondary coil carefully with 34 silk-covered wire, using plenty and layer of thin paper between nect up as shown. When the cur- increase it by drawing out tube. nother very good way of making a Mr. Bottone's "Electrical Instru- or Amateurs," which I would advise you want an intensity coil, make d by W. Perren-Maycock, A.S.T.E. E.M." a few weeks back.

PORTHOS.

e-**Cream.**—The right proportion of freezing mixture should be about to three of ice. But, in order to a freezing mixture, the materials e capable of producing by them- nt of cold more than 30° below the of water, and this the ordinary es will not do. About the cheapest d for ordinary use is one which is loyed in France, both for making l for cooling wines. It consists of red Glauber salt (sulphate of soda), red about two-thirds its weight of (muriatic acid). This combination ee of cold 30° below freezing.

C. W. S.

lency of Sulphur.—There does e any marked change in the views this subject. Most of them con- exadic, a few look on it as being a tter of fact we have no proof of its we refer it to hydrogen), since it ine with six atoms of hydrogen, or d. If one atom of any element does th six atoms of hydrogen, we cannot nty state it to be hexadic, since, if th three atoms of a dyad, it may , as was shown by Piria and Lieben ight years ago. Let us take, for ur trioxide SO_3. We may represent dyadic or a hexadic sulphur com-



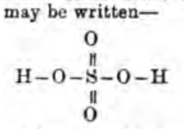
$$\begin{matrix} \text{—} \\ | \\ O \\ | \\ \text{—} \end{matrix} \quad \text{or} \quad \begin{matrix} O \quad O \\ \diagdown\!\diagdown \ /\!/ \\ S \\ \| \\ O \end{matrix}$$

dic. Hexadic.

ly adopts the simplest methods; for ther incline to the former view.

S. BOTTONE.

lency of Sulphur.—This element arded as a hexad, but its strong gen, which is always considered a throw some doubt on the subject. may be written—



$$\begin{matrix} & & & O & & & \\ & & & \| & & & \\ H & - O - & & S & & - O - & H \\ & & & \| & & & \\ & & & O & & & \end{matrix}$$

ad, but it could also be writte n—

–O–O–S–O–O–H

oing element as a diad. A sulphur said to exist, but only at tempera- reezing point, and according to om Rath, a compound having the sulphur hexiodide SI_6 may be ob- tals by evaporating a solution of sulphur and iodine in carbon disulphide. These two compounds seem to indicate a hexad atomicity for sulphur. According to Mendelejeff's classification, O S, Se, and Te form a natural group; and O S, Cr, Mo, W, and U also form a group presenting many points of resemblance. This is very clearly shown by the spiral diagram due to Prof. Odling. The whole question of atomicity is in a very confused condition; we seem to have got hold of part of a law only, instead of a whole law.

WM. JOHN GREY, F.C.S.,
Analytical Chemist, Newcastle-on-Tyne.

[65695.]—**Valency of Sulphur.**—In a book published about 1884 I read that in the case of H_2S the S acts as a diad, in SO_2 as a tetrad, and in SO_3 as a hexad. I have forgotten the name of the work in question, but I think it was called "Outlines of Chemistry." Sulphur may also be regarded as a hexad with the affinities partly latent in the above instances of H_2S and SO_2 PRINCIPIA.

[65696.]—**Electrical.**—There are numerous modifications of Daniells' elements. To which do you refer? W. PERREN-MAYCOCK.

[65697.] — **Chlorophyl.** — TO "CHEMIST."— Chlorophyl appears to be a definite compound. Its composition has not hitherto been satisfactorily ascertained. Some observers maintain that it contains iron, others deny this. It has been obtained in a separate condition by Boussingault and others, and presents the appearance of a dark green powder, somewhat waxy in nature, insoluble in water, slightly soluble in ether, more so in alcohol. It can resist a heat of 200° C. (392° F.) without undergoing change. Boussingault states that a large tree yielded only 100 grains of chlorophyl; from this we may infer that it is not itself converted into starch. From the insolubility of chlorophyl as we know it in the solid form, it is possible that the preparation is a decomposition product, and that we have not yet succeeded in eliminating the unchanged chlorophyl. S. BOTTONE.

[65698.]—**Breathing of Plants.**—It is a generally acknowledged fact. S. BOTTONE.

[65698.]—**Breathing of Plants.**—The fact that plants cannot break up the CO_2 without sunlight is universally admitted, for the force which empowers plants to break up the CO_2 is no other than the rapidly-vibrating rays of sunlight; but when this power is hindered from acting a reaction takes place. SATINE.

[65698.]—**Breathing of Plants.**—I believe it is generally admitted that plants exhale CO_2 during the night, and thus would vitiate the atmosphere. It is so stated in some of Roscoe's books. The liberation of oxygen is caused by the chlorophyl under the influence of light; when that is withdrawn it takes place no more.

R. A. R. BENNETT.

[65698.]—**Breathing of Plants.**—The theory that plants exhale carbonic acid and absorb oxygen at night has been much combated of late. I do not think the victory is clear on either side. At all events, the quantity is so small that any usual quantity of flowers in a bedroom would not be so deleterious to the atmosphere as keeping a dog or cat in the room.

Plymouth. B.Sc.

[65698.]—**Breathing of Plants.**—The exhalation of CO_2 during darkness by plants has been explained by the fact that during the light absorption of CO_2 is more rapid than the decomposition of the gas; consequently, when the light fails, the undecomposed CO_2 is returned by the plant to the air. It is not generally admitted that plants in rooms are unhealthy, but the reverse. If the plant exhaled CO_2, not previously absorbed, it would cause a waste of tissue. SM.

[65699.]—**Animal Heat.**—The heat of the body is due, no doubt, chiefly to the oxidation of fuel foods; but the fat contained in the body is a valuable reserve "bunker" of fuel, and is often drawn upon in disease or in starvation.

Plymouth. B.Sc.

[65699.]—**Animal Heat.**—The heat of the animal body is due both to the oxidation of food and also to the oxidation of the effete tissues. Formerly it was supposed that most of the heat was generated in the lungs by the oxidation of sugar; but it is now considered that oxidation of tissue is the principal factor. DOCTOR MED.

[65699]—**Animal Heat.**—The "fuel foods" as you call them, are not consumed as such. The heat is principally generated during the oxygenation of the blood; but, of course, the blood is but the great renewer of the tissue waste, so that the statement has truth in it. It is simply another way of viewing the same thing. S. BOTTONE.

[65699.]—**Animal Heat.**—A small amount of animal heat must come from the chemical action of the gastric and pancreatic juice and the gall on the food; but the most comes from the oxidation of the tissues themselves; for when we breathe in a quantity of air, part of the oxygen burns up the waste matter brought from the tissues by the blood in the lungs; another part combines with the hæmoglobin, and is taken in the blood to the tissues themselves, where it helps to oxidise them.

SATINE.

[65700.] — **Hydrokinone Developer.** — Yes. One of the features of this developer is that it keeps longer than the pyro, and can be used over and over again; for very short exposures, however, G. A. Kenyon (in the *B. J. of Photography* for 18th May) says it should be used fresh.

Plymouth. B.Sc.

[65701.] — **Breaking Strains.** — "Area of bottom flange" is evidently a section of the material forming the flange, whether it be angle-irons or plate; but it must be the area at the weakest part if there are holes in it. "Effective depth" is usually taken as the distance between centres of flanges; in the case you first give it would be 19in. "Strain on top or bottom flange at centre in tons" is the load at one of the piers multiplied by the leverage due to span and depth of girder. Thus, suppose load at centre 22 tons, it is evident each pier carries 11 tons; and if span is 35ft., and depth 19in., the strain on top or bottom flange $= \frac{35 \times 12 \times 11}{2 \times 19} = 122$ tons; and as area = 6sq.in., this gives a strain in compression or tension of about 20 tons per square inch, which would break the girder, and most probably by buckling sideways, as the upper flange is weakest in compression if of same section as bottom. A very general formula is written $\frac{80ad}{l}$ which agrees pretty well with Fairbairn's. There seems to be an error in the example given— $\frac{5}{8}$ is probably intended, instead of $\frac{5}{16}$.

Bristol. T. C.

[65702.]—**Infinite Series.**—

$$(\tfrac{1}{2})^2 + (\tfrac{1}{3})^2 + (\tfrac{1}{4})^2 + (\tfrac{1}{5})^2 + \&c., = \frac{\pi^2}{6} - (\tfrac{1}{1})^2$$

See Luby's "Trigonometry," or almost any other.

TRIA.

[65702.] — **Infinite Series.** — The current number of *The Bizarre Notes and Queries* (American magazine) says that, according to John Bounoulli (Bernoulli is probably meant), the sum of the infinite series $\frac{1}{1} + \frac{1}{4} + \frac{1}{9}$, &c., is equal to $\frac{\pi^2}{6}$. This is equal to 1·644934. Consequently, the series mentioned would be this amount less unity, or ·6449, &c.—a definite, though incommensurable, amount. F. S. S.

[65707.]—**Damp Walls.**—I read some time since the following, while looking through some old books:—"Damp Walls.—A stall, of which the walls were constantly damp, though every means were employed to keep them dry, was intended to be pulled down, when M. Schmitthals recommended, as a last resource, that the walls should be washed with sulphuric acid. It was done, and the deliquescent salts being decomposed by the acid, the walls dried, and the hall was afterwards free from dampness."—From "Recreations in Science," London, 1830. WEIRD.

[65709.]—**Transparencies.**—Yes, you can take them on gelatine dry-plates; but nothing comes up to the wet process used by Ferrier and his successor. R. THOMAS.

[65709.]—**Transparencies.**—Can be done on ordinary gelatine bromide plates; but "Lux" will probably have failures. Try Cowan's gelati chloride plates, or albumen plates. The results are perfect, and the manipulation very easy; but requires strict attention to formulæ given.

F.R.S.E.

[65709.]—**Transparencies.**—There are very few who can get satisfactory lantern transparencies on gelatino-bromide. Far better to use collodio-chloride plates. For all information on the subject look up back numbers of the *British Journal of Photography* and also the Almanacs of the same journal for the last three years.

Plymouth. B.Sc.

[65709.]—**Transparencies.**—It is quite possible to make transparencies with dry plates if the film is sufficiently thin. I have a lot of plates that are of no use whatever for taking negatives. The picture lacks density; but for transparencies they are just the thing, when developed properly. If "Lux" will write to me I shall be happy to send him one of my lantern slides to look at, and, if he wishes, a box of plates to try.

Rugby. A. Percy Smith.

[65709.]—**Transparencies.**—It is perfectly possible to get beautiful transparencies for the magic-lantern on gelatine dry-plates, and more especially on those specially prepared with mixed chlorides and bromides. A *sine quâ non* is a ferrous oxalate or citrate developer. Pyro certainly does not do for this work, whatever may be its merits for negatives. Ferrier's beautiful pictures are believed to have been printed on albumen plates. I am an old worker with the collodion process, and have a hankering after the sparkle and brilliancy of the collodion transparencies; but still, I must admit that I have obtained some superb slides by following the subjoined recipe: A.—Sulphate of iron (free from oxide), 140gr.; sulphuric acid, 1 drop; distilled water, 1oz. B.—Potash citrate, 136gr.; potash oxalate (neutral), 44gr.; hot distilled water, 1oz. The plate having been exposed under a good negative, with plenty of detail, in a well-fitting printing frame from one to five seconds in diffused daylight, or at a distance of 12in. from an ordinary fish-tail gas or paraffin burner for five to twenty minutes (according to density of negative), is developed by being placed in a dish containing a mixture of three parts B with one part of A. Measure out B first, pour in A in a fine stream, stirring with a glass rod. The liquid should be orange-yellow, quite clear. The dish must be kept rocking. The picture should develop slowly; it should take from one to ten minutes to attain full density. The plates should develop absolutely clean in the parts that have received no exposure. The development may be retarded if a plate has accidentally received too great an exposure, by the addition of five or six drops of a 10 per cent. solution of common salt. There is an excellent recipe for albumen slides for the lantern in the "E.M." for Jan. 4 and 11, 1884. S. Bottone.

[65710.]—**Electroplating.**—An electrical work published as long ago as 1860 would afford you more harm than good. Get the latest edition of Sprague, Roseleur, or Gore.

W. Perren-Maycock.

[65710.]—**Electroplating.**—Why not make and use the double cyanide solution of gold or silver, made thus?—Get a half-pint jam-pot, ½oz. refined grain silver, and about 2oz. nitric acid. Place the silver and acid in the jar; cover with a piece of tissue-paper; stand it on a warm hob till dissolved. Be sure and let the fumes pass up the chimney. Keep it hot till it crystallises, then dissolve in about one quart of cold water. Dissolve ½oz. of cyanide in one pint of water, and carefully add to the silver solution about one tablespoonful; thoroughly stir the solution each time on adding the cyanide solution. When no more silver can be thrown down, let it finally settle; then pour off the liquid, and thoroughly wash in cold water five or six times the cyanide of silver; then dissolve the cyanide of silver in a strong solution of cyanide; 2oz. to the quart you will find enough—if not, drop into the solution, piece by piece, the cyanide, until the solution is clear; then you have the double cyanide of silver, which can be worked cold or warm. I prefer to use it cold. The gold solution is made in the same way; but you make the chloride of gold by dissolving the grain gold in one part nitric acid and two hydrochloric acid; then treat the same as the silver. One that Tries.

[65710.]—**Electroplating.**—For preparing a small quantity of solution, such as that mentioned by "Perplexed," the battery method is the most suitable, as there is no risk of losing metal. The porous cell, however, may be dispensed with, as it is not necessary. For larger quantities of solution the best method is the chemical one, and you proceed as follows:—Dissolve pure gold in a warm mixture of one measure of nitric and two of hydrochloric acid; gold dissolves slowly with evolution of gas. When all is dissolved evaporate gently to a small bulk, so that it solidifies on cooling, the salt is gold chloride (a saucer will do to conduct this operation in). Dissolve the chloride in distilled water (if there is a brown insoluble residue, the salt has been overheated, and the residue must be dissolved in acid again). To the solution of gold chloride add a solution of as pure potassium cyanide (KCy) as you can get, as long as a precipitate is produced, but no longer, as the precipitate is soluble in excess; decant clear liquid, and wash precipitate carefully (wash-waters should be kept for future treatment, as they contain a little gold); dissolve precipitate in KCy, note how much it takes, and add about a quarter more, to form free cyanide. Dilute so that it contains about 1oz. of gold per gallon. The above solution, which is the double cyanide of gold and potassium, is worked hot, and a pure gold anode used. To make silver solution, dissolve pure grain silver in pure and strong nitric acid (3oz. acid to 1oz. silver). When all is dissolved, evaporate to dryness (this operation may be conducted in a glass flask on a sand bath either over gas or on the fire), and then proceed in same manner as with gold. This solution is worked cold, and a pure silver anode used; 1oz. of silver to the gallon is a very good proportion for this bath. With regard to batteries, I prefer the Bunsen, and one 6in. cell will work a gallon of silver solution, and two (connected for quantity) will work the gold solution. Excite each cell with ½oz. sulphuric acid, and three-parts fill the porous cell with strong aqua fortis (1½d. per pound.)

Birmingham. H. H. L.

[55711.]—**Motor.**—To Mr. Bottone.—Perhaps you have got your brushes at a wrong angle of commutation. Or there may be leakage from brush to brush. Or you may have wound the F.M.'s so that you have not got consecutive poles top and bottom, as you should have.

S. Bottone.

[65712.]—**Disappearance of the Moon.**—Due to eclipses. Did "Circe" read the notes on the last eclipse? Tria.

[65715.]—**Mechanical Problem.**—The weights will adjust themselves so that the distance of the lighter weight from a vertical through centre will be $\frac{3}{4}$ distance of the other weight. Call this distance x, and the vertical to the centre will be $\frac{3}{4}x$. We have therefore $x^2 + (\frac{3}{4}x)^2 = 16^2$, or $\frac{25}{16}x^2 = 16^2$. Take square root, and we have $\frac{5}{4}x = 16$, or $x = \frac{16 \times 4}{5} = \frac{64}{5}$. The verticals are therefore 12⅘in. and 9⅗in. below centre.

Bristol. T. C.

[65717.]—**Winding Electro-Magnet.**—There ought to be no difficulty in winding No. 16 by hand. I frequently wind No. 12 by hand. If you can't manage it, take off all the wire, and rewind with No. 16 on two light wooden bobbins. Tapes are very useful for holding the layers in place, when bobbins are not used. A tight-fitting wooden washer at each end is also very good, and looks neater. One gallon chromic acid with two square feet negative surface will develop full power.

S. Bottone.

[65718.]—**Dynamo and Accumulator.**—To Mr. Bottone.—The dimensions and amounts of wire given you are fairly correct. A laminated armature is one built up of laminæ, or thin punchings of iron sheet, in the form of the finished armature. You would be obliged to use a laminated armature if you wish to run the machine for any length of time; otherwise it will get hot and destroy the insulation. You had better take the superficial area of the plate only. If you do not understand the above, see my book, "The Dynamo: how Made and how Used." S. Bottone.

[65721.]—**Dynamo.**—To Mr. Bottone.—If you want to reverse the direction of rotation without reversing the relative position of brushes, reverse the connections of the field-magnet wires. Therefore, place the brushes as you desire them. Try in which direction the machine gives current. If it does not give current when driving right-handed, but does give current when driven left-handed, all you have to do is to disconnect the F.M. wires, and reconnect them in the reverse position. You need not demagnetise or unmagnetise to do this. As you do not state the gauge of the wire or the field-magnets, I cannot tell you what your machine will do. I can tell you what it should do if properly wound for incandescent lighting. It should, if driven at 1,200 revs. per minute, give about 10 ampères at 50 volts, enough to light ten of Swan's 48-volt 10c.p. lamps.

S. Bottone.

[65723.]—**Pump.**—This is the usual effect with hot feed, unless the pump is so placed as to be below the water so that it may flow into the barrel of itself when the plunger is raised. The valve-seats should be metal.

Bristol. T. C.

[65726].—**Non-Conductor.**—No metal can be made a non-conductor. Will not some preparation of asbestos (millboard, paper, &c.) suit your purpose? Principia.

[65727.]—**Magnet.**—To Mr. Bottone.—Put on 1lb. No. 20 s.c. S. Bottone.

[65729.]—**Solutions of Cane Sugar.**—17lb. of cane sugar, if dissolved in any quantity of water, is equal to one bulk gallon; therefore, if 17lb. sugar be dissolved in 20lb. of water, or two gallons, the result will be three gallons, weighing 37lb.; and any dependent question can be resolved by simple proportion. W. H.

[65730.]—**Solution.**—Chromic acid, 8oz saturated solution of common salt in water for zinc, which can remain in the liquid. It is preferable to have zinc in porous cell, and carbons in outer cell, thereby utilising the whole surface o the zinc. I presume your arrangement is *a la mod* Bunsen. E. Ward Bussell, A.E.E.

[65732.]—**Dynamo.**—If you will kindly turn t my reply 65330, at p. 311, No. 1,210, you will se the design of a Manchester type dynamo. If thi is made with an armature 4⅝in. diameter, 2¼ deep and wound with 3lb. No. 20, the field magnets bein made smaller in proportion, and wound with 15lb No. 22, you will get what you require. It can be driven by water power. If you turn to my advertisements in the Sale Column you will see that I supply all the needful castings, &c.

S. Bottone.

[65734.]—**Champagne Corks.**—Having had nearly two years in the champagne country, I beg to inform "E. M." that the corks when put into champagne bottles are cylindrical. The string and wire acting against the internal pressure, round the tops of the corks. As to the making, after the vintage, the juice of the grapes is put into large casks and allowed to ferment, till stopped by the cold. About April or May a second fermentation sets in, and the wine is then bottled before the fermentation is complete. The bottles are put in a cool cellar, and before shipment are left for some weeks in a frame, cork downwards, at an angle of about 45°. Every day the bottles are shaken with a rotary motion, *in situ*, to allow the sediment of fermentation to settle on the cork. The original cork is then taken out, with the sediment, and if any of the wine escapes the bottle is filled up, a new cork driven in, and wired and stringed. There are, of course, more details; but these would take up too much space. F.R.S.E.

[65734.]—**Champagne Corks and Champagne.**—The heads of champagne corks are brought to the shape usually seen by the pressure of the wire and string tied over them. That they were the shape of an ordinary cork originally "E. M." can see for himself if he will boil one in water for some time. The manufacture of champagne commences only when that of ordinary wine ends. After the wine is put into bottles they are placed in racks slanting neck downwards, to allow the sediment to collect in the necks; the bottles have to be twisted every day for a month or six weeks to get the sediment down to the cork, when it is finally got rid of by drawing the cork, holding the bottle neck downwards, when it goes out with a pop. If it is dône dexterously, there is not more than about half a gill of the wine lost. Then they are again filled up with wine, and receive from 1 to 6 per cent. of liqueur (finest old wine, in which sugar-candy has been dissolved, and a little of the best Cognac), according to whether the wine is wanted "brut" (dry) or rich—for, as Sam Weller says of the meat pies, "'tis the seasoning that makes the difference"—when they are finally corked and wired, and laid by for another six weeks or more, to allow the liqueur to thoroughly amalgamate with the wine and ferment, as it is the fermentation in the bottle that charges the wine with the gas that sends the cork out with a bang and causes the wine to sparkle. If that is not enough for "E. M.," I shall be pleased to reply further about champagne, or almost any other wine.

F. W.

[65737.]—**Chrome Alum.**—Set the solution aside in dish, in a warm, dry place, free from dust, for a week or so. Pour off the mother liquor from the crystals when they have formed, wash quickly in a little running water, and dry on blotting paper. S. Bottone.

[65737.]—**Chrome Alum.**—Place the exhausted solution in a gallipot or other similar deep vessel, and set aside in a warm place free from dust. In about three months you will have as fine a crop of crystals as you could wish for—that is, providing the solution is well worked out, which is known by its turning deep grass-green. If the crystals are mixed with any crystals of zinc sulphate, the latter may be picked from the alum as much as possible, and the rest washed rapidly with warm water, which will dissolve out the zinc salt, and hardly dissolve any of the alum.

Principia.

[65738.]—**Preserving Stonework.**—There is Browning's invisible stone solution, which has been applied with success to Cleopatra's Needle

.e Natural History Museum, South : don't think it has been applied to Parliament. The address of the facture it is 27, Cannon-street, E.C.

SATINE.

ık-Stains.—You might try essen- ɔn (oxalate of potash) or oxalic acid oisons). I fear anything that will k will also spoil the picture.

R. A. R. BENNETT.

ık-Stains.—If these are printer's :h suspect that you will have rather to take them out. Wash with a of chloride of lime (1 : 20), and if ıe or organic inks, they will very vay to this treatment.

PRINCIPIA.

:ost on Watch Plates.—Brush hot solution of soda to remove all ɔroughly rinse in clean water; then :e of copper wire in a mixture of d and 2 of muriatic acid; dip the out a second, then quickly rinse in n scratch-brush and gild.

ONE THAT TRIES.

ating Dynamo.—TO MR. BOT- .icker the better; 1¼in. is certainly The more iron in the F.M. and core, dily the machine will run. I am e you no simple, and yet hard and calculating the least amount of iron n your machine, as it depends upon :he iron, which varies from 40 to 50 .ng good Swedish iron as a standard, roughly, that you may expect to get tts for every cwt. of iron in the ould not advise you to use less iron

S. BOTTONE.

ɜw Algebraical Symbols.—The :ntioned by "F. S. S."—viz., three expresses equality between the two . identity, as distinguished from an ɔndition (see footnote to page 277, this part of "F. S. S.'s" question). :y sign of equality with a vertical means inequality, or "is not equal third sign mentioned means "not ' or "not less than," according to

A PUPIL OF CHRYSTAL'S.

ew Algebraical Symbols.—The t which "F. S. S." inquires, as I :m from the description appended to by no means new. The first (three ıtal lines) I first met with in Frost ılme's "Solid Geometry," published used to express that the two ex- een which it is put are identically distinguishing identities from equa- a is identically equal to $2a$, whatever ıave, whereas $x^2 + 2ax + a^2$ is only n x has certain values. The other e very old ones, two parallel lines :rtical one signifies "is not equal to," ıe with a line through it signifies than" or "is not less than," accord- of the V is towards the left or the

T. PERKINS.

WERED QUERIES.

◆

nd titles of queries which remain unan- eeks are inserted in this list, and if still repeated four weeks afterwards. We trust ɔok over the list, and send what information nefit of their fellow contributors.

Gear, p. 200.
S.C.R. Locomotives, 200.
e, 200.
ɔ0.
.0.
'k recording Cylinder, 201.
:es, 201.
e Rectilinear Lens, 201.
; Lathe, 201.

: for Woodenette Perambulator, p. 290.
ols Again, 290.
an Ry. Loco.
.ntern, 290.
r Pointing and Drilling Wire, 290.
Gas-Engine, 291.

ted that the actual density of the ıtion is, in Europe, 34 for every kilo- ı, 19; Africa, 6; Australasia, 3 to :a, 2 to 3. Taking the entire globe, t 10 people for every square kilo- uropean States, Belgium contains :s per square kilomètre; the Low ; the United Kingdom, 179; Italy, , 86; France, 72; Switzerland, 70; ıry, 59; Portugal, 50; and Spain, 31.

QUERIES.

◆

[65747.]—**Banjo.**—Will any reader give me the size of finger stick and position of keys for piccolo banjo, with 6in. hoop and six strings.—JO.

[65748.] — **Ice-Cream Tubs.** — What scientific objection is there to making these of galvanised iron, zinc, zinc-lined wood, or double zinc filled with sawdust?— E. T.

[65749.]—**Refining Gold.**—Will some one kindly tell me the simplest and cheapest way to refine small quantities of gold, say, 2oz. or 3oz.? Sometimes there is only silver in it; at others copper, brass, and lead, and then in very small quantities, but quite sufficient to prevent it being sent to the gold office for sale.—T. W., New Zealand.

[65750.]—**Lemon Squeezer.**—I want a good strong lemon squeezer, not so elaborate and expensive as those on hotel bars, and stronger than either of the ordinary cast-iron or wooden ones usually sold, because both the latter break with a thick rind.—VOOGHT.

[65751.]—**Telephone Appliance.**—Many thanks to "H. H. E." and Frank Caws for replies to this query? Will the former kindly state his opinion of the holder recommended by the latter for the Bell telephone? I should also be glad of full-sized sketch as mentioned.— VOOGHT.

[65752.]—**Hard Beard.**—The sharpest razor and hot soaping fails to relieve me of my beard in less than half an hour. Can any reader kindly suggest anything that would prevent this loss of time?—A. BOWERS.

[65753.]—**Accumulator.**—Will Mr. W. Perren-Maycock or Mr. F. C. Allsop be good enough to inform me the best way to make a small, light, portable accumulator, and the best way to charge the same, and what batteries would be best, and how many would it require to charge? — the plates to be 3½in. by 2in.?—A. E. CHANDLER.

[65754.]—**Improving Old Flute.**—Would "Vulcanite" kindly say if it is possible to improve the tone of an old form of flute, 8-keyed, by reboring? The bore is very small at the lower end, and I find it most difficult to get the lower C and C sharp.—P. HARVEY, Liverpool.

[65755.]—**Pig Iron.** — Will some one give me the maximum allowable amounts of S, Si, P, and Mn (sulphur, silicon, phosphorus, and manganese) in pig iron available for (1) foundry purposes; (2) Bessemer purposes, (*a*) acid method, (*b*) basic method; (3) Siemens process; (4) puddling process?—J. HY. THOMAS.

[65756.]—**Electric Bobbin Winding.**—Would one of our electrical contributors kindly give directions for making a small winder with a guide that will guide the wire even? I want it for winding bobbins for bells and indicators with the poles in the bobbins, so that the wire will lie close to the core. A sketch would oblige.— W. W. B.

[65757.]—**Metal-Turning Tools.**—Can any reader inform me best shape for slide-rest turning tools for iron and other metals? I cannot make one that will take a good shaving off and turn smooth at the same time. I also have some difficulty in making a parting tool.— H. M. E.

[65758.]—**Railway Gauge.**—Who first used the 4ft. 8½in. gauge on railways and at what date? In practice would not a wider gauge of, say, 5ft. have been better?— PLATELAYER.

[65759.]—**Scotch Express Trains.**—All the three great lines to Scotland are reducing the time from London to Edinburgh and Glasgow. The North Western have taken off an hour, the Midland half an hour, and the Great Northern also half an hour. Now what I want to know is how the time is saved? Is it by higher running speed, lighter trains, or fewer stoppages? Is the Midland run of 123 miles 61 chains the longest run there is in England without a stop? This is performed from St. Pancras to Nottingham.—LOCOMOTIVE.

[65760.]—**Astronomical.**—Would "F.R.A.S." or any other of our astronomical friends kindly mention one or two works in which the formula and computation of cometic orbits are given at length by elementary mathematics? I should also be glad to hear of a good modern work on the solution of mathematical problems by the graphic method —AMATEUR.

[65761.]—**Dissolving Sulphur.** — When making some experiments with sulphur I have discovered an oil which dissolves it quickly by heat without any disagreeable smell. I am informed that this combination may be valuable for medical use, or as a lubricator. Will some brother reader give me his opinion as to its practical value?—M. M.

[65762.]—**Dynamo.**—TO MR. BOTTONE. — In the standards of my 50c.p. Gramme castings there are two ⅝in. round holes. Have they to be bushed with brass for the armature shaft to run in? If so, what diameter should the shaft be? Also what diameter and length should the commutator be?—A. W. H.

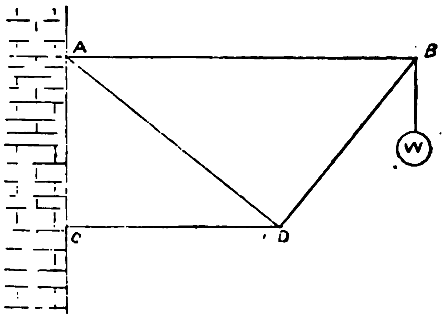
[65763.]—**Boiler.**—Will "T. C., Bristol," or any competent reader give dimensions of a 2H.P. vertical boiler with one flue up the centre, giving thickness of plate, diameter and height of boiler, height of furnace, and diam. of flue. Should this taper? If so, please give diameters at top and bottom; boiler to be constructed with angle iron at the corners. Will best charcoal iron do for plates?— R. H. R.

[65764.]—**Grandfather's Clock.**—I have an eight-day, long-cased, English striking clock, commonly called a Grandfather's clock. It has the days of the month, also the moon's changes. The parts that are wanted to make the moon part act are gone. The moon dial is about 6in. diam., and revolves once in two months. Would one of "ours" kindly tell me how to make the above act, and where the necessary parts required can be purchased, and if it can be done without a lathe? I have tried to make the wheel that moves the days of the month make the moon act, but it does not answer. There is a small pivot about ¼in. long, about ½in. from the hole in the dial which the hands go through, that is riveted or screwed into the dial. One of our valuable mechanics would be conferring a great favour by helping another in a matter he cannot understand.—GEO. LLEWOP.

[65765.]—**Small Electric Light for Shop.**—Will anyone who can speak from experience tell me if a one-man-power gas-engine would have sufficient power to drive the necessary machinery to produce light from six small lamps such as are in the berths of any of the New Zealand Shipping Company's mail steamers, and also state the quantity of gas used per hour when at full work? Can each light be used separately? How long will the lamps last? Also any advice about extras, as I can procure nothing here.—T. W., New Zealand.

[65766.]—**Harmonium.**—I have a splendid harmonium by Alexandre, in polished oak case, 13 effective stops, 4 full sets reeds, good tone, but has the following defect:—When I press the left foot pedal there is a buzzing or grunting noise proceeds from the left-foot bellows. I have had a professional to examine it, and he says it is the air that escapes past the leather that acts as valve over the holes at the under side of the bellows. The wood of the bellows bottom is all in one piece, with only the holes covered with the leather spoken of inside. I shall be very thankful to any friends who will kindly give me their advice as to the best means of getting it put right again.—A WORKING MAN.

[65767.]—**Mechanics.**—A B is a bar fixed in a wall at A, C D is another bar resting against the wall at C, and connected at the point D with the bar A B by means of connecting pieces A D and B D, and a weight is hung from B; C D is shorter than A B. Required the stresses on all the bars, and show which are in tension. Find also resultant stress on the point A. May neglect weight of bars.—STATICS.



[65768.]—**Dynamo.**—TO MR. BOTTONE.—Many thanks for your reply to my query 65610. I now find I have made a mistake which has misled you. My F.M.'s are wound with 7lb. No. 16, instead of 18 as I before stated. I tried the F.M. in parallel, but with no success. I have an idea the F.M. cores are too thin. They are ¾in. thick 6½in. long, and 5½ high, and have four coils of wire on them. Would I get a better result by winding a coil of naked soft iron wire round them of, say, 12 B.W.G.? This would make them 1in. thick. The armature core is also ¾in. thick. I have a table of resistances, which states that No. 20 = 2·095 ohms per pound, but this is wrong according to your calculation.—NO SIG.

[65769.]—**Photography.**—Would some of "ours" kindly help a beginner? My negatives come out miser-[illegible], and although I have tried various exposures I still [illegible] lost in the fog. One brought out the pattern of the [illegible] paper beautifully, but there was scarcely any image of the friend whose photo I tried to take. I use the ferrous oxalate developer and I develop till the picture has come to its best and just begins to fade. Then I well wash and put it into solution of hyposulphite of soda, and this seems to take the picture away, leaving it miserably thin with scarcely any outline of the subject visible. Should it be put into anything after the hypo. or before it? —STOKO.

[65770.]—**Pitch of Screw.**—What is the definition of the pitch of a screw?—THORNFIELD.

[65771.]—**Wood-Lice in Cucumber Frame.**— Can any reader tell me what will destroy wood-lice or prevent them from entering a cucumber frame and devouring the cucumber?—R. A. R. BENNETT.

[65772.]—**Giffard's Injector.**—Will some of your readers inform me the best method of keeping the inside from burring, and keep it in working order when constantly using rock water?—R. B.

[65773.]—**Iron Roofing.**—Can any reader inform me if gas-tar will destroy galvanised iron roofing? If so, which is the cheapest and best article to use to preserve it?—J. J. S.

[65774.]—**Formula for Solar Heat.**—This is suggested by the Cane paradox (letter 29812, p. 393) that the Pole must receive, during Midsummer Day, more than a place at the Equator receives in any day whatever. If we call the heat a place at the Equator receives during a day of Equinox, 1, what formula is there for that received in any other given latitude during a day that the sun has (or may be assumed to keep) a given P D? Also what formula for the whole yearly receipt in a given latitude? I make the Poles yearly receipt but ·41475 of the Equator's —namely as sin. 23° 27′ to sin. 73° 35′, the latter being the suns P D when his longitude is 45°, 135°, 225°, or 315°. The Equator's yearly receipt is about 351 times that of its warmest day, the day of Equinox. Either Poles (were they equalised) would be but 145 times the same unit.— E. L. G.

[65775.]—**Secondary of Vertical Coils.**—A careful search through the last six volumes of the "E. M." has enabled me to collect much valuable information with respect to the construction of induction coils on the vertical plan, but I cannot find any precise directions as to the method in which the wire of the secondary is wound. After filling one section, is the wire carried without a break to the bottom of the next and so on, until the whole of the sections are completed, or are they wound separately and afterwards connected? If so, how? In describing a large coil made by Messrs. Siemens, Prof. Fleeming Jenkin says:—"The coils are connected in series, so that the current flows from the outside to the inside of one compartment and from the inside to the outside of the next." This plan would appear to necessitate a hole being made low down in every alternate partition for the passage of the wire from one compartment to the next. I should like to know if this is so, and if the secondaries of the powerful coils which have been from time to time described in these columns by Mr. Baugh, Mr. Higgs, and other correspondents are wound on the same principle. Any information on the subject will much oblige.—SODIUM.

[65776.]—**The Movements of the Heart.**—Whilst in bed one night my attention was drawn to a gentle tapping. On investigation I found that it was caused by the vibration of the foot of the bedstead against a wood casement. I also noticed that the taps were simultaneous with the beating of the heart. Being interested, I investigated still further and found that by stopping the free access of air to the lungs that the taps were less frequent; during expiration they were rather quicker, but during inspiration they were quicker still. Would the movements of the respiratory organs cause the iron framework to vibrate quicker, or does the heart beat slower or quicker according to the supply of air to the lungs?—W. E. YELTSA.

[65777.]—**Crystallisation on Battery Zincs.**—In Vol. XXIV. of the "E. M.," p 79, "Sigma" repeats the information given in his book:—"It is false economy to to use alkaline solution with the zincs." In this I quite agree; but having read the admirable reply of "An A.S.T.E.," on p. 398, of Vol. XLV. "E. M.," I tried a Bunsen cell with salammoniac in place of the usual dilute sulphuric acid. I am quite satisfied with the result; in fact, with the same resistance in circuit the deflection is a little greater than when sulphuric acid is used. Unfortunately, if left standing, the crystals deposit and adhere firmly to the zinc. I should have thought had the nitric acid passed through the porous cell, as suggested by "Sigma," it would have dissolved it off as rapidly as it formed, but it is not so. How would it do to add a few drops of muriatic acid in the zinc cell—not enough to cause the solution with the unamalgamated zinc to effervesce, but just sufficient to prevent crystals forming? I ask because I have a lot of zincs that have been cast in sand, and the rough surface seems to facilitate the evolution of hydrogen; however well I amalgamate it soon breaks down. Any suggestion will much oblige, as I know well nitric and muriatic acids mixed are a most powerful solvent.—M.M.I.&C.S.

[65778.]—**Indicator.**—Have a small indicator with three holes and bell attached, and have four No. 2 Leclanché cells to work it, distance about 30yds. with return wire. There are two coils for the bell and one for the flag in the indicator, which is termed, I think, a fall-back indicator. Very often one of the three flags refuses to fall, but the bell rings always, so the circuit must be quite right. There is a small iron armature about 1-16in. from the coil. I have changed the coils. The first one did not work at all well, but when put in the place of one of the others it worked all right. I then put the one I changed in the place of the first one. It worked all right in its own place, but does not work at all satisfactorily when put in the place of first one. I also changed the flags, but with no better result. The coils are fixed in an iron frame, and I am certain the ends of coil wires do not touch anywhere. Will one of "ours" please say what is the probable fault in this case? Is there not sufficient battery power? The cells are all new and so is the indicator, and each cell shows the same deflection on the galvanometer—50°. Is the small No. 1 cell best for this kind of work?—PERPLEXED.

[65779.]—**Time Balls.**—To MR. W. PERREN MAYCOCK, A.S.T.E.—Thanks for pointing out my error. I sketched the diagram with the holes—not thinking it would be published, as it was not exactly the thing asked—before putting connections, which I did not overlook. Would you or others also oblige me with a description of the working of the Greenwich time balls? We have had one put up by Mr. Willing on his clock tower here—Brighton. A sketch would oblige.—WEIRD.

[65780.]—**Tubular Organ Action.**—Can any of the numerous amateurs or professional organ correspondents tell me which is the best and most reliable tubular action for pipe organ? I shall be glad of a sketch. I want to be able to play an organ some distance away from the instrument.—W. S. L. D.

[65781.]—**Magnet for Magneto-Machine.**—To MR. BOTTONE.—I am making a magneto-machine to your instructions in "E. M.," No. 1,176, p. 127. I have made a magnet of the best tool steel to the sizes given. Would you advise me the best way to magnetise it, giving quantity and size of wire to lap it with? I may mention that I can obtain the use of a dynamo giving 800 volts and 10 ampères to magnetise it with. Would you oblige by stating what c.p. I should get from above machine when finished?—A. W. R.

[65782.]—**Lithographing.**—Could any subscriber advise how I might take impressions from printed matter, say, two or three years old, so as to adhere to stone by means of chemicals that will soften the old ink, and make it become fresh, and by placing it on stone adhere to and print from the same as if taken from a copper-plate, or a new litho. writing?—LITHO.

[65783.]—**Repairing Flute.**—I have an old concert flute made of ivory with silver keys. It has been a very good one, but the springs have got weak. They are made of brass. Is this necessary? If not, will steel do? Also please give short directions for hardening and tempering either metal.—C. H. B.

[65784.]—**English and Foreign Meat.**—Can any of our scientific readers say whether there is any difference between the beef fed in Belgium, Australia, or America and the English fed? If one of each were killed in this country and hung in a slaughter house, together could any practical butcher distinguish the one from the other, and is the analysis and synthesis of each the same?—NEEDY INQUIRER.

[65785.]—**Type Metal.**—Is bismuth ever used in type metal instead of antimony? I lately dissolved some old printer's type in boiling aqua regia, and obtained a white mass. This I shook up with water and filtered. I reduced the remaining white insoluble substance with $NaHCO_3$ on charcoal and got metallic globule with yellow incrustation. I then dissolved the lead in HNO_3 and added H_2S and got a black precipitate. Would not this prove that there was bismuth in the alloy, as all the lead salts would be dissolved in the water?—E. H. L. S.

[65786.]—**Accompaniments on the Banjo.**—Will any reader inform me how to play accompaniments to simple songs? I know all the chords, &c. I am told that the ear is the only guide, but is there no stated rule. For instance, if a tune is written in the key of C, is not the accompaniment same key all the way through?—BEGINNER.

[65787.]—**Gums and Gum Resins.**—Will our old friend "Eos" or others give some information about the following? Mastic, copal, frankincense, sandarach, olibanum, tragacanth, ammoniac, and assafœtida. The points required are preparation, chemical and physical properties, and use.—PRINCIPIA.

[65788.]—**Carpet-Beating Machine.**—What is the principle of carpet-beating machines, and is machine beating more or less injurious to the carpets than the old-fashioned hand-beating?—URSA MINOR.

[65789.]—**S.E. Locomotives.**—Can anyone give the numbers and dates of the 7ft. bogie expresses illustrated on p. 333 (64999)?—V. J. B.

[65790.]—**Channel Steamers.**—Will some kind reader tell me where I can find descriptions of the newest steamers running between this country and Holland, Belgium, France, and Ireland?—V. J. B.

[65791.]—**Angle Rings.**—Would "T. C., Bristol," be kind enough to say the best way to make small angle rings for model boiler? I want them about 1-16in. thick, and about ⅛in. in the flange.—W. S.

[65792.]—**Revolving Stereoscope, to Construct.**—I beg to ask some of our kind readers to tell me how to make the above with cost of lenses and slides for the same? A diagram will oblige.—T. CASSON.

[65793.]—**Gramme Dynamo.**—Will some of the many electrical correspondents kindly offer advice on the following particulars? I have made a dynamo, the results from which are far from satisfactory. The armature is 4in. diam., 3in. long when wound, core is made of iron wire to a thickness of ⅛in. The armature is wound in 16 sections, wire used about 2⅜lb. No. 20 c.c., giving a mean resistance between the brushes of 0·81 ohms as measured on W.B. The F.M.'s are four in number, screwed into one base. They are each 4in. long by ⅜in. diam. The yokes are fastened on the top, one to each pair of F.M.'s. Being under the impression that the running resistance of A. would be about 1·5 ohms, I wound the F.M.'s with about 8lb. of supposed No. 16 d.c.c., having a calculated resistance of about 1·6 ohm. This brings the diameter of F.M.'s to 2⅜in. They are wound quite correct as regards the distinct poles. The F.M.'s were connected in series with A. brushes, these being adjustable round the shaft. On working the dynamo I obtained very slight traces of electricity, even up to 1,500 revs. per min. I then connected all F.M's in parallel and in series with brushes. The results were this time much better, but far from satisfactory. I then connected each pair of F.M's in parallel, in series with the brushes. The results this time were much better, sparking violently at the brushes, which are adjusted to the most favourable position (horizontal). The brushes are made of hard drawn copper wire, being about ⅜in. broad. There is also a perceptible drag when placed on short circuit. If the circuit be broken, great sparks of self-induction take place across the intervening space. If the bare wires are held in the hands, on breaking the circuit distinct shocks are felt. If driven at about 1,500 revs. per min. will raise to incandescence about 1⅛ of Pt. wire, having a diam. of 0·0048 of an inch. If driven at about 2,000 revs. will raise to a dull red heat about 3in. of 0·013 iron wire. I have tried connecting F.M.'s in shunt with A., but the results are not so good as previously enumerated. I therefore use at present the previous connections. The current as measured on a self-made Sprague's galvanometer gives about 4 ampères. This galvanometer I consider gives very fair results. I had reasons to doubt the thickness of the wire on F.M.'s. On measuring found it to be 0·057 of an inch diam., which makes it into No. 17, as compared to No. 16 having a diam. of 0·065in. I then measured the F.M.'s coils with a W.B., with the following results:—F.M. coils in series 2·636 ohms, 2 in series and placed in parallel as in the experiments previously described 0·66 ohm. These resistances point to the fact that the F.M.'s are wound with No. 17, not No. 16. I shall be very glad if anyone will suggest any alterations, which I will willingly make, so as to increase the efficiency. Also the probable results. Whatever the final results are, I will make known.—R. A. K. SAL.

[65794.]—**Spermaceti.**—Can any of "ours" tell me anything concerning the above?—PRINCIPIA.

PEROXIDE OF HYDROGEN, according to Dr. Love, of St. Louis, is a most valuable agent in the treatment of diphtheria, ozæna, and in all cases of cancerous ulceration and of suppuration or necrosis. He employs it in a solution containing 0·5 to 3 per cent., using most frequently, however, a strength of one per cent., diluting the commercial "ten volume" peroxide with two or three times its volume of water. Of its value in clearing away and effectually deodorising the decomposing exudate in cases of diphtheria he speaks in the most emphatic terms, and he regards the remedy also as one of great usefulness in scarlet fever, whooping-cough, and other specific diseases.

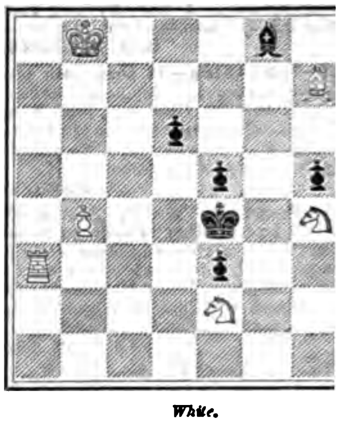
THE kind of food taken by cows alters the milk both in taste and appearance. Madder and saffron will colour it; the odour will be altered by taking plants of the onion tribe, and the taste by such articles as turnips. Milk may acquire medicinal properties by cows feeding on certain plants, and this method of treating diseases has been suggested.

CHESS.

ALL communications for this departme
addressed "CHESS EDITOR, ENGLISH MEC
Strand."

PROBLEM MCIV.

Black.



White.

White to play and mate in three mov

SOLUTION TO 1,102.

White.	*Black.*
1. Kt-B 6.	1. Anything.
2. Kt or B mates.	

(Three variations).

NOTICES TO CORRESPONDENTS

CORRECT solutions to 1,102 by T. H. Bill
Methuen, T. A. Pringle, R. G. Briscoe, H
Fellows, J. Kistruck, A. Wheeler, J. G. Hankin,
W. Jay, G. W. Middleton, A. Dean, and Link;
A. Dean, W. Jay (2), Link, G. W. Middleton.
(2), R. G. Briscoe (2), J. Methuen, and T. H. Bill

THE *Wesley College Quarterly* has just start
column. There is an excellent article on "Chess:
and Prose." Problem and Solution Tourneys
mence with the present number. Prizes are
money and books. Chess brilliants are given in
of selected games and there are problems by Mr.
Rowland.

THE *Daily American* received with thanks.

WE append a problem by Dr. Zukertort (is
only one by him?) dedicated to Alderman F. I
president of the Bradford Chess Club. It was
in 1884. White:—K, Q B 6; Q, Q Kt 3; R's, Q
K sq; B's, K 8 and K B 6; Kt K Kt 3; Ps, Q
Q B 6, K 5, K Kt 4, and K R 4 (Thirteen pieces)
K, K 3; Kt, Q Kt sq and Q B 2; P's, Q 4, K 2
(Six pieces). White mates in two moves. It
worthy of his great reputation.

DR. ZUKERTORT was buried on Tuesday,
Brompton Cemetery, the funeral being atte
number of chess friends.

THE death of Dr. Zukertort has seriously inte
the progress of the British Chess Club Handic
ment, besides placing difficulties in the way
mittee as to the assessment of the scores of
competitors.

Photographing the Sun.—Mr. J. C
of Liverpool, writes:—While experime
a ray of sunlight in a darkened room,
attention directed to pinhole pictures,
the opinion that startling results can b
in photographs of the sun or moon in
In a room darkened by blocking up win
thick paper, make a small hole in the pa
"darning needle" so as to admit a ray
sunlight; hold a piece of white paper i
of the ray 12in. from the hole, you wi
image of the sun ⅛in. in diameter, at 4ft.
of ½in., and at the distance of 8ft. from
image, and so on. The size of openin
lens does not alter the size of image at
distance, but only its sharpness and b
Say the opening is $\frac{1}{16}$in., and gives a sha
at 4ft., by enlarging the opening to ⅛th
the image at 4ft. would be still the sam
sharp, so that the screen or plate must b
to twice the distance to obtain equal
In a room 100ft. long a 12in. picture o
could be had, and of the moon one
larger. A series of pipes 100 yards long
would give a 3-foot photograph of the
fact, there is no limit to size of ima
length of camera. Perhaps someone who
time and space at their disposal than I
take the subject up.

FROM London to Manchester is 184 mi
Midland or London and North-Western
miles by the Great Northern. All the c
perform the journey—by the fastest trai
hours. Taking the three together, the
down and 28 up trains doing the dista
day under five hours, averaging thr
round, or 42 miles per hour, including

we shall describe the method of working and joining shell. For the present we shall suppose that there is at hand an ample stock of flat plates and cylindrical pieces of all sizes, or, at least, that one is at hand suitable for the box with which we are engaged. . . . There are to be had pieces of horn also made to imitate shell, upon which beginners should make their first trial, owing to its low value.

If the cylinder to be used is not perfectly round on the outside, and of uniform thickness, it must be mounted on a chuck turned perfectly cylindrical. This must enter it a little tightly, without using force, and the work must be finished on the outside to a cylindrical form, and must be dressed with special accuracy on the end, which will have to be at the bottom. Some light grooves must be also made on the part that is to be joined to the wood, that it may the better hold the glue.

The plate which is used to form the bottom is ordinarily sufficiently well dressed. Some roughness can be produced on one of its faces with a coarse file. Then, placing on the centre a little piece of brass, on which a slight centre punch-mark has been made, the point of a pair of compasses is to set there, the other point of which should be a cutting one; and by this means the plate is to be cut out of a suitable size for the box. At the bottom of the box is to be put a thin layer of vermilion, diluted with a little hot glue. This mixture gives an agreeable tint, and conceals the wood, which the transparency of the shell would allow to appear. The plate is then to be laid upon it.

In the same way the cylinder is to be glued, which should enter tightly, and the whole is to be placed in some kind of press, so that the pressure screw may be applied against a cylinder very nearly the size of the box inside, and a little less in height. All this can be managed without removing the box from the chuck. As regards the cylindrical lining, it suffices to press it down on the bottom, and if only some heavy weight is placed upon it, it will be sufficiently well secured. In order to fasten the bottoms and linings of shell to boxes and other articles demanding neatness and strength, fish glue is the safest to use. Its whiteness does not alter the brilliancy of the colours which it is desired to preserve. Besides, it dries very quickly, and holds much better than the best strong glue, even of English manufacture, which is justly considered the best, whereas ordinary glue has always a brown colour, which it communicates to the joinings and renders them conspicuous, whatever care may have been taken to make them well. The same operation is to be used on the cover, and the small cylindrical lining must be glued in with great nicety, and the whole placed in some similar press. As soon as the glue shall have become thoroughly dry, which will take about twelve hours, the box is to be returned to the lathe, and with a side tool the inside is to be accurately turned, reserving a sufficient thickness at the neck. As regards the height by which the neck should exceed the body of the box, the custom is to give it about one-third the height of the box. A last touch is to be given to the outside to make sure that the box has not got out of truth. The inside is to be polished with pumicestone and a little oil, and, finally, the last polish is to be given with tripoli ground in water, which is sold in Paris in small cakes called "Trochisques." The inside of the cover is to be finished with the same precautions, and as we are supposing that it is desired to ornament its outside with circles of shell, the following is the way in which it is to be taken in hand.

O. J. L.

(*To be continued.*)

THE Natal coalfields are now connected by a *railway* running from the pits to the sea, and the *first train-load has arrived in port.*

BRUNETTI'S PROCESS FOR ORNAMENTING GLASS AND CERAMIC WARE.

AN improved process of decorating or ornamenting articles of glass, porcelain, ceramic, and vitrifiable materials in general has been patented in this country on behalf of C. J. Brunetti, of the Faubourg St. Martin, Paris. By means of this process it is stated that results are obtained equal in respect of sharpness and delicacy to those obtained by hand decoration. According to this improved process, the ground of the design to be reproduced is first printed upon any suitable transfer surface which is capable of being applied upon the object to be decorated, care being taken that the design is in blank or in reserve, and that the ink or varnish covers all the ground or parts of the surface that are not to receive the metal which is to constitute the decorative medium. This impression having been transferred to the article, a coating of some incombustible material, such as asbestos or a silicate, and preferably pulverised chalk, is then applied by dusting or otherwise to the ground, which has been printed on as above mentioned, so that when the article is afterwards placed in a muffle the material shall not become incorporated therewith. The ground having been thus protected, there remains exposed only the portions reserved for the design upon which the gold or other vitrifiable metal is then applied either with a brush or by dabbing or by immersion or other means.

The article is then fired, and after removing the protective coating from the ground which surrounds the design there remains only the gold or other metal in sharp and clearly defined outlines upon the porcelain or other surface to be decorated.

DUN AND HASSLACHER'S SECONDARY BATTERIES.

IT is well known that the lead plates of many forms of secondary batteries are rapidly destroyed by the repeated chargings and dischargings; but Messrs. Dun and Hasslacher, of Frankfort-on-Main, believe they have invented a secondary battery which is possessed of long life, and they have accordingly patented it in this country. The battery is said to have a durability which is not limited, and nevertheless possesses all the requisite properties, such as sufficiently high tension, powerful current, and capability of application immediately after the first charging. The negative plate consists of retort or other artificial carbon, or of a metal that is soluble in caustic soda or potash solution, such as copper, silver, iron, platinum, antimony, &c. The depolarising substance consists of a metallic oxide or peroxide insoluble in caustic alkali solution, or hydrates of such oxides, which have the property of passing to a higher stage of oxidation by combining with oxygen—in particular, oxides of silver or copper, peroxide of manganese, protoxide, and peroxide of nickel, protoxide of cobalt, and oxide of bismuth, these bodies being used either alone or in combination. The use of oxide of copper alone is less suitable, because the higher stages of oxidation thereof are too unstable; but it can well be used in combination with one or more of the other oxides, such as with silver oxide, nickel protoxide, &c., probably because a peroxide or acid assists and accelerates the higher oxidation of the other bodies by its readiness to part with oxygen. In order to increase the effectiveness, carbon powder or powdered or finely granulated metal, insoluble in caustic alkali, such as copper, iron, silver, and antimony, may be mixed with the depolarising substance. The depolarising substances, combined by water or other binding medium to form a homogeneous plastic mass, are applied in suitably thick layers to the surfaces of the carbon or metal plate serving as negative electrode, and that is dried until it is sufficiently hard to stand the further treatment without becoming detached from the plate.

The prepared electrode is wrapped in a covering of asbestos or parchment paper or linen, jute, or hemp tissue, or other suitable material that will allow the liquid and the current to penetrate through it. For insuring greater stability the plate may be further inclosed in a tightly-fitting covering of iron or copper wire. The negative electrode when provided with a conducting strip is then ready for use. Instead of using solid metal plates, plates of copper coated with silver or platinum or other electroplated metals may be used, such as nickel-plated iron, or again, a plate of one metal can be mechanically covered with another, such as iron with copper. The positive electrode also consists of a metal or carbon plate insoluble in caustic alkali, copper being used by preference. For exciting liquid is employed a more or less concentrated solution of zinc oxide or lead oxide in caustic alkaline lye with greater or less excess of potash or soda. For making up the battery the negative electrodes are arranged alternately with the positive electrodes in any desired number in a vessel, so that spaces intervene between them, and the negative and positive plates are then respectively connected to a common pole. In charging, the electric current is introduced in such manner that the separation of oxygen takes place on the negative or coated plates. The oxides are in consequence hereof converted into the higher combinations with oxygen, while metallic zinc or lead is deposited on the positive electrode from the solution of zinc or lead oxide and potash of soda solution.

In discharging, the operation is reversed, the higher oxygen combinations previously formed becoming deoxidised, so as to reassume their original condition, while the zinc or lead deposited on the positive plate becomes oxidised and dissolves in the alkaline solution again. Instead of using zinc or lead any other metal may be used that will combine with the alkaline solution on closing the circuit, such as tin in the form of stannate of potash or soda. At each successive charging and discharging, the above operations repeat themselves in the same manner, without deterioration of the plates, so that a secondary battery thus constructed is of practically unlimited durability. It is advisable to amalgamate the copper plates, as the zinc deposit is then not only more compact, but also adheres more firmly than with unamalgamated copper plates. By this means also, even the slightest local action between copper and zinc is prevented, which is of importance if the battery is to remain charged for any length of time.

In order to prevent partic[illegible] zinc that may become detached when ve[illegible] deposit thereof take place from falli[illegible] bottom beyond the action of the curr[illegible] not become dissolved again, it is ad[illegible] the bottom surface of the vess[illegible] with [illegible] layer of mercury, into which a[illegible] plates are made to dip, care bein[illegible] taken [illegible] the negative plates are not in c[illegible] with. Or in place of mercury a pl[illegible] may be used, which, being put in [illegible] with the positive plates, will ke[illegible] particles under the action of the c[illegible] the entire vessel of the battery migh[illegible] of iron, copper, or other metal insolu[illegible] exciting liquid employed, and serve a[illegible] the positive electrode. In place of [illegible] copper plate one or more layers of copper [illegible] netting or gauze may be used, whereby [illegible] will the deposit of zinc or lead be facil[illegible] but the adhesion of the deposit will be [illegible]creased. Or perforated copper plates may [illegible] used for this purpose, which may be co[illegible] with one or more layers of copper wire [illegible] In order to prevent the action of atmo[illegible] carbonic acid upon the exciting liquid, [illegible] should be covered with a layer of paraffin [illegible] or the vessel may be hermetically closed [illegible] a cover of solid paraffin and gypsum, th[illegible] which the two polar leads are passed. [illegible] cover has an opening closed by a ball [illegible] permitting the escape of the gases given [illegible] and serving for the introduction of water [illegible] make good the quantity converted into [illegible] during the charging operations.

PHYSICS WITHOUT APPARAT
THE COMPRESSION OF AIR

"HERE is a decanter with a large [illegible] which I am holding horizontally. I [illegible] in the neck a cork. Will you," say I to a y[illegible] friend, "blow upon the cork? I defy you, [illegible] blowing, to make the cork enter the bottle."

My pupil takes the decanter in one hand, [illegible] represented in the figure, and with the seren[illegible] the tension draws it straight. The die, therefore, which moves up to form the inside of the curve, is grooved out, and the edge, being received in this groove, is kept from crimping. They are now punched with the two holes in the heel, for the attachment of the false heel indicated by the dotted lines of Fig. 4. They are then heated in an open fire, so that they may not get hot except where they are to be hard, on the heel, and their propensity to get hard having received a slight stimulus by a dose of cyanide of potash, they are dipped to the proper depth in a tank of oil, and allowed to remain until they are cool. They are then sawdusted to remove the oil, and are then ground on hard emery wheels, wherever they will touch the soil, and are afterwards polished on buff wheels.

Although considerable pains is taken to make these shoes as hard as they can safely be made, yet the constant scouring in the sand through which they are drawn acts with as much efficacy as a sand blast, and it is only a question of time and use when they will be worn out on the heel. To avoid the expense of replacing the whole thing, a false heel is made, which is shown in Fig. 7. It is made of sheet steel, and is first folded at the drop, in the shape shown in Fig. 6, and at the same time receives the curved form on the bottom. This makes a solid, unwelded joint in front, directly under where the edge meets, and prolongs the edge of the shoe. This edge is left solid, because a weld continually presented to fine sand, in that position, would be severely tried. The holes are punched, and this curve also brings up the stock, for support in punching the front hole. After punching, the pieces are sheared to shape, the lower back corner is welded and sharpened, and the sides are then opened by a "former," and then the cutting edge is hardened. They are afterwards ground and polished, and when needed are riveted on the old shoe by the purchaser.

PROTECTION OF BUILDINGS FROM LIGHTNING.—III.*

By Prof. OLIVER J. LODGE, D.Sc., F.R.S.

(*Continued from page* 409.)

THE word "inertia" one uses as conveying a correct general notion of the behaviour of an electric circuit to sudden electromotive forces; a behaviour which is caused by the influence or induction which every portion of a circuit exerts on every other portion. Consider a conducting-rod as analysed into a bundle of parallel wires or filaments, and let a current be suddenly started in all. The rising current in any one filament exerts an opposing force on all the others; and this self-generated opposition E.M.F., due to induction between the different filaments of the conductor, exactly imitates the efforts of ordinary inertia as observed in massive bodies submitted to sudden mechanical forces.

The term commonly employed to denote the electrical inertia-like effect is "self-induction"; which is becoming gradually shortened to "inductance"; its original form when first dealt with by Sir William Thomson was the "electromagnetic capacity" of the circuit.

Now, since electric inertia is due to a mutual action between the filaments into which a conductor may be supposed divided, it is manifest that the closer packed they are the greater their inertia will be; and that to diminish inertia it is only necessary to separate the filaments and spread them out.

The main count of the indictment against ordinary procedure is, that too much attention has been hitherto paid to conducting power, and too little to inertia. In fact, it is not too much to say that practically nothing but conductivity has been attended to, or thought of, in the erection of lightning conductors.

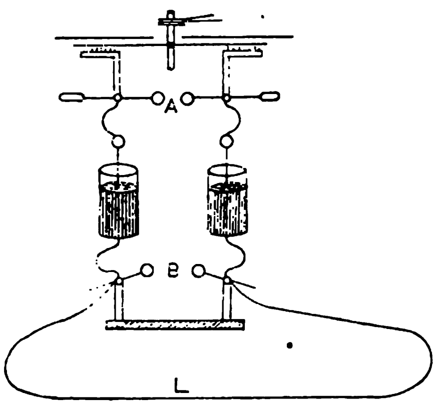
I want to show that conductivity is, from many points of view, of hardly any moment, and that the circumstances of a discharge are regulated far more by inertia than by conductivity. I can even show that, under certain circumstances, high conductivity appears to be an actual objection, and that a stout rod of good conducting copper carries off a flash less well and quietly than a thin wire of badly-conducting iron. Let us proceed to verify this paradoxical statement at once.

Experiment of the Alternative Path.

The first form of experiment I have to describe is a very simple one. I call it the experiment of the alternative path. It consists in giving a Leyden-jar discharge the choice between a certain conductor and a certain length of air, and in adjusting the length of air until it had as lief take one path as the other.

I am not aware that the particular mode of carrying out this simple experiment has any special significance, but to be definite, I depict, in Fig. 1, the symmetrical arrangement I have most frequently, though not exclusively, adopted. The knobs marked A are the ordinary terminals of a Voss machine. The jars stand on an ordinary wood table, and their outer coats are led to the discharger, B, the distance of whose air-space can be varied. The alternative path L is shown by a dotted line. The discharge has to choose between B and L. Sometimes L is absent, and in that case the charging of the jars is quite well effected through the wood of the table; this is the advantage of having the jars imperfectly insulated. At the same time, the conducting power of the wood is too low to enable the jars to discharge themselves at all satisfactorily, unless the knobs B are within striking distance, or unless some path L is provided. The only discharge obtained at A when both paths, B and L, are absent is a feeble spitting or intermittent and frequent sparking, very different from the loud report heard as soon as the knobs B are brought within striking distance. But it is not to be supposed that the B knobs must be as close together as the A knobs in order to permit complete discharge; on the contrary, the B knobs may be almost twice as far apart as the A knobs, and yet the discharge shall be complete and noisy.

FIG 1



It will be understood that the two sparks occur together—a spark at A precipitates, and is the cause of, the spark at B. Not *vice versâ*, for until the A spark occurs there is not the slightest tendency for a spark at B. The two B knobs are at the same zero potential, and may be touched with impunity except at the instant when the flash occurs at A. Remember that the jars are standing on a common table all the time.

Lest it be thought that there is anything occult in this mode of obtaining the spark at B, let us subjoin as Fig. 2 another arrangement of connection which does just as well, and, in fact, represents the first experiment I tried. The condenser is a very large one of tinfoil and glass plates, with carefully insulated terminals. My object in making it was to obtain a sudden rush of a considerable quantity of electricity (like lightning), and then study its behaviour under various circumstances. I found afterwards that for most experiments an ordinary gallon or even pint Leyden jar served just as well, was much quicker in use, and less dangerous. Moreover, the use of insulated terminals necessitates the continued presence of some alternative path (L) or other, else of course the condenser declines to charge.

It may be noted at once that with either arrangement the spark A was very loud whenever the spark was allowed to occur at B as well; but so soon as the discharge was compelled to traverse the alternative conductor, L, by putting the B knobs too far apart, then the noise of the discharge was much diminished, not merely because there is now only one spark instead of two, but plainly because, for some reason or other, the discharge meets with considerable obstruction in the wire, whereby its duration is lengthened, and its noise therefore very greatly lessened.

The numbers given below are extracted from a page of the laboratory notebook, and refer to an experiment with two Leyden jars, of a size which I sufficiently specify by calling them "gallon" jars, arranged as in Fig. 1. The length of the A spark was maintained at 1in. throughout the experiment; or as it happened to be accidentally convenient to measure lengths in tenths of an inch, I will call the A length 10. The B length is variable, being altered until a B spark sometimes passes and sometimes misses.

The first alternative path I show is a length of about 40ft. of stout No. 1 (B.W.G.) copper wire or rod, suspended round the room by silk ribbon. Its resistance to ordinary currents is very small, being ·025 ohms. Nevertheless, we shall find that the discharge refuses to take this apparently easy path,
and persists in jumping the air gap
until the B knobs are separated 14·3 te
inch. This is the critical distance. I
further apart than this, the discharge c
thick copper wire by preference, and i
suddenness is then much less.

As a contrast with this, I next try
length of fine iron wire (No. 27, B.W.
resistance to ordinary currents is 33·
1,300 times as great as the other. We fi
discharge very distinctly prefers this
other. For if the B knob remain at t
14·3 we never now get a B spark, no
one until they have been brought distin
The critical spark length is now 10·3.
was surprised at this result.

Let us next try an enormous resistan
lary tube of liquid (very dilute acid)
ordinary measurements some 300,000
critical spark length at B is indeed a litt
by this great resistance, but not much
found for the stout copper wire. I h
exact measure of it, but 16 or 17 will
out. The spark at A now becomes
indeed, pointing to the fact that wh
observing all along was, in some sense o
effect of true resistance; for the
resistance in the capillary tube gives ju
kind of effect as does the copper or iro
a little more pronounced.

I have suspended three other conduct
the same length, which it is easy to try
way, keeping the A spark-length 10 a
The results are here summarised:—

Alternative Path.		(sp
Stout copper wire, No. 1	R = ·025	c
Ordinary copper wire, No. 19	R = 2·72	
Stout iron wire, No. 1	R = ·086	
Ordinary iron wire, No. 18	R = 3·55	
Thinnest iron wire, No. 27	R = 33·3	

The copper wires seem to obstruct almo
and the iron wires almost obstruct equa
themselves, notwithstanding their ver
diameters; but the coppers obstruct mor
irons.

There is nothing absolute about these
they are the record of a definite experi
their precise value depends on the circum
the experiment.

Reason of the Enormous Obstructio by a Good Conductor.

Now, what is the cause of all this a
obstruction offered by good conductors to t
rush of electricity? One may express it in
way, thus:—It is due to electrical inerti
is also called "self-induction." A curre
start in a conductor instantaneously any m
water in a pipe can start moving at full sp
instant. Give the water a violent blow
it move, and it resists like a solid. T
if very quick and violent may burst the
it will not appreciably propel the water.
manner, is it with electricity. The fla
and the conductor must either carry it c
or not at all. There is no time to think
and the E.M.F. needed to overcome th
like obstruction is so great that a co
thickness of air may be burst by it, an
charge may flash off sideways to anythin

We will remember, then, that a Leyd
charge through good conductors is oscill
that the oscillation continues until all
energy is rubbed away. The oscillatio
enormous frequency; they may be
second, for the whole lot of them hav
during the excessively minute durati
visible flash. It is well known that a
far less real duration that the persistence
impression on the retina would lead one
as is easily illustrated by illuminating
wheel by an electric spark. However
arily speaking) the wheel is spinning it
be stationary, and the spokes are seen
clearly by the light of each spark.

It is for this reason that, although
minating power of a powerful flash n
greater than weak moonlight, its actu
while it lasts may exceed strong sunlight
may exert a damaging effect upon the
cause blindness.

There is another fact which it behov
aware of. It is one to the importance of
attention of scientific men has but re
called. Experimentally it has been dis
Prof. Hughes, theoretically by Mr. Ol
side, Lord Rayleigh, and Prof. Poy
though the necessary theory is really co
Clerk Maxwell, it required digging o
playing. This has now been abundantl
the knowledge has scarcely yet pen
practical men; indeed, it has not
thoroughly assimilated by most physi
fact is this. When a current starts in a
it does not start equally all through its
begins on the outside, and then gradu
rapidly penetrates to the interior.

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* *Extracted from the Dr. Mann Lectures before the Society of Arts.*

uniformly through the whole section ɔr, a variable current does not. It is ɜt the surface, and it is stopped first at

ing the rapidly oscillating character of discharge, remembering also the fact current begins on the outside surface tor, we perceive that, with a certain ɪation, no current will be able to pene- he most superficial layer or outer skin uctor at all. In the outer skin, of hickness, electricity will be oscillating ut the interior of the conductor will lly inert and take no part in the

rrive at a curious kind of resistance, ɜrtia in a roundabout fashion, and yet ance, a reduction in the conducting a rod, so that no portion except that surface can take any part in the con- hese rapidly alternating currents or It must naturally be better, therefore, a lightning conductor of solid rod, but out into a thin sheet, or cut it into res; any plan for increasing surface ig it out laterally will be an improve-

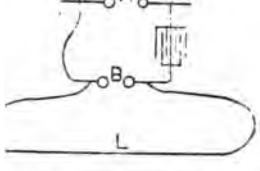
may be as well to guard against one isconception. It has long been known ıarges exist only on the surface of con- ıas also long been known that ordinary through the whole section and sub- ıeir conductors. It is now beginning n that alternating currents may be apid to traverse only the outer layers s, and this last piece of knowledge is her disturbing by those who have been to dwell upon the behaviour of steady l seems like a return to electrostatic an attempt to lord it over currents by But the first and third facts mentioned behaviour of static charges and the alternating currents—are two distinct ɜndent of each other; not rigorously perhaps, but best considered so for rposes of explanation.

hus mentioned two causes of obstruc- h by rapidly oscillating currents trying metal rod. First there is the direct effect of self-induction to be added to e proper; the resulting quantity being r. Heaviside "impedance," to distin- m resistance proper. For there is a listinction between them; resistance pates the energy of a current into heat, Joule's law; impedance obstructs the does not dissipate energy. Impedance ncy to side flash, resistance causes a o heat and perhaps to melt. The resistance of a conductor, the more the energy of a discharge be dissipated, ns being rapidly damped; the greater ce of a conductor, the less able is it to ash, and neighbouring semi-conductors gly exposed to the more danger. Re- analogous to friction in machinery; s analogous to freely suspended mas- tion, in addition to whatever friction e. To slowly changing forces friction y the sole obstruction; to rapidly forces inertia may constitute by far the of the total obstruction; so much the that friction need hardly matter.

Tape v. Rod.

here note a vigorous controversy, or f opinion, between Faraday on the one Sir W. Snow Harris on the other. s often consulted about lightning con- ighthouses, and consistently maintained ıal area was the one thing necessary, linear foot, and that shape was wholly Harris, on the contrary, maintained onductors were just as good as solid hat flattened ribbon was better still.

FIC 2



ɔrted to have said that the other knew all about the matter. Of course, we Faraday was thinking of nothing but and conduction for steady currents. probably no theoretical reason to give, ded either by instinct or by the result ce. I think we shall have to admit s particular, Faraday was wrong and Harris was right. The following experiment may serve to illustrate the point further:—

I take two copper conductors of the same length and approximately of the same weight, but one of them in the form of wire, the other in the form of ribbon, and I use them successively as an alternative path. The knobs at A being fixed at two centimètres apart, the B knobs were adjusted until the spark sometimes chose the air gap and sometimes the alternative conductor. (See Fig. 1 or 2.) The critical B spark length was then:—

	Millimètres.
With the wire as alternative path ...	8·36
,, ribbon ,, ,, ...	6·26
,, wire ,, ,, ...	8·45
,, ribbon ,, ,, ...	6·05
,, wire ,, ,, ...	8·21
,, ribbon ,, ,, ...	6·06

Very distinctly showing the advantage of a flattened form of conductor over a mere round section.

The dimensions of the two conductors here compared are as follows:—Wire: No. 12 B.W.G., 218 centimètres long, weight 91·6 grammes. Ribbon: 218 centimètres long and 6·4 centimètres broad, weight 88·7 grammes.

Iron v. Copper.

You remember we have found that a rod of iron carries off a discharge more satisfactorily than a rod of copper. It would seem as if the poorer conducting qualities of iron enabled the discharge to penetrate deeper, and so to make use of a greater thickness of skin.

But everyone will say—and I should have said before trying—surely iron has far more self-induction than copper. A current going through iron has to magnetise it in concentric cylinders, and this takes time. But experiment declares against this view for the case of Leyden-jar discharges. Iron is experimentally better than copper. It would seem, then, that the flash is too quick to magnetise the iron; or else the current confines itself so entirely to the outer skin that there is nothing to magnetise. A tubular current would magnetise nothing inside it. Somehow or other, the peculiar properties of iron, due to its great magnetic permeability, disappear.

It is easy to try another experiment. I have here two conductors made of tinfoil; each is made of a long slip of tinfoil, about 3in. broad and 21ft. long. One is zigzagged backwards and forwards, with the interposition of three thicknesses of paraffin paper between each zigzag to secure insulation, so as to abolish self-induction as far as possible. This I call the tinfoil zigzag. The other is coiled spirally on a glass tube—again with the interposition of paraffin paper—so as to give as much self-induction as possible. This I call the tinfoil spiral. A bundle of fine iron wires—the core of an induction coil, in fact—can be introduced into this glass tube, or withdrawn, at pleasure. The resistance of these conductors, measured in the ordinary way, are:—·614 ohms for the spiral, and ·708 ohms for the zigzag. They were intended to be alike.

The connections being made as in Fig. 1, one or other of these tinfoil conductors is used as the alternative path L, with this result:—

The length of the A spark being 7·3, the critical spark at B, when sparks sometimes passed and sometimes failed, was 11·1 when no alternative path was provided. When the tinfoil zigzag connected the outsides of the jars instead of the wire L, it was not possible to get a B spark till the distance was shortened to 0·6; when this was replaced by the tinfoil spiral, the critical B spark length rose to 6·4. The iron bundle was now inserted in the spiral, and the experiment tried again. The B spark length remained 6·4. The iron made no perceptible difference whatever.

Here is a magnetic time-lag raised to an extreme. Prof. Ayrton tells me they have noticed the permeability of iron begin to diminish with very quick alternations. Here it is becoming virtually no bigger than that of air. It may be said that the iron fails to get magnetised because of the opposing action of the inverse "Foucault" currents induced in it, just half a period behind the inducing currents. I thought this would be so, of course, with thick rods of iron; but with a bundle of thin wires I felt doubtful. Lord Rayleigh, however, thinks these induced peripheral currents competent to explain magnetic time-lag in every case; and I have no doubt that he is right. Whatever the explanation, the effect of time-lag in iron is patent. Yet there is something strange about it, for that a steel knitting-needle can be magnetised by discharging a Leyden jar round it is mentioned in every textbook, and (what does not necessarily follow) it is certainly true. There are points here requiring further examination.

However, if it turns out to be true that an iron rod does not get magnetised by the passage of a rapidly alternating current, it may be held a natural consequence of the fact that such currents flow mainly in its outer surface; and that such tubular currents have no magnetising power on anything inside them.

The magnetisability of iron is no objection to its employment in lightning conductors. Its inferior conductivity is an advantage in rendering the flash slower, and therefore less explosive. Its high melting point and cheapness are obvious advantages. It is almost as permanent as copper, at least when galvanised; and it is not likely to be stolen. I regard the use of copper for lightning conductors as doomed.

Experiment of the By-Path.

We have seen that a conductor is more efficient in carrying off a discharge and preventing side-flash in proportion as its self-induction is lessened; say by spreading it out into a thin sheet, or cutting it up into a number of wires, or otherwise. But no conductor is able to prevent side-flash altogether, unless it is zigzagged to and fro so as to have practically no self-induction; in that case the side-spark is nearly stopped. But so long as a conductor is straight (and a lightning-conductor must, of course, be straight), so long will there be some tendency to side-flash, however thick it be made. It may be a foot or a yard thick, and yet not stop it.

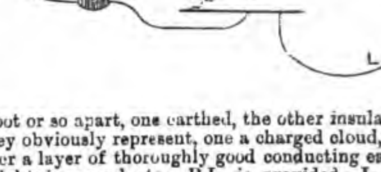
One may easily try the following experiment. Take a yard of stout brass or copper rod an inch thick, arrange it in the path of a Leyden jar discharge, and then arrange, as a sort of by-path or tapping circuit, some very fine wire, such as Wollaston platinum wire. (Fig. 3). It may seem absurd for any portion of the discharge to leave the massive rod and take the hair-like wire for preference, especially if an air-gap exists at A or at B, or at both. Nevertheless, a portion does choose the fine-wire path, and you get a little spark at A or at B about a sixteenth of an inch long. One may vary the experiment by trying to get a shock by holding two different parts of a thick copper rod through which a discharge is passing. The mere difference of potential between conductor and earth must of course be avoided. It is not easy to get an appreciable shock from a few yards of very stout conductor; still it can be done. Holding two points of a stout open spiral, consisting of about five yards of No. 1 copper wire, connected to earth, a faint shock can be felt with wetted hands whenever a Leyden jar is discharged through the copper. No doubt with a very large condenser the shock would be quite noticeable; and a man touching a lightning-conductor, however well earthed, might perhaps receive a shock sufficient to kill him. At all events, I should not care to try the experiment with a real lightning flash.

FIC 3

Experiment of the Side-Flash.

Let me illustrate the tendency to side flash by a more directly applicable looking experiment. Fig. 4 shows a couple of tin plates or teatrays fixed a foot or so apart, one earthed, the other insulated. They obviously represent, one a charged cloud, the other a layer of thoroughly good conducting earth. A lightning conductor, B L, is provided; L consisting of a considerable length of stout copper wire or rod. At C a possible side path is provided, so that, if the flash chooses, some of it can spit off through an inch or so of air, and through an interposed resistance, R, to earth. A side-flash, C, is found to occur unless the sparking distance is made too great; and the effect of increasing R is not to stop the side-flash, but to weaken it. Thus, even with the liquid resistance of nearly a megohm at R, an inch spark still passes at C for every flash at B, though the C spark is now very weak.

FIC 4



How can this tendency to side-flash be further diminished? At the end of the last lecture I hinted at a partial remedy—elasticity. To stop a pipe full of water from being burst by a blow given to the water, you will make the pipe elastic. An elastic cushion will ease off the violence of the shock of a water-ram.

Electric inertia was known by the other name of self-induction; electric "elasticity" is known by the other name of capacity. Increase the capacity—not the thickness of conducting power but the electrostatic capacity of your conductor—and it will be able to carry off more.

This phrase, "the capacity of a conductor," when used by the old electricians, commonly signified merely its conducting power, this being the sole thing most of them thought of; but using it in its modern signification, let us see what advantage is to be gained by increasing the capacity of a conductor—say, by connecting to its two ends the coatings of a Leyden jar.

Take the No. 18 wire round the room and use it as an alternative path, as in Fig. 1, first without a jar connected to its ends, then with a jar. Length of spark at A, 5·35 tenths of an inch; corresponding critical B spark-length:—

Iron wire without jar, 6·5;
Iron wire with jar, 5·0.

Not a very great difference. Not so great a difference as would be gained by diminishing the self-induction by flattening the wire out into foil. Still it is in the right direction, and we see what we have to do: diminish self-induction as far as possible, and increase capacity whenever convenient. One may also try the experiment by attaching a jar to the conductor B, in Fig. 4: the side flash C is somewhat shortened.

But of an actual lightning conductor how is it possible to increase the capacity? There is no sense in surrounding it with an earth tube, because that, after all, would only act as an additional conductor, and might as well be so considered from the first. Neither does a great series of polarisable voltameter plates seem a feasible suggestion. No; the only practicable plan is to expand it over as much surface as possible. A lead roof, for instance, affords an expansion of fair capacity which may be easily utilised; and there should be as little mere rod projection as possible before some extent of surface begins. Flat sheet for chimneys is better than round rod—it has at least some more capacity and much less self-induction.

For tall isolated chimneys I would suggest a collar of sheet metal round the top, and at intervals all the way down; or a warp of several thin wires instead of a single rod, joined together round the chimney by an occasional woof; or any other plan for increasing capacity and area of surface as much as possible.

Liability of Objects to be Struck.

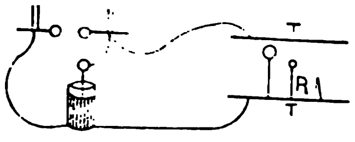
Now try experiments on the liability of things to be struck. Is a small knob at a low elevation as liable to be struck as a large surface at a higher elevation? Is a badly conducting body as liable to be struck as a well conducting one? In other popular words, does a good conductor "attract lightning?"

In answering this question experimentally, we must draw a careful distinction between the case of a flash occurring from an already charged surface, which has strained the air close to bursting point before any flash occurs, and the case of a flash produced by a rush of electricity into a previously uncharged conductor too hastily for it to prepare any carefully chosen path by induction. The two cases are—1st, steady strain; 2nd, impulsive rush. Take them separately.

First with Steady Strain.

First an experiment on the liability of things to be struck when the air above them is in a state of steady strain gradually increased. I take the two tin plates arranged one over the other, and stand between them three conductors, one ending in a large knob, a second ending in a small knob, and the third ending in a point (Fig. 5).

FIG 5



The experiment consists in working up the charge of a jar attached to the top plate until discharge occurs, and in adjusting the three conductors so that they may be indiscriminately struck. One finds that the point, even when very low, prevents discharge altogether. It may indeed be too low to be effective; or again, it may be insufficient to cope with the supply of electricity; but we see here the well-known function of a point—prevention of discharge. Remove or cover up the point now, and attend only to the large and small knobs. If the knobs are negative and the plate above them positive, brush discharge goes on from the knobs, and it is not easy to get a long flash; but by reversing the connections the tendency to brush is greatly lessened, and we now get flashes some 3in. or 4in. long. But always to the small knob. The small knob has to be pulled down three times as far from the charged surface as the big knob is before it ceases to protect the big knob; and the latter is then for the first time struck. This occurred, for instance, when the distance of the big knob from the top plate was 9, and the distance of the small one 29½ (tenths of an inch). They were then either of them struck indiscriminately. If the little knob was any taller than 29½, it alone was struck.

Now, what is the effect of resistance upon the knob? Scarcely any. Instead of connecting the small knob direct to the bottom tray, connect it through the liquid megohm R, and it gets struck just as easily as before.

Here are distance readings when they get struck with equal ease:—Large knob distance, 7·5; small knob distance, with high resistance, 22·0. The point protects both up to distance 60·0, until covered up by a thimble.

Thus the flash actually prefers to jump three times as much air, and encounter a megohm resistance, rather than take the short direct path offered by the bigger knob. The sizes of the knobs in this experiment are:—1·27in. diameter for big knob, and ·56in. for small knob.

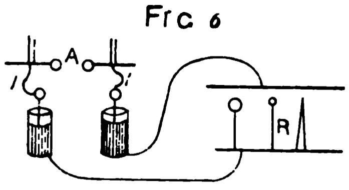
Of course, the cause of this is well known. It is merely that the air breaks down at the weakest point—viz., on the surface of one of the knobs, and the tension on the small knob is much greater than that on the big one, for a given difference of potential. The fact that the discharge begins in the air above the conductor explains why it is that adding resistance—even enormous resistance—to a conductor makes no difference to the length of the spark which strikes it. The path is prepared inductively in the air, and the resistance of the path which the discharge must ultimately take makes no difference, provided it is not so nearly infinite as to prevent the free adjustment of the static charges and inductions set up as the machine is worked. But though high resistance makes no difference to the length of the spark, it does affect its noise and violence. The discharge striking the small knob has now only a small velvety noise. Its energy, or heating effect, is much the same, but its suddenness, and, therefore, its noise and violence are enormously lessened.

This water resistance is equivalent to a shocking bad earth; and its effect is, we see, to make the spark gentle. But it is an evident advantage to have a discharge take this quiet and manageable form. The worse a conductor is the quieter will be the flash, and, up to a certain limit, it will protect just as well apparently. Hence, surely a bad earth is an advantage. But wait a bit; we have not yet considered the other case—the impulsive rush.

Second, with Impulsive Rush.

Let us now modify the experiment to try the second form of the experiment—the impulsive rush. Fig. 6 shows the connections. There is no difference of potential between the trays up to the very instant of discharge. The jars gradually charge up (they stand on the same wooden table), and ultimately discharge at A; a violent rush then takes place into the two plates, and the conductors between are struck. Adjust them till they are all struck with equal ease, as before; we find the conditions utterly different. No longer does the small knob protect the taller big knob; no longer does the point exert any special protective influence. All three bodies—large knob, small knob, point—are equally liable to be struck if at the same height, and no one is more liable than another; simply the highest is struck if they are at all equally conducting. It is easy to get all three struck at once. Now make one bad conducting, and its protective virtue is gone. Putting the liquid meghom into any one of the three conductors, and that one is no longer struck. It ceases to protect the other two even if taller than they; nay, even if it be raised so as to touch the top tray, thus establishing direct conducting communication of a poor kind between cloud and earth, still next to none of the flash chooses that path, and the other conductors get struck with apparently just the same ease as before. This is the real objection to a bad earth; it cannot protect well against these sudden rushes.

FIG 6



Sudden rushes are liable to occur; the clouds spark first into one another, and then, as a sort of secondary effort or back kick, into the earth. For instance, two clouds one above the other; the top cloud sparks into the lower, and this at once overflows to the earth. In these cases the best conducting and highest objects are struck, quite irrespective of any question of points and knobs. Points are no safeguard against these flashes, as you see. The points get struck by a vivid flash, exactly of the same character as that which strikes one of the knobs; it has no time to give brushes or glows; its special efficacy in preventing discharge exists only in the case of steady action, where the path is pre-arranged by induction. In the case of these sudden rushes, the conditions determining the path of discharge are entirely different. No doubt they have to do with what is called the "time-constant" of the various conductors.

(To be continued.)

ELECTRIC LOCOMOTION.

IN view of the amazing, not to say nonsensical, statements which have appeared in the daily press as to the use of electric locomotives on the underground railways of London, the following remarks by Mr. C. P. Elieson, contributed to the *Electrical Review*, may be interesting:—

Taking, for instance, the work performed by one of the motors of about 4H.P. on the electric locomotives at Stratford; when coupled to a full-sized car loaded with 48 passengers, the E.M.F. being 160 volts, it takes 25 ampères at the rate of between 8 and 9 miles an hour; but on some occasions, when the road is dry and the grooves are clogged (by no means a rare occurrence, and, I may state, almost continual in dry weather, as watering the line is considered a luxury), the engine and loaded car in starting will take as much as 75 ampères for a short time, which would mean about 16 E.H.P. If the motor and all other parts have not been constructed to sustain such a strain, which is repeated every few minutes, it will be easily seen that breakdowns will succeed on a rapid scale, to the disgust of everyone. Do these failures teach others better? No; there seems an almost fatal inclination to attribute the failure to anything b the real cause, and for years different systems h started on the same principles, and everyone h gone through exactly the same mishaps.

I will abstain as much as I can from speaking of my own system, as I do not seek for praise or publicity; but my experience of electric locomotion has given me knowledge of facts which I have gained while engaged in overcoming difficulties. Therefore, in the interests of electric traction, I strongly urge all who are trying to bring the work to a practical issue to avoid these mistakes and the advice of some amateurs and so-called connoisseurs of electrical engineering; what they i their limited knowledge may consider a clumsy combination or construction is the very soul of the intended purpose which has been aimed at, and must be secured on and above all anticipation. If the mechanism be heavy, power must be provided in proportion and above. If the weight of the machinery (of whatever nature it may be) be reduced in order to economise the motive power, the object for which it was intended is de The persons interested in the work hitch will, to a man, condemn it at once.

Many good things have been lost t working seeker, not on account of hi being useless, but simply on mechanis or on the relation between strength a power to be applied having been badly I do not intend here to pass an opini systems used and applied between the axle of a car, I believe this can be arr many different ways. Too many failu been experienced in the past, and will st with in the future, unless a sensible motor be for ever secured. In neglecting this, be made in one direction, but on the the evil of failure is created exactly in proportion. These remarks, I feel sure, all dynamos where efficiency, combined wi ness, lead to weakness, quick wear and te frequent breakdowns.

In accumulators the same evil principle been followed, and an accumulator of large capacity and minimum of weight is still the the day. It is astonishing, considering the wide and, I may say, indispensable applica accumulators, that electricians have not yet out what should constitute a good and accumulator. In my experience of the should advise, before all, strength, or, words, duration of life. After securing would combine it with the best means the highest storage capacity, but under sideration is the storage capacity to be at the expense of its durability. Acc with numerous thin plates have prov practically useless. Their storage cap have appeared astounding as compared weight, but their life was of a duratio only. Thicker plates are now employed results obtained, but there is still the tendency to economise weight, which the accumulators in an unsatisfactory ignorant public, who know nothing of stitutes the working of a storage batte for impossibilities, and the maker, i secure business, tries to distort the fact and to deceive himself in order to demand. The result is that an article fit to fulfil its work. But if of secondary batteries would arrive usions and identify themselves with their large experience has already viz., that a pound of lead should be ertain storage capacity, up to which ld be safe, then strain and extra ch greatly adds to the expansion and he positive plates, would be avoided. were stopped at that point, I am ould insure a long life to the This, of course, would diminish ity as against weight, but it would e proper thing to do, instead of try- odate sheer impossibilities.

rules makers would be enabled to daylight instead of groping in the r and buyer would mutually benefit n. A boiler maker for steam engines iler to be worked with safety at so pressure on the square inch and no ld manufacturers of accumulators working limit of storage capacity ead. I am therefore of the opinion nd battery makers have only them- ne for so many hardships and un- ork which has so greatly injured the of electrical matters at large. Let ourselves, and we shall not deceive

AUSES, DEGREES, AND EANS OF SLEEP.

ble causation of sleep is a subject as often in the history of physiolo- attracted the efforts of scientific It cannot be said that, after all, we to define the processes involved in influence; but some such suggestion s, nevertheless, within the reach of nation. Most of our readers have ed some opinion on this subject, and accepted as a provisional creed one theories advanced with regard to it. ay appear that the accumulation of in the brain is enough to account ficient oxygenation offers another othesis. Each of these processes no ert a certain soporific power, and operates in its degree; but it is how either can be taken to afford rpretation of that state of rest with singular regularity of recur- ore or less, whether sick or healthy, y employed. There is something to r the theory that sleep is a conse- rebral anæmia. The pathological hermicrania, of epilepsy, and some es favours this view, as does also allor of the fundus of the eye has onnection with natural sleep. These o not, however, settle the question anæmia is commonly a cause or t of the general relaxation of d in the soporific process. So far y of sleep that, following and pre- iod of wakefulness and constant the senses, it represents a transient from the activities of tissue change. corresponds with the quiescence of nd more especially of the nervous th a timely languor of circulation in ssues. By the gradual changes of s now virtually become a mere habit ody. At first it was doubtless the haustion and an expression of the w, which it still fairly illustrates, balanced by reaction. The opposite eeplessness will commonly be found n some continually acting cause of ement. This may consist in the ocal irritation or very usually in the ability of a sensorium over-wrought nsitive to the most trifling impres- ve already spoken of morbid somno- lation to certain diseases, and have onnection with a defective cerebral We might also refer to instances of ifferent condition, in which anæmia ss are closely associated. This fact show that healthy sleep requires a utrition of brain tissue, and that ia or hyperæmia has with respect to tive significance. The influence of nic states must also be remem- ng with this subject. Whether due t of function in the lung, liver, only reliable remedy for inconveni- d is, of course, to be found in cor- ure of excretion. Whatever, indeed, ror, be it the want or the excess of means of so-called sleeping draughts and must be, only palliative. The eans of cure in any case is no mere thod, and consists in the detection the source of mischief by a well- em of treatment.—*Lancet.*

PORTABLE MAGIC LANTERN.*

A VERY compact form of magic lantern is illustrated in the cuts accompanying this article. It is adapted for all experimental purposes, as well as for the projection of views. The best way to give a correct idea will be to take, as example, a 4½in. condenser lantern, and give the dimensions of the different parts, as shown in the cut. The size of the condensers settles the question of the measurements of the other parts.

FIG 1

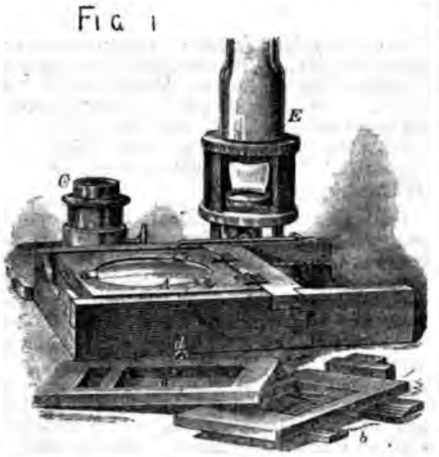
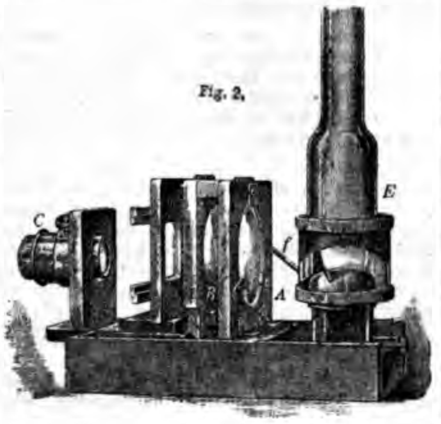
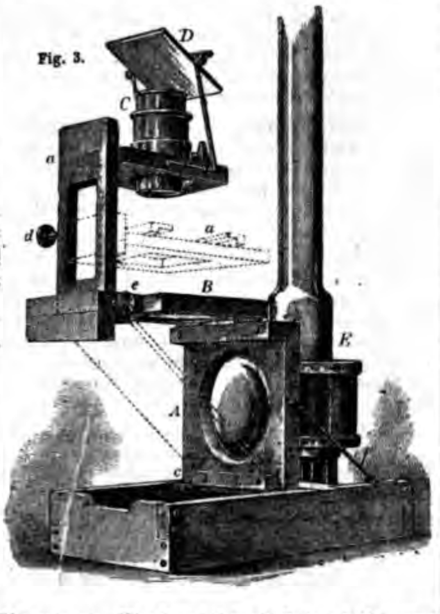


Fig. 2.



The two condenser lenses, plano-convex, are mounted each in a separated board. A circle is turned out with a rabbet in each board, in which the condenser seats itself, and is secured therein by three buttons. The rear condenser board A is 6¾in. square. The front board B is of the same width, but 8¼in. long. To the rear one a strip is screwed across the top edge, and the front one is hinged to this strip. At their bases, coming between them, two small abutting strips are secured. The thickness of the strips is such that the boards, when brought together, with the strips in contact, are strictly parallel, and the lenses are held apart from each other.

Fig. 3.



The frame or base of the lantern is a three-sided square, a little over 6¾in. across, and 13in. long in internal measurement. It is closed at the front and open at the back of the lantern. It is 2½in. deep, 7½in. from its front, the back condenser board is hinged to a strip that runs across the top of the frame, and is screwed firmly thereto, flush with its upper surface. A long brass hook *f* and staple is provided for holding the condensers in place when vertical. The boards are held together, when desired, by another shorter hook *c* with staple. The condensers are then in place for horizontal projection. To arrange them for vertical projection the small hook *c* is unfastened, the front condenser B is pushed up until the two are at an angle of 90°, and a plane mirror is inserted, resting against the two bottom strips. The mirror should be mounted on a thin board or on a brass plate so as to provide strength and protect its back.

A mortise is cut in the front condenser 6¾in. from its top, ⅜in. wide, and 3⅛in. long. A piece of board, *a*, is cut to slide smoothly back and forward through this mortise. For retaining the strip in any desired place, a hand screw, *e*, is placed on the side of the condenser board, which is notched at both its lower corners. A strip of brass is attached to the side of this strip for the screw to press against.

The strip carries the slide carrier *b* and lens C. The lens is attached to a board about 4in. wide and 5½ high, with a tenon projecting from its base. A mortise is cut near the end of the sliding strip to receive this tenon.

A second mortise or slot 4⅛in. long and 2in. wide is made in the strip *a*. The slide carrier *b* is a board 6½in. high by 4½in. wide. To its base is attached a piece of wood 3in. square. This is ⅛in. thick, and below it is a second piece of the same length, but just 2in. wide. The second piece enters the slot in the sliding strip *a*, and the slide carrier rests upon the shoulders formed by the upper block. A hand screw, *d*, is arranged to hold the slide carrier in place where desired.

A smaller movable mirror D is supplied, to be supported above the objective when the lantern is to be used for vertical projection.

A piece of sheet iron is fastened across the bottom of the main frame, on which the lantern E rests. In the front of the same frame a notch is cut in which the piece *a* rests. To make its position in the front condenser board more secure, a second strip may be attached just below the mortise and to the back of the board.

For lantern any good form of screened lamp may be used. If necessary, a sheet-iron box may be arranged to inclose the source of light; but with such a lantern as is here shown it is quite unnecessary.

In the drawings, Fig. 1 shows the whole ready for mounting, the lamp being lighted and ready for work. The lamp should always be lighted before beginning, as it may take five minutes for it to attain its full power. Fig. 2 shows the whole put together and arranged for exhibiting views. By removing the slide-carrier the entire space between condenser and objective is free for the introduction of apparatus or performance of experiments. A soap bubble can be blown and projected in this space. A glass of water can be very prettily shown, and the lantern will be found admirably adapted for the experimenter's use. Fig. 3 shows the lantern arranged for vertical projection, the outline of the mirror being given in dotted lines. As the slide carrier is not always used for work in this position, it, too, is shown in dotted lines.

If all is properly constructed, the apparatus will be susceptible of all kinds of adjustments. The sliding board *a* can be moved back and forth in the mortise in the front condenser board. The slide carrier can also be moved backwards and forwards. By these two adjustments the slide carrier can be brought to any point desired in the cone of rays converging from the condensers. By moving the lantern backwards and forward, any modification in the direction of the light rays emerging from the condenser can be given.

A lime light can be used instead of an oil lamp; but as the object was to show a portable lantern, the former has been shown in the cuts.

THE *Great Eastern* has entered upon another phase of its history. The owners, Messrs. Henry Ball and Sons, of Liverpool, have arranged with the Naval Construction and Armaments Company, provided Captain Barnett, R.N., harbour master of Barrow, could arrange for the entrance of the *Great Eastern* into Ramsden Dock at that port on the top of spring tides, that the work of breaking up this vessel or in altering her in some way will be undertaken at Barrow. It is suggested that after the ship is dismantled she should be fitted up with new machinery, with a view to her employment in the cattle trade.

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* By T. O'CONOR SLOANE, Ph.D., in the *Scientific American.*

SCIENTIFIC SOCIETIES.

THE AERONAUTICAL SOCIETY.

A GENERAL meeting of the Aëronautical Society of Great Britain was held at the Society of Arts on the 5th inst., whereat the following papers, &c., were announced:—

"Kite Balloons and Kite Tandems," by Mr. Douglas Archibald; "A New Method of Ascertaining the Power Required for Propelling Balloons and other Bodies through the Air," by Mr. Wetter, for the author, Mr. Beugger, from Switzerland.

Exhibition, by Mr. Howard Lane, of a model balloon and compressed gas cylinder, and its inflation therewith.

Explanation and exhibition of Norman's petroleum air-burner, which, amongst numerous adaptations, is particularly suitable for the inflation of balloons. James Glaisher, Esq., F.R.S., took the chair, supported by the hon. sec., Mr. Fred. W. Brearey.

Norman's burner attracted much notice. The petroleum is under pressure in a pump holding five gallons, stationed some 3ft. away from a fireclay furnace, into which is inserted two nozzles, having each an orifice not larger in diameter than the finest cambric needle. The air is consumed under the Bunsen principle, the petroleum taking the place of a wick. The combustion is perfect, and the heat engendered from these two burners only is so intense that it will heat iron rivets, such as are used for iron bridges, in five minutes—will melt copper wire in a few seconds—disintegrate granite, which falls into powder in 15 minutes.

The heat for these purposes can be maintained automatically without any attention for hours, and it is said at a cost of only a farthing an hour.

A multiplication of these nozzles terminating from the tube attached to the pump, and arranged in an annular form within the mouth of an uninflammable balloon, has fully inflated one of 50,000ft. capacity in 25 minutes.

It is claimed that such a balloon will need no valve, as the heat can be regulated or extinguished at will. This is generally shown at work between two and three at 147, Queen Victoria-street; but the apparatus is about to be removed to Chatham for experiments, by direction of the War Office.

USEFUL AND SCIENTIFIC NOTES.

The Theory of Diamagnetism.—According to many physicists, Weber and Tyndall amongst others, diamagnetic bodies take, under the influence of magnets, a state of polarity opposite to that which is taken by iron under the same conditions, and this opinion has become classic in teaching. M. Blondlot, however, according to *Cosmos*, has demonstrated that in reality diamagnetic polarity does not exist at all: and that, following the opinion of Becquerel, all substances and the air itself are in reality, paramagnetic, a diamagnetic substance being only a substance less magnetic than air. He recalls, in the first place, the experiments which led Tyndall to his conclusions. A bar of bismuth, placed on a coil, and submitted to the action of a powerful electromagnet, takes contrary poles to those which a bar of iron takes under the same conditions. The experiments of M. Blondlot show that bismuth becomes magnetic in the same manner as iron, but the change in its polarity arises from the fact that the medium which surrounded it is more magnetic than itself, when the medium is air. He replaced the bar of bismuth by a tube filled with a weak solution of perchloride of iron in methylated spirits. This tube is magnetic, and becomes magnetic in the same manner as the bar of iron when it is in air, a medium less magnetic than itself. But when it is plunged in a vessel containing a concentrated solution of perchloride of iron, a medium more magnetic than itself, it becomes magnetic like the bar of bismuth of Tyndall's experiment.

EXPERIMENTS have recently been made on the Philadelphia and Reading Railroad to find the relative economy of Wootten and other locomotives. The engines selected for the test were what is known as a waggon-top boiler and narrow fire-box, and a Wootten boiler and fire-box. Each engine hauled 145 loaded coal cars from Palo Alto to Port Richmond, and 165 empty cars on the return trip. The ordinary engine consumed 26,000lb. of steamboat coal, costing 2·45dol. per ton, in making the round trip, and the Wootten engine consumed 32,700lb. of buck-wheat coal, costing 60 cents a ton. The actual cash difference in favour of the latter was 20·49dol. Engine 915, also of the Wootten pattern, hauled a train from Cressona to Philadelphia containing 2,280 tons of coal. This, it is said, was the greatest single haul ever made on the Reading Railroad.

SCIENTIFIC NEWS.

THE establishment of the Lick Observatory, which is now made over to the University of California, seems to have stimulated other generous endowers of scientific research in the United States. It is not even to be allowed to remain the most elevated of American observatories, for Mr. H. B. Chamberlin, of Denver, Colorado, has ordered an equatoreal of 20in. aperture for the university of that city, and the observatory will be located on a site about 5,000ft. above sea level, or 800ft. higher than the site on Mount Hamilton, where the Lick Observatory is placed.

The instruments of the Dearborn Observatory, Chicago, have been dismounted, and a new building is in course of erection at Evanston, about sixteen miles to the north of the old site and twelve miles from Chicago. The new observatory will be located about 300ft. from the shore of Lake Michigan, on grounds belonging to the North-Western University, with which institution it will be connected as one of its departments. It is considered that the new site, free from the smoke of a great city, will be much better adapted for astronomical work than the old one. The building, which will house an 18½in. refractor, with transit room, library, &c., is to be the gift of Mr. James B. Hobbs, and the establishment will continue under the direction of Prof. Hough, maintaining also its former relations with the Chicago Astronomical Society.

Rochester, a comparatively small town in New York State, near the falls of the Genessee, and a few miles from Lake Ontario, has no fewer than seven observatories, the best known of which (one of some importance) is the Warner Observatory, under the direction of Dr. L. Swift.

The director of the observatory of the Priory of St. John, Grignon, Côte d'Or (F. Mayeul Lamey), alleges that he has discovered four new rings round Saturn outside those well known. One of these is near the outer ring; another reaches the orbit of Enceladus; the third and brightest touches the orbit of Tethys, and the fourth and faintest lies between Dione and Rhea.

An unusual atmospheric phenomenon was witnessed in the Channel on Monday, when the atmosphere became rarefied to such an extraordinary degree that objects could be discerned with remarkable distinctness at a distance of between thirty and forty miles from Dover and Folkestone. The lighthouse at Cape Grisnez, Calais, and the dome of the cathedral and Napoleon's column at Boulogne could be distinctly seen with the naked eye, and every prominent object could be picked out along the French coast. The distance from Dover to Boulogne as the crow flies is 28 miles, and the column is about two miles further inland.

The summer meeting of the Institution of Naval Architects will be held at Glasgow, in the Corporation Galleries, on July 24—27. Papers will be read and discussed, and excursions be made to places of [illegible] st in the neighbourhood.

The National Co-operativ [illegible] l, Flower Show, and Exhibition will [illegible] 1 at the Crystal Palace from Augus [illegible] 25. This exhibition of "home indust [illegible] deserving of attention, and there are a [illegible] of prizes offered. Particulars can be [illegible] from Mr. W. Broomhall, the secretary. [illegible] lk-street, Strand, W.C.

The Photographic Conventi [illegible] United Kingdom will meet at Birmi [illegible] July 23, and the excursions, &c., will e [illegible] July 28. A neatly printed programme, [illegible] l maps, has been issued, and, given [illegible] her, no doubt a most enjoyable holida [illegible] spent. Mr. J. J. Briginshaw, 128, S [illegible] -street, London, S.E., is the hon. sec [illegible] asurer, while the local hon. secs. are [illegible] d, 361, Moseley-road, and Mr. W. Ro [illegible] t-road, Moseley, Birmingham.

The expedition to the An [illegible] regions which was stated to be in cou [illegible] ganisation by Dr. Neumayer, of the H [illegible] Observatory, is scarcely likely to w [illegible] as it appears that, in spite of the J [illegible] about the British having missed the chanc some unknown problems, the Germ tion is not likely to start, and that was any intention that it should doubt there is a wide field for disco Antarctic regions; but it can be ex when the Government provides the is to be hoped that the Government

Next Monday Prof. W. E. Ayrton at the City and Guilds of London course of six lectures (to be d Mondays, Wednesdays, and Frida construction, testing, and use o measuring instruments. This cou clude experimental lectures and sp tory work. The lectures will co principles and practice of construc tion, and testing for faults of voltmeters, ohmmeters, wattmeter meters, and ergmeters as used for alternating current systems. Th practical work will be conducted i tory specially fitted with accumulat instruments, &c., for electrical testing; and they will have the of examining and practically tr more important electrical meters at ordinary use.

Mr. Clement L. Wragge, the Meteorologist for Queensland, h specimens of the papers issued by t logical branch of the Post and Te partment of Queensland, with chart. Specimens of the charts is seen at the offices of the Agent- Queensland, 1, Westminster Cham but it is doubtful whether the ad be gained are worth the cost. F United States, where the Governme money than it wants, Congress ha cussing the important question of t the Weather Bureau to the new Dep Agriculture.

The *American Meteorological* desiring to attract the attention of tornadoes, in hopes that valuable r be obtained, offers the following p the best original essay on tor description of a tornado, 200dols given; for the second best, 50dols those worthy of special mention 5 be divided. The essays must be sent of the editors, Prof. Harrington, A Michigan, or A. Lawrence Rotch, Meteorological Observatory, Readvi U.S.A., before the first day of July. must be signed by a *nom de plume* accompanied by a sealed envelope with the same *nom de plume* and inc real name and address of the autho independent and capable judges will to award the prizes; and the papers them will be the property of the jou ing the prizes.

Athletes in variety have been lowering the "records" all round, an the Transatlantic steamers. The r tween the three great railway lines north from London is also likely another "record breaking." The Great express to Edinburgh is now timed distance in 8½ hours, and what is m complishes the feat. In connection matter the *Engineer* says:—"On the the Flying Scotchman, as it is called cipal express train on the East Co commenced to run with accelerated left Edinburgh punctually at 10 a.m. rived at Newcastle in two hours a minutes, and at London in eight h thirty minutes. Third-class passen still carried from Edinburgh and oth British stations; but persons bookin south by this train must take first o class tickets. This is rather tantal English passengers who desire to eco the utmost." Speed must, however, for, and it is well known that high a are, these express trains do not pay well as those devoted to local traffic. sengers could be induced to "book" se hours beforehand, they could have hig and the companies a dividend out of now half-empty trains.

A delicate test for bismuth was recently at the Chemical Society, F. B. Stone showed that a strong sol

potassium produces a bright yellow
very dilute solution of sulphate of
The test is said to be quite equal to
one part of bismuth in one million of
else.

iry under the presidency of M. Léon
h has recently been held in Paris on
d alcoholism. shows that the cause
er depends as much on quality as on
The commission agrees that a maxi-
mpurity may be tolerated in alcohols
for industrial purposes (the making
es, &c.). but that those intended for
on in the human economy should be
possible.

nograph is a remarkable instrument
of painstaking skill and ingenuity,
ple are asking of what practical
can be. It may be very useful in
come, when records of telephonic
are wanted.

rnil has established the fact that at
Jardin d'Acclimatation an epidemic
cholera" in ducks was due to the
microbe described by Pasteur. M.
nd in the blood of the ducks a small
hich is identical with that described
in the case of fowls; but strangely
hen inoculated it kills only ducks,
wls, pigeons, or rabbits, which are.
lly by the injection of the choleraic
cognised by Pasteur.

ERS TO THE EDITOR.

hold ourselves responsible for the opinions of
dents. The editor respectfully requests that all
ns should be drawn up as briefly as possible.]

ications should be addressed to the EDITOR *of*
MECHANIC, *332, Strand, W.C.*

and Post-office Orders to be made payable to
EDWARDS.

er to facilitate reference, Correspondents, when
any letter previously inserted, will oblige by
e number of the Letter, as well as the page on
rs.

ave everyone write what he knows, and as
nows, but no more; and that not in this only,
her subjects: For such a person may have
lar knowledge and experience of the nature
son or such a fountain, that as to other things,
re than what everybody does, and yet, to keep
a this little pittance of his, will undertake
whole body of physicks, a vice from whence
eniences derive their original."—*Montaigne's*

◆◆◆

TO THE LICK OBSERVATORY UCH AS IN THEM LIES: A EM—THE FATAL THIRTEEN— TION—SCIENCE AND THEO- —DISAPPEARANCE OF THE —POWER OF HUYGHENIAN ECE—THE DIAMETER OF THE STARS—A PROTEST—ACETIC TALITY — WHAT IS THE T?—COMETARY ORBITS.

-I AM indebted to the kindness of a
d for a presentation copy of a "Hand-
Lick Observatory," by Prof. Holden,
no exaggeration to describe as the very
at such a work ought to be. In addi-
excellent, popular, and well-illustrated
of the instruments and building, there
giving just the kind and amount of
as to the nature of astronomical obser-
estial photography, spectroscopy, &c.,
enable a visitor to appreciate intelli-
he will see and hear. I am glad to
he regulations framed by the director,
are to be admitted only on Saturday
veen 7 and 10 p.m. This disposes of
expressed (in letter 28902) on p. 390 as
ble vulgarising of the great equatoreal
version "into a kind of glorified peep-
nple time will be afforded to the very
the observatory to turn it to its legiti-
By the bye, on p. 71 of his capital little
Holden three or four times speaks of
The fact is that our first great maker
tic telescopes spelt his name "Dollond,"
e this specially here because certain
his side of the Atlantic are—or were—
it of engraving "Dolland, Optician,
on instruments calculated rather to
inct vision than to assist it. Terres-
opes thus inscribed are still far from
at our watering-places on the English
I do hope that none of our American
ill ever be deluded into buying one by this typographical erratum in the tiny volume before me.

Certain of my brother-readers of the ENGLISH MECHANIC seem to take a childish delight in the solution of elementary equations. Here, then, is a problem which seems to me (in the words of the Vagrant Act) "suited to the age, strength, and capacity" of some of those who have recently contributed to these columns. If A tells the truth three times out of four; B tells the truth four times out of five; and C tells the truth six times out of seven, what is the probability of an event which A and B assert and C denies?

Apropos of letter 28904 (p. 391), I recollect that *Punch*, in days gone by, strongly affirmed that it was exceedingly unlucky to sit down thirteen to dinner—when there was only dinner enough provided for twelve!

I should like to make two remarks in connection with letter 28918 (p. 395). The first is, that I happen myself to have seen Bosjesmans (or "Bushmen," as "Dens" calls them), and I assert, without the slightest hesitation, that the gap separating them from our Stokes's, Herbert Spencers, Tennysons, and Millais's is greatly in excess of that intervening between them and the higher apes: an assertion which I defy anyone without some theological dogma to uphold to contravene. My second observation is, that disputants of the school of your correspondent seem to think that, because no perceptible change is ordinarily seen to occur in any given type of animal life during the lifetime of a human being, hence such change must be impossible during the æons of ages which have elapsed since the earth cooled down sufficiently for organic life to appear upon its surface. Which is much as though the ephemeron, whose entire existence is comprised within twenty-four hours, should deride the notion that an oak ever by any conceivable possibility could have proceeded from an acorn, because a particular oak-tree on the banks of the pool which formed the insect's world had preserved identically the same size and appearance during that insect's entire lifetime!

In reference to this question of evolution, &c., Captain Battersby (letter 28925, p. 396), and those who think with him, have distinctly no right to claim to be candid and unprejudiced inquirers. The real scientific spirit is that which seeks after the *truth*, whithersoever it may lead the investigator; and no one who earnestly pursues it will pause to think for an instant of the consequences. Current theology may, and does, claim that we shall ignore and cast to the winds the plainest results, and most irrefragable demonstrations of our investigations; and we must bow down before this image of Baal, because, forsooth, the contradiction is "inspired." (I wonder whether Capt. Battersby ever troubled himself to study the history of the Canon). When, though, a Chaldean or Alexandrian legend is shown to be absolutely incompatible with incontestable facts, then "there are some questions which . . . cannot be argued by Christians on scientific grounds alone." In short: Heads, theology wins; tails, science loses.

Presumably "Circe" (query 65712, p. 402) is aware that the disappearances of which he (or she) speaks have occurred only during total eclipses of the moon? I am not familiar with Wesley's "Natural Philosophy," but I am a little doubtful as to its author or compiler's dates. Kepler witnessed the disappearance of the moon on December 9th, 1601, as did Hevelius on April 25th, 1642. The same thing happened on May 18th, 1761, when the phenomenon was observed by Wargentin; on June 10th, 1816, and so on; while our satellite was barely, if at all, visible during the eclipse of October 4th, 1884. On the other hand, in a large proportion of cases during a lunar eclipse, the moon, at the time of totality, is illuminated by a red light, which renders her perfectly discernible. Now if the earth had no atmosphere, her shadow would blot out the moon from the face of the sky during every total eclipse; but the shell of air which surrounds us acts as a lens, and refracts or bends the sun's rays to a certain extent *inside* of her shadow, so that some of them reach the lunar surface. "Circe" certainly must know that our terrestrial atmosphere, when vapour-laden, transmits the red rays; in fact this is demonstrated twice a day, at sunrise, and at sunset, when those rays have a great thickness of air to travel through. Very well, then: the sunlight, after traversing a considerable thickness of our atmospheric envelope, is tinged red, and this red light bent, as I have said, into our shadow, illuminates the moon's disc sufficiently to render it visible. "Circe" probably saw something of this on the 28th of last January. If, though, instead of our atmosphere being clear at that limb of the earth sectionally square to the sun's rays, it should happen to be heavily cloud-laden, no light from the sun would get through, and we should have such a practical disappearance of the moon as has been noted on the occasion, to which your correspondent refers.

"Chi" (query 65789, p. 402) can find the focal length of any Huyghenian eyepiece, of which the foci of the component lenses are known, by this simple formula. Divide twice the product of their focal lengths by their sum. Thus, suppose that it is a low-power eyepiece, of which the focus of the field-glass is 3in. and that of the eyeglass 1in.; then we say $\frac{2 \times 3 \times 1}{3 + 1\ (\text{or } 4)} = 1\frac{1}{2}$.

I do not know whether it is worth while to point out to "Capella" (letter 28939, p. 411) that a star radiates light in all directions, and by no means whatever merely along a cylindrical space of its own diameter.

I am entirely in accord with Mr. Berdmore Compton (letter 28942, p. 412) as to the impolicy of dragging what he calls religion, but which I prefer to designate theology, into scientific discussions in these columns; but I, for one, have more than once found myself in this difficulty: that discussing some question—cosmological or geological—from an absolutely scientific point of view, I have incontinently been answered (?) by "E. L. G." and Co. (Limited) with some reference to Genesis and the like. Now, of course, I might have taken no notice of these appeals to the Bible, in which case many of the weaker-minded brethren would have been firmly impressed with the most pernicious idea that a question of pure science may be decided at once by a text; or I might (and have) pointed out that the said text was contradicted by irrefragable facts, and hence must in no sense whatever be suffered to influence our opinion or decision on a merely scientific question. If the theologians will only keep quiet and suffer men of science to pursue their investigations and enunciate their results according to the scientific method of inquiry, I can, I think, pretty confidently promise your reverend correspondent that "no onslaughts on revealed religion," big or little, will ever appear in the ENGLISH MECHANIC at all. If, though, as I have hinted in my answer above to Captain Battersby, every such discussion as those to which I am referring is to be conducted on the implied principle that "Heads theology wins, and tails science loses," then I am afraid that, unless you, Sir, veto all argument whatever, the very undesirable form of it of which Mr. Compton legitimately complains will persist as long as this paper itself does.

Was there ever a greater satire on the heading ("No More Death") of letters 28949, *et seq.* (page 413) than the words employed by "F. W. J." concerning an eminent acetopathist, "the late lamented Dr. Dirk"?

I really imagined that I had read Darwin's works through several times with sufficient care and attention to enable me to understand his doctrine, and it is certainly news to me that he anywhere predicates "that the survivors were fitted to survive because they *improved* and evolved their several races, and *benefitted the world generally*." I should feel obliged if "B.," in whose reply (65473, on page 418) the words I have quoted occur, will give me chapter and verse in Darwin for the allegations which I have italicised in my quotation.

I cannot off-hand call to mind any such work as that for which "Amateur" inquires in query 65760, page 423, but he will find a clear explanation of the *principle* on which cometary orbits are computed on pp. 266 *et seq.* of Loomis's "Treatise on Astronomy."

A Fellow of the Royal Astronomical Society.

LUNAR MIST-BOW.

[28968.]—THIS evening (27th May), the moon being two days beyond full, a well-defined lunar mist-bow was visible. The bow was without colour. I have not seen this phenomenon recorded.

Blakiston, South Australia. **T. D. S.**

LATHE MATTERS.

[28969.]—AS regards testing the lead screws of lathes referred to by "J. K. P.," I wish we had more information. How could we test our screws? Can it only be done by those who have special appliances? I think any information as to the limit of accuracy attainable very instructing, whether it be of the accuracy of a screw or of gauges or (as in the recent papers extracted from the *American Machinist*) of holes produced by rymers.

As to the Haydon cutter-bar, I use it and like it; but its fault I think is the considerable overhang, and it is to this effect I attribute any inferiority it may have in heavy cuts. I use the face or plan angle of about 120°; but do not set the following or parallel edge quite parallel with the shaft, but at a very slight angle, so as to avoid the chattering. I think it is a mistake to take off the shaving at a slant, and requires considerably more power to drive. 120° of plan angle gives 30° for the cut, which I think rather too much. Turning the 120° tool sideways gives the point side rake, which is a great assistance. 1-16in. deep, I should say, is a good cut for a foot lathe; but, of course, a deeper cut can be driven by putting on a slower speed ratio if it paid to do so. I think it rather important to have the point of tool not project too high above the sling—several of my cutters (of ½in. square steel) have broken at the sling. I think the point should not project more than ½in. Mr. Milne's London agent (see "Sixpenny Sale" column) showed me a new cutter-bar I thought good, but have not tried it. **F. A. M.**

[28970.]—I OBSERVE that my initials appear in letter 28951, by "F. A. M.," in which he says that a certain internal gearing for obtaining a slow motion on a lathe is described in Vol. XI., which it is, by "G. W. A.," on p. 349, and is "commended" by "J. K. P." I don't see precisely how my answer to query 4899, on p. 524, in which I say "I do not much approve of this plan in a general way" can be said to be *commendation* of the thing. I do not like complicated things boxed-in, where you cannot easily get at them to see what is the matter when they stick fast, as they invariably do some time or other. **J. K. P.**

INTERNAL GEARED LATHE.

[28971.]—THE delay in publishing my letter explains the first mistake "F. A. M." has fallen into. As to the second, it might be corrected if he would read again query 4399, Vol. XI., p. 574. **Fredk. Carre.**

HAYDON CUTTER-BAR.

[28972.]—I HAVE found this (see letter 28954) a capital tool, and frequently use it in a 10in. lathe. If the cutters are the correct angle, it is a splendid tool. Of course, a solid tool correctly shaped is as good. It appears to me the tool used by you—viz., $\frac{3}{16}$in., is far too light; use nothing under ¼in. to $\frac{5}{16}$in. With tool ¼in. square I have taken a cut the shaving of which was ½in. by $\frac{1}{10}$in.

Bristol. **T. C.**

[28973.]—I HOPE "J. K. P." will find time to reply to the two querists who wish to know if this is a good practical tool, as I know that he has used it largely. Also, as regards the double-edge principle: I believe he agreed with Haydon, who, nevertheless, did not claim the discovery, but rather worked out what was first observed by Prof. Willis. I became godfather to the said cutter bar at a time when Mr. Haydon was too ill or too busy to write; but all I have ever written was directly from the private notes and illustrations of the inventor, whose house and workshop I also visited.

I have a traversing mandrel lathe at present not suited to metal work, on which, however, with a Haydon bar I trued up a 10in. cast-iron face-plate, with, of course, a very light cut. But I have had a fair amount of practice with the cutter bar on other lathes, and always found it reliable, and I am quite satisfied that if well ground and (which is no less important) accurately placed, it will always do good work. The immense advantage, peculiar to cutter bars, of enabling minute vertical adjustment of the cutting edge, will be fully appreciated by all who try them. They are suitable for steam-driven lathes as for use in those of small size. **O. J. L.**

[28974.]—I HAPPEN to possess a set of large-sized models of nearly all the forms of cutters referred to by F. Carre, and if that gentleman wishes to borrow them for a reasonable time, and will furnish me with his full postal address, I shall be pleased to forward them for his inspection.

I do not think the small size of "F. C.'s" cutters will account for his non-success, assuming them to be properly shaped; the difficulty probably arises at the grindstone. If Mr. Carre once masters the knack of grinding his tools in accordance with "D. H. G.'s" theory, he will have very little reason to complain of the Haydon cutter bar, or the short life of the cutters. **S. Stevens.**

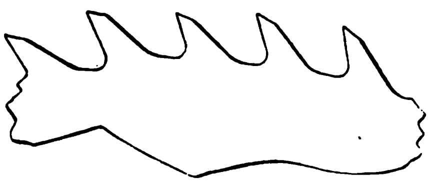
5, Princes-street, Mansion House, London, E.C.

SOME LITTLE-KNOWN PLANTS OF THE "FLORA MEDICA."

[28975.]—AURANTIACEÆ—genus, Ægle. *Ægle marmelos* is a tree of large size, found in a cultivated state in the hotter parts of India, immensely valued by all classes—European and native—bearing a large, spheroid fruit with a hard shell, known to everybody as "bail fruit." This woody receptacle, in a ripe condition, contains a considerable quantity of aromatic, delicious, exquisitely fragrant pulp, noted as aperient and detersive in the removal of habitual constipation, soothing and astringent in the early stages of dysentery and obstinate diarrhœa. It is a favourite medicine for children, who usually eat it greedily; but as the fresh fruit is only obtainable for a limited period, the Indian pharmacopœia devised several preparations, in addition to those of domestic invention; liquor belæ, a concentrated fluid extract, "conserve of bel," more than a ton weight of which was exported to Europe in one season by a Calcutta chemist; "dried bel," "inspissated bel pulp," called, in India, "bel opium," from its colour and appearance. The last I used to make for the facility of stowage, merely dissolving a lump in hot water as a dose. When fruit could not be had, I have seen both leaves and pieces of root made into a decoction by native women, and administered in diarrhœa infantum. The fresh pulp of bel fruit bears a high reputation as a prophylactic to Asiatic cholera. I knew a resident of forty years in Calcutta who took a large vessel of bel sherbet every morning of his life, and attributed his general health (though daily at his office desk most part of six days in the week) to the virtues of this domestic *régime*. The glutinous and tenacious matter which surrounds the seeds is one of the many adhesive substances used by the Indian bricklayers, especially in well-building. I have employed it myself for this work and in concrete pavements for bath-rooms. **Eos.**

CIRCULAR-SAW TEETH.

[28976.]—A FRIEND was speaking to me recently on the above; he said that in America teeth of circular saws were so formed and sharpened that the saws require much less power to drive them than they do in this country. If you have space in your valuable columns, would you kindly insert this letter?—it may benefit some of our readers, and be the means of benefit to myself, should there be a reply. I have had great practice in the sharpening of most kinds of saws, more especially circular saws. I have tried different forms of teeth and angles, varying from 60° to 85°, and for cutting the long way or slitting I don't know of a better form of tooth than the sketch I inclose, with a rake for soft wood to an angle of 75°, and the top and front of teeth to an angle of 70°; greater the diameter of saw the longer the teeth, and the gullet space more.



For hard wood about the same form of teeth, but shorter, and the rake or lead to an angle of from 80° to 85°, angles of top and front of teeth from 75° to 80°.

I should deem it a favour if any of our American readers who have had good experience in the above and know of any form of teeth or angles that would answer better than those stated, would give sketch of teeth, and state angles for soft and hard wood generally, and thickness of saws up to 60in. diameter, as generally used in America for soft wood. **Scorrier Saw Mills.**

METHYLATED SPIR[illegible]

[28977.]—I SHOULD not again r[illegible] (letter 28961) if Mr. Higson had not said [illegible] stated the facts; I did nothing of the s[illegible] I must say that the most gentlemanly [illegible]'d have been for Mr. H. to have sent the [illegible] to the "E. M." for insertion, where it [illegible] have met the eye of the parties interest[illegible] as of others "ignorant" as myself. I[illegible] doing so, the method pursued had the app[illegible] wishing to obtain the address of the cor[illegible]t in case it might be handy to the Excise. [illegible] now done with the matter.

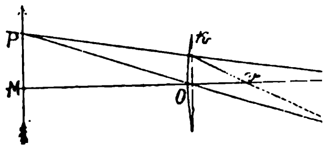
Bristol. **T. C.**

"GLIMPSES IN THE [illegible]."

[28978.]—WILL "Sigma," [illegible] reply to "Kappa," speaks humorously [illegible] up to the clouds by turning a ladder o[illegible] one has got to the top of it, tell me his opi[illegible] of the story of the Indian juggler, told in [illegible] od-faith by the Rev. F. G. Lee in his [illegible] Glimpses in the Twilight"? The story is to [illegible] ing effect—I am sure of the facts, but [illegible] member the exact words:—An Indian ju[illegible] rming many feats in the open air in the [illegible] of a number of officers and Civil servant[illegible] whose names are, I believe, given), aston[illegible] the spectators by concluding the entertainme[illegible] Producing a ball of thin silk thread, h[illegible] unwound it, and then threw the ball up [illegible] air. Of course, it came down again. The [illegible] threw himself into a passion, praying, gest[illegible] leaping, rolling on the ground, &c., and, fi[illegible] nging up with a shout, again flung up the [illegible] fore. Again it fell. The same process [illegible] n again gone through, but with greate[illegible] the man foaming at the mouth and [illegible] generally as if demented. At last, however, he aga
shouting as in triumph, and flung up t
time it *stuck*, some twenty or thirty
his head, and the man in the sight of
climbed up the thread, one end of w
retained in his hand, and so disappear
I suppose (but Dr. Lee doesn't say so
viously sent round the hat. This is
of a "Master in Israel!"

ON THE IMAGES FORMED B

[28979.]—LET P be any point i
placed before a lens whose centre



whose axis is M O. The following is
method of finding the place of the
which it is hoped will be found satisf

Join P O and produce it. Let P
incident upon the lens at k, and le
course after refraction, v being the p
meets the axis, and p where it meets
Draw P M and pm perpendicular to
produce P k to meet the axis in u.
O u are connected by the well-known

$$\frac{1}{Ov} - \frac{1}{Ou} = \frac{1}{f} \quad \ldots\ldots\ldots\ldots$$

where f is the focal length of the
there will be three pairs of similar tr
figure, one pair having a common
another in v, and the third in u. T
us the three equations—

$$\frac{MO}{Om} = \frac{MP}{mp}, \quad \frac{mr}{Ov} = \frac{mp}{Ok}, \text{ and } \frac{O}{M}$$

By multiplying these three together—

$$\frac{MO}{Om} \cdot \frac{Mv}{Ov} \cdot \frac{Ou}{Mu} = 1$$

but $mv = Om - Or$ and $Mu = MO$
fore the last equation may be written—

$$\frac{Om - Ov}{Om \, . \, Or} \cdot \frac{MO \, . \, Ou}{MO + Ou} = 1$$

or—

$$\frac{Om - Ov}{Om \, . \, Ov} = \frac{MO + Ou}{MO \, . \, Ou}$$

or—

$$\frac{1}{Ov} - \frac{1}{Om} = \frac{1}{uO} + \frac{1}{Ou}$$

or—

$$\frac{1}{Om} = \frac{1}{Ov} - \frac{1}{Ou} - \frac{1}{uO}$$

and finally by (A)—

$$\frac{1}{Om} = \frac{1}{f} - \frac{1}{uO} \quad \ldots\ldots\ldots\ldots$$

This determines the position of m
fore of p.

Now equation B, being independent
O v, gives the same value of m whateve
the ray may be thrown in—that is, p is
in which all rays meet. Also, equation
that m is the conjugate focus of M.
struction, therefore, is—Take m the
focus of M, draw mp perpendicular t
and the point where it meets P O will
jugate focus or image of P.

The peculiarity of this process cons
introduction of equation (A), and it appe
to simplify the method. (Compare
Arts. 68 and 112, 3rd edition.) It
further introduction of "ultimate ra
beyond what are wanted for the for
equation (A). Besides which, it appe
more exact, for the exact approximate
for the relation between the conjugate f
p is, $\frac{1}{Op} = \frac{1}{f} - \frac{1}{OP}$; but this, conf
only exact when P lies in the axis, an
more and more from the truth as M P i
whereas by the present plan M P does n
in the result, and therefore the accuracy is a
independent of its value, and our conclu
be as true for large obliquity as for sma
we may now see that *the image of a str*
perpendicular to the axis is also a straight
much as the image of any point in M P al
in mp, the position of m being the sam
points in M P.

Moreover, equation (B) is true qui
pendently of any particular numerical
between M O and f, and therefore it hol
cases, for virtual images as well as real;
I hope, will make good what was stated
28697, that the image formed by an ap
lineal, except so far as it is modified by
therein mentioned.

et me express my sincere regret that
ihould have been misled by a previous
e. I can only say, in excuse, that the
a it would have been perfectly cor-
stortion and curvature of the image
depended upon the quantities upon
are said to do. But if the distortion
1 the cause mentioned in letter 28697,
f he will make the calculation, that
aberration for rays from a very dis-
greater when we use a combination
a convex and concave than that pro-
single lens of the same power, and
than that of a Huygenian, in conse-
iich the distortion will be exaggerated
iminished by such a plan, as he, in
to be, and as I have found myself.
is been said above, the *thickness* of the
neglected, as is usual for a first ap-
It is, however, by no means an un-
ctor; and so, if space can be spared
letter, I will give the displacements
on of *m* when a plano-convex is used,
we turn the one side or the other
object.

.--Our printer has devised a new kind
In the heading of letter 28697 he
ysical" instead of "Spherical."

W. G. Penny.

E BOEHM FLUTE.—IV.

EBONITE is composed of indiarubber,
de of antimony, and colouring matter.
wood in some particulars—viz., it is
vious to moisture, and not liable to
k, except at low temperatures; it is
er in weight than cocus wood, and
ed or grain, can be cut and carved in
s with equal facility, and with the
metals, ivory, and horn. It is said to
the action of light, if kept perfectly
this there is not much proof as yet,
s well made.

s ago it was conclusively proved, from
ments made by Dr. W. H. Stone, I
"ebonite has the singular power of
part of musical vibrations into heat,"
en thought "that the flute, especially
egister, having no excess of musical
ch as the clarinet, oboe, piccolo, or
ht be somewhat enfeebled in tone, if
material." This supposition, of course,
than proved to be correct, and it may
er be settled, whether or not this loss
any) is not entirely compensated, by
r stopped holes and a smoother and
ore than could be possible with wood.
ever, did not approve of this material
, and considered that it did not produce
ous tones; yet he did not explain why,
ites are now made of this material,
lon and Paris. Metals have been used
s nearly as long a time as wood, and it
y well decided that sterling silver is
tal that obtains favour at present,
ny have been tried. The reasons of
are only partly known, and may be
nical. Thus a flute of this material has
te parts, better action, more perfect
he keys, greater conductivity to heat,
s the instrument rapidly to reach its
erature, and consequently its pitch.
good record, however, if one over-
has an inferior lip embouchure, or a
ply of wind, then the tone is thin and
strument is not easy to manage, and
er would produce a better result from
te. A silver flute demands the best
duce the best results.

of the sounding holes in flutes have
ed over and over and over again years
h very little results. It stands this
holes tend to destroy the confidence of
when taking wide intervals rapidly;
more difficult to keep tight, and they
ic capacity of the flute-tube more than
o, making it depart from the cylinder
practically a series of cones, whose
e together, and whose large ends also
ier. This tends to disturb the relation
t or harmonic notes, and render them
e makers compromise matters by using
holes, the largest being at the end of
ere the tones are weakest—the smallest
at the top or nearest the sound-pro-
the column of air is most sensitive to
. Most players are now agreed that
d holes are best, as the gain in tone, or
is not compensated by the risk of ex-
holes.

ly been proved that very thin wooden
worse tone than those of moderate
r on a flute-tube, say, of 3½ millimètres
e edges of the holes can only be one
ick at most, even if they are moderate
s thin part does leak air more or less
pores of the wood. Again, the risk of
unskilful manufacture have always to be considered alike by maker and player, so that thin flutes are now out of fashion, there being no advantages for the higher price which makers must charge for extra risk or extra skill. The above remarks apply only to wood flutes, for the proper thickness of ebonite or silver flutes cannot be arranged on the same lines. A silver flute tube of one millimètre thickness would be too heavy, while an ebonite tube of one millimètre thick would be too elastic to cut the holes out of and impossible to manufacture. The most difficult part of a flute to make is the head. Few makers like to produce a head in wood without being lined with metal, on account of the difficulty of correctly forming the parabola that shall be correct at every part to one thousandth of an inch. Constructive difficulties are great; but there are other considerations. It is found that no matter how careful the maker is in producing correct form, the moist breath of the player will alter both its curves and its capacity, and even if it plays well to-day it may not do so in a week or two. So that makers prefer to line all wooden heads with thin tubing, which can be made to correct size, and prevents the breath warping or altering the internal shape of the head. The lined head is a disadvantage: it is rare that it produces a good tone, and it may be accounted for on the supposition that "we cannot really join wood to metal," and if they are imperfectly joined, there must be a want of sympathetic vibration with the column of air inside. The best flute-heads I tried are all wood or all metal; composite heads seem to give a hard tone, and are deficient in flexibility and freedom. Again, the key mechanism must be in good order, and the pads and springs free from jar—a good test for which is to touch the flute firmly with the lower end of a large tuning-fork in active vibration. The size and shape of the "mouth," or sound-hole of a flute, determines, in a great measure, the volume and quality of tone produced. A large mouth-hole, approaching the shape of an oblong square, is advantageous for volume when the performer has good lung capacity and a good embouchure. But the best quality of tones are generally obtained from a smaller hole, and of an oval shape.

Vulcanite.

RAILWAY SPEED AND LONG RUNS.

[28981.]—THE acceleration of speeds to Scotland is causing such a commotion in the railway world that I should like to know more about the locomotive power to work the trains. Have new engines been built for the fast work, or are the old locomotives able to accomplish it?

A paragraph has gone the round of the papers to the effect that the Midland and North-Western are each 184 miles from London to Manchester. This the latter Company resent, and claim the "shortest route," and, clearly, the claim is correct, as the Midland route is 190 miles, and 197 miles *via* Nottingham, as run by the 2 p.m. express from St. Pancras.

The great speeds seem to have been possible simply by dividing the trains, and running two in place of one. It may be very fine running; but will the great pace and the duplicate trains all pay?

Shareholder.

OBJECT-GLASS— "SIRIUS" —DELUGE.

[28982.]—I AM afraid query 65555 has escaped the notice of Mr. Bradbury. Should this meet his eye, may I ask him again to look at it? I am obliged to "Orderic Vital" for his remarks, but he has not given me exactly what I wanted. That was an opinion on the formulæ as I gave it—curves *in situ*—and I should like a numerical value for the error of aberration, and the correcting number for the ratios of radii selected. By the way, in query, "ratio of 26 to 46" should have been 26 to 45, and the back of flint is *convex*. I know from the little experience in o.g. working I have had that results depend on practice, and clearness of definition on unmitigated patience and perseverance; but correct theoretical knowledge gives a fair start, and as Mr. Bradbury points out, "satisfaction in practical work agrees very closely with computed radii." He instances—

Practical Radii.		Computed Radii.	
Flint.	·8125 ·25	Flint.	·8125 ·25
Crown.	·25 ·8125	Crown.	·2513 ·796

Along with "Orderic Vital," I bewail the scantiness of optical matter in the "E.M.," but from the papers on the achromatic o.g. by Mr. Bradbury, o.g.-working by "Prismatique," and speculum-polishing by Mr. Wassell and Mr. Wenham, a very great deal may be learned, both in the way of theory and practice. However, hammering away is good for one, and no knowledge is superior to that gained by personal effort.

I am afraid what "F.R.A.S." says to "Sirius" is only too true. From his query, I should gather that he has done nothing as yet to lens-grinding. I may, of course, be wrong; but if not, let him start with some smaller lens than an o.g., and study a little optics, taking, say, Aldice's textbook to begin with.

We are being subjected to an Evolution deluge. Has it not poured enough now? Surely nearly forty days. And *cui bono?* The only thing that occurs to me to say is that, if science is going to be advanced in a satisfactory way, it must be by some other means than dispensing hypotheses with little or nothing to support them, or applying deprecatory epithets to a book for which many readers of the "E.M.," besides clergymen, have a great regard.

July 4. **J. A. Campbell.**

MR. GRANT ALLEN'S SCIENCE.

[28983.]—IN a story now running in one of your contemporaries, the following incident is related:—The villain of the tale wishes to destroy a poplar tree. He studies Gordon's electricity, and then causes a wire to be fixed to the top of the tree, terminating in a knob. The lower end is connected to a "Ruhmkorff induction coil," and to three barrels of petroleum concealed under the roots of the trees. During the next thunderstorm the tree is supposed to be struck, and with the coil and barrels, utterly consumed.

Is all this science, or nonsense? The author of the experiment was careful to order "secondary wires" with the coil—without which a "coil" would be indeed remarkable. But the E.M.F. of lightning wants no coil for "intensity." Was the idea to use the coil as a "converter," attaching the tree wire to the secondary, and another wire from the primary to the petroleum barrels? Would such dimensions diminish the E.M.F. and increase the volume of the current, thus rendering ignition or explosion of the petroleum more probable?

The reference given to Gordon's "Electricity," whether the large two volumes, or the school edition in one, is purely imaginary; and the experiment, though imaginary also, should be consistent with known facts, and be described so as not to mislead a reader with a turn for science.

The author of this novel, Mr. Grant Allen, seems to be also the writer of an article, insulting the English people, and advocating the virtues of the Celt, in the June number of the *Universal Review*. "Saxon, and Norman, and Dane, are we," and we have always been ready to welcome the Celt as a full partner by amalgamation if he will only respect the laws of the united nation; but we are not going to let him ride roughshod over us, for all that!

Antares.

"DELTA" AND THE DELUGE.

[28984.]—TWO correspondents—one of them the "F.R.A.S.," at third column of p. 390—have adopted or condescended to refer to letter 28864, p. 354, which the latter considers to treat Noah's story "from the seaman's point of view" (!), not, as I should have said, poor Tom Paine, the mountebank's, point of view. The Ark must have "grounded in the good old times," because, forsooth, it did not behave quite like a ship of to-day wrecked on a lee coast by storm! There is neither a shadow of reason for bad weather at the time, nor was there any coast, nor the least resemblance between the vessels' bottoms. Built far inland, the Ark must have been the shape of one of our canal barges, but full 450ft. long and the floor 75ft. wide, of probably about the longest timbers well procurable. The ends were doubtless pointed by bows of about 56ft. radius, or three-fourths of the width, making the curved ends bear to the straight sides the ratio of 2 to 5, mentioned by Berosus. The width was quartered by three rows of uprights, the middle row or masts, bearing the ridge, being as long as the floor timbers, according to the Assyrian tablet, which gives the structure's width and height as equal, though the dimension is lost; and this is quite consistent with Genesis calling the height only 30 cubits, that meaning doubtless the side walls. The difference would leave 8 cubits of height for each of the two parallel rafter slopes, lower and upper, and yet 4 cubits for the intermediate upright lantern or clerestory. That gave abundant daylight to the whole interior. "A *zohar* [lantern or skylight] shalt thou make to the ark, and in a cubit finish it above," or reduce the ridge to merely a cubit wide, just enough to walk upon if necessary. "And the door of the Ark shalt thou set at the side *thereof*"—that is, the side of the zohar or lantern. The door was a mere flap of the lower lateral roof (as shown on the Apamean coin), and this being propped up for the cattle's entry from some cliff or natural quay beside which the Ark was built, the first blast of the Deluge removed the prop, and thus "the Lord shut him in."

The lower story was merely the hold, there being but two decks, neither below the water-line, the first probably 20 cubits from the bottom, and the second at 27 or 28; so that between them were stalled the tallest of the young cattle, having descended, of course, by an inclined plane. Smaller quadrupeds and all the birds were provided for between the upper deck and lateral roofs; and the two ends of the lantern lighted the men's and women's apartments, connected by a long central gallery. Perhaps there was some kind of chain-pump. Of course numerous instructions not recorded were given, the kinds and quantities of stores especially.

The first day or two of downpour hurried the vessel, at railway speed, the course, as I hold, that Osiris was said to have drifted, from Thebes to the sea by the Tamitic mouth, then the principal. The mere impetus of this descent would carry it on, in the same north-east direction, over the North Syrian lowlands of to-day, before they emerged; and would hardly be spent by the 150th day, when the new upheaving shoal that is now Ararat just caught the flat-bottomed vessel, that it might, in the next seven months be hoisted, as the health of its prisoner's required, into a cool, pure atmosphere above the clouds, all through that year of most sweltering and pestilential heat the globe can ever since have known; while all our elder lands first, and then the new Armenian plains, were being reclad and the foul animal wreckage converted into vegetation. Now, a voyage of five months with no bad weather is no unusual thing. That a wind is only mentioned at the end of that time is hardly so strange as the fact of no land being seen, which, however, has far more than a parallel, in Magellan's vessel's first crossing all through Polynesia. We need not suppose even Lebanon, or the nearest hills to his course, any lower then than now.

Where does "Delta" find a word of "forty days submergence" of trees or anything else? All vegetation must have been uprooted and afloat; but the little that rooted again, if any, or that restocked the lands, the few animals clinging thereto, or still fewer of which both sexes survived, there is no occasion to suppose afloat a single week. Noah's imprisonment was to give the vegetable kingdom at large a whole year's start of him and his animals, and that the hottest and fertilest year the new world would ever know, that they might thus enter a prepared world.

On a correct map, a circle described from Ararat, with any radius between 1,000 and 1,300 miles, has this unique property, to be paralleled, if by any other point, certainly by no other mountain—that all crossing streams enter the circle, and none leave it. Thus it rose in the very centre of the area whereinto the drowned world's chief wreckage was all swept. Moreover, as I pointed out a year ago, it stands just between the centres of the two depressed basins that alone were so closed as to retain the fresh waters falling on them, and thus to receive four or five times the additional pressure that the oceans at large would. This modern physical geography shows it exactly the likeliest region to be caused by such a catastrophe to swell up in a new upheaval. It is geologically of the newest kind, and the principal highland of that latest kind. In Johnston's "Physical Atlas," plate 4, where are three tints for volcanic upheavals of different ages; the largest patch by far, of the newest tint, is around Ararat, exceeding about tenfold all the European patches of the same about Bonn, Le Puy, Rome, and Naples. The spot of this volcanic highland that caught the Ark need not be what is now the highest. It was in Noah's time the highest he ever afterwards saw, because, otherwise, he could not have handed down that "fifteen cubits upward did the waters prevail, and (or when) the mountains were covered." But when we find the volcanicity so far from extinct that there was a destructive movement as late as 1840, it is plain there may have been changes disguising exactly where Noah's summit was.

If anyone besides "Delta," by the way, should follow the advice of "F.R.A.S." to him, to refer to Colenso "On the Pentateuch," such a one will do well, on coming to the first "fact" in the poor bishop's preface, to try and ascertain where that French cone of "tight and loose materials" that stood from before Noah's time undisturbed stands now. The French geologists, who have classified 2,000 of these Auvergne cinder heaps, have known nothing of it: and whether this remarkable *pièce de conviction* against Noah had more existence than the Phœnix, or the Jews' famous "Sabbatical river," or the foundation whence the angels brought the Virgin's "holy house" to Loretto," was a question neither poor Colenso nor his "persecutors," nor any clergy of his generation (who have gravely referred to it in their "Speaker's Commentary") thought of asking! Is "F.R.A.S." or "Delta" aware that a live fish put into a vessel of water adds no weight? Let me commend the fact to their serious consideration.

But the existence of that special cinder cone you will find the bishop based upon this broader position: that all the French volcanic eruptions had been pre-Noachian. Not any action had occurred there in these fifty centuries. He was not at liberty to shut his eyes to "any fact that God in His providence brings before us." Not many geological bits of local fact, I suppose, were so brought before a man as Anglican parson. Not congregations what holy days or fasting days "are in the week following to be observed." Now, the Prayer-book table of such days contained "the Rogation days" (peculiar to the Churches of two lands—Gaul and Britain), and the origin of these (as also of the Litany) was in fasts appointed by an archbishop in Southern Gaul, St. Mamert, to deprecate the terrible eruptions from some of those volcanoes in A.D. 460—just *fourteen* centuries (instead of fifty) before our bishop's portentous discovery!

It happened, by the way, that the same French volcanic region (of part of which there is a model at the head of the stairs to the Jermyn-street Museum) is the most plainly evidential of the Flood, of any yet known in the old continents. One class of lava streams, the antediluvian ones, that must have flowed along troughs, are now capping lines of hills which they protected from the scour of the Deluge, causing it to scoop the clay and marl between them (which were hills) hundreds of feet deeper, making the present vales, in which exactly similar lavas, only since the Flood, have run. Precisely similar tracts of country are now known in regions nearly as distant as possible —in California, in New Mexico, and in New Zealand. No century since Noah's death (or his sons') can have had, on the whole, a tithe of the evidence as to the Deluge that this age has thrust upon us, and chiefly by English discovery.

E. L. G.

A PROTEST—A REPLY.

[28985.]—MR. COMPTON'S protest comes, on p. 412, immediately below a letter of the kind protested against, and such as I quite think ought to have been rejected, as unscientific and out of place. But, first, I must beg to oppose the rev. gentleman's suggestion that "natural and supernatural" knowledge (or belief) can or ought to be "wholly distinct" provinces.

They might, perhaps, be so kept apart, if churches based their religion on the Koran, the books of Swedenborg, of "Mormon," or of the late Queen Esther's "Latter House of Israel." For prophets, if not as early as Mahomet, very soon after him, became increasingly shy of touching aught that seemed likely ever to be physically knowable. But the Bible-writers, or whatever spirit might be behind them, were utterly without such caution. Its chief books go out of the way—if religion or the supernatural was their special way—to pledge themselves to statements on such purely and merely physical questions as these:—Whether the earth or the sun was the older body? Whether the earth's materials were at first solid, fluid, or both? Whether she had time measured by days and nights before there was a sun to rule them, or only since? Whether the extant marine, or flying, or walking animals originated the earlier? Whether creation of new species, or what creates them, works at so doing continually, or has rested, or after resting has resumed such work? How long ago was the latest geologic change, or the present order begun? Whether such change was gradual or catastrophic? Whether by a deluge, and if so, how physically caused, and whether a general or partial one? Whether there were men on earth before it; if so, in what way a race of them, or of most extant animals were preserved? Whether future earthly time, till the end of this order of things, is dated, or anywise knowable, or may become so? Whether it will be by another deluge, or what other kind of catastrophe; and the physical causation or effects thereof?

All these are surely points of pure physics, having *in themselves* no sort of connection with religion or the supernatural; but the Bible having gone out of its way to treat of them, this alone establishes such a connection, and makes, as I have said, Mr. Compton's desire that the natural and supernatural might be kept "wholly distinct," impossible, where any church admits Biblical claims at all. Physical science may and ought indeed to keep independent on any of their doctrines, but not so their doctrines independent of it. Their Scriptures make assertions on all their physical points, which are either true or false. If any one of them be demonstrably false (which a multitude of your writers—the "F.R.A.S." "Delta," "Satine," "J. R. C." Mr. Grey, "F. H. W.," &c.—seem to assume many or all of them to be), then Mr. Compton and all Churchmen ought to be not "annoyed week after week," but attacked, not with "sneers," but with serious impeachment, or what would doubtless be held "persecution," disestablished, disendowed, and expelled to Africa, or wherever there is ignorance enough to support them. But I should still say, with him, that "sneers" such as constitute nearly the whole letters of most of the above, were wantonly stupid, and to be rejected.

If one of the Bible's many physical statements be proved false, all its claims must be treated as equally so, and all its supernaturalism and church religions hanging thereon be fought against as mischievous. How can there be "salvation" in a "the day that Noë entered the ark, and the flood came and took them all away," if such a thing never happened but, as all your above writers pretend, in legend?

But no facts of any kind in disproof of any single legendary point are produced. All is idiotic rant and bare assertion against assertion—this was not so, this is unhistoric, this must have been "in the good old times." What single matter of fact does "J. R. C." touch in his letter on p. 412? No physical statement in Genesis; but merely that he rejects the God of Genesis as inconsistent with his ideas of Deity. But what has that to do with mechanics or natural science? I must protest, like Mr. Compton, that Bradlaugh's or Foote's papers are the place for such metaphysics. Who on earth reads the ENGLISH MECHANIC to know what kind of God "J. R. C." believes in?

And who cares what may be the chemical ideas of such a person as "Satine," who fancies the atmosphere a "mixture of oxygen and hydrogen"? (p. 395). Who can care whether one like "Delta" thinks he could have carried out the directions given to Noah or not? (p. 354). But the continual ascribing to the Bible things it never said ought to be replied to. Where has it ever said we had a single ancestor?—or even pair of ancestors? Where did "Delta" find—or "F.R.A.S."—any "forty days' submergence," or any survival of submerged trees, or submerged anything?

E. L. G.

[28986.]—THE protest of the Rev. B. Compton (letter 28942) is surely out of place in a scientific journal when he speaks of "natural" and "supernatural" being distinct, and deprecates the idea of those who would seek to bring scientific knowledge to bear on "revealed religion" and reconcile them. Is it that he fears that the truth may ooze out, and it become plain that science and superstition cannot live together peaceably, and also that science, which is knowledge grounded on demonstration, destroys dogmas which mislead men, it being the enemy of fear and credulity? Surely a revealed religion has nothing to fear from science.

Finally, will he give us a scientific reply to this question, How can a "natural" being possess "supernatural" knowledge?

Chelsea. **Tammuz.**

[28987.]—I ENTIRELY agree with the sentiments expressed by the Rev. B. Compton in his letter under this head in your last (28942). A very large number of your readers profoundly resent the letters which are constantly appearing, endeavouring to undermine the fundamental belief of the Christian faith, particularly with reference to the truth of the Scriptures.

If evolution, or anything else, is contrary to the Scriptures then it is not true. *Of this we are certain*, and time will reveal it. It may seem contrary to our present understanding of the Scriptures, as it was in Galileo's time—this is a very different thing. But I submit that the facts of science can be studied and investigated without this appeal being made, and they have indeed nothing to do with it, especially in a magazine such as the ENGLISH MECHANIC.

If any apparent facts of science seem contrary to the Scriptures, one thing is certain—viz., that we do not understand both, perhaps not either, fully. When we do, we shall find that they agree.

Fordingbridge. **T. Westlake**

[28988.]—I QUITE agree with the Rev. B. Compton's letter last week (No. 28942); but, at the same time, I must say that people who pay any attention to both religion and science are continually being confronted with (apparently) difficult questions for reconciliation. Is it not true that our clergy, as a rule, ignore the teachings of science, which are day by day spreading wider afield, and thus laymen who are perplexed rush to the columns of a newspaper to give vent—and, I hope, to learn?

Quite recently I heard a clergyman, who has attained a certain eminence in natural history, say, when lecturing on and supporting Darwin, "that he hoped the time would soon be when Natural History was an essential part of the curriculum of a clergyman, and that we should not then hear such unscientific statements made from the pulpit as we now do." I also would like to see that. I have had frequent experience of this want of scientific knowledge on the part of our clergy.

Leon Nobard.

[28989.]—I AM very pleased to see that the Rev. Mr. Compton (28942) has had the courage to protest against the increasingly infidel character of your journal. I am continually hearing the same remark.

I am surprised at your daring to suppose that *all* your readers take pleasure in reading such blasphemy as you indulge them with.

Do you not know that all such heathen sentiments will have to be accounted for by those who from satisfactory. Probably some seed of good was sown, or some latent power "stung into activity" to become visible later on; but as yet there seems little likelihood. For the coming season, my mind is busy with the question, "What can I do?" and knowing the many able contributors to the "E.M." are always ready to place their knowledge and experience at the disposal of needy workers, I am hoping, by this letter, to draw upon their resources. Perhaps the promoters or the managers of one or other of the ENGLISH MECHANIC societies will give me the advantage of their successes or failures.

I have plenty of tools with which to start my school; but my difficulty is to know how to commence, the best lines upon which to work such a school, and, more especially, how to keep the interest alive. It may help if I enumerate the available tools: three cabinetmakers' and one carpenter's bench, a set of cabinetmaker's tools sufficient to keep four professionals going; a good 5in. lathe—the latter I know how to use, having served an apprenticeship at one of our large locomotive works; plenty of carving tools, and the necessary punches, chasers, &c., for pure repoussé work. Then I have a fair knowledge of drawing, cabinetmaking, and wood carving, and some knowledge of art metalwork. All the foregoing I am prepared to use for any who will accept it. A suitable room is obtainable, and I can reckon on the assistance of a few friends competent to join the teaching and lecture staff. But here is another difficulty.

Being the minister of a church, which keeps me fairly well occupied in visitation, sermon and speech-making, &c., my time for the preparation of designs or clay models for drawing, carving, or brasswork is very small—too limited, in fact, for doing the thing properly; then funds are scarce. I am unable to purchase them or pay for their production. Yet they are essential. I have been informed some Art Society in London would lend me this necessary apparatus, but after repeated attempts, I have failed to obtain the name of secretary, or location of office. Do any of our readers know? Now, to put my case succinctly, I want to commence a practical and technical evening school, not for personal or sectarian ends, nor for personal pecuniary profit, but solely to help in a very small and humble way to keep the young men of our village from wasting their spare time, and at the same time to add to their mental store and moral elevation. And I am not alone in my wish. Many of my ministerial friends are anxious to do something on similar lines, but the question of apparatus bars the way, in some cases; while in all "How to do it?" seems to be the greatest difficulty. Surely there must be some way out of this. The establishment of such classes in our towns and villages would, to my mind, give the subject of technical education a tremendous lift, and probably remove it from the region of parliamentary talk to the domain of activity. Can any of "Ours" help?

The interesting letters of Dr. Edmunds, A. Caplatzi, and "Orderic Vital" have opened up another possible art for my school, especially as I number among my friends a first-class practical optician, who is willing to help me. I sincerely trust the subject of object-glass working and optical brasswork will not end with the letter on page 392.

Irex.

THE ENERGY IN A LIGHTNING FLASH.

[28997.]—IN the examination for admission to Sandhurst in July, 1885, the following appears among the questions:—

"How may the amount of electricity discharged by a flash of lightning be estimated?"

This question appears to me singularly unfit to be addressed to a set of lads. But to older students it may be interesting, and I have endeavoured to deal with it. I should be grateful to "Sigma" if he would read what follows, and tell me whether he thinks the result is anywhere near the truth.

I ought to apologise to him for the use of the word "potential"; but if he likes to erase that word and to substitute for it the expression, "fluid pressure," I shall not object, provided that he will not hold me responsible for the hypothesis involved.

W. M. M.

ANSWER.—By observing the heating effect produced upon some substance, through which we know the whole of the flash has passed, and comparing that effect with the effects produced in a laboratory by the passage through the same kind of substance of a known current of electricity for a known time; then, by observations upon the duration of lightning flashes, we can calculate the quantity that must have passed in order to produce the observed effect.

Thus, it is reported that in 1772 lightning struck a bar of iron on the top of the dome of S. Paul's, and made it red hot. The bar was 4in. broad, and ½in. thick. Wheatstone estimated, by means of his revolving mirror, that the duration of a flash certainly does not exceed the millionth part of a second.—[Tait's Lecture, *Electrician*, June 14, 1884].

The heat generated by the passage of Q coulombs in t seconds through a conductor whose resistance is R ohms, is RC^2t joules, where $Q = Ct$ (C being the current in amperes). Iron at a red heat is at a temperature of about 1,000° Fahr.; to raise one pound of iron to this temperature requires about 119,000 joules of heat. Hence, RC^2t must have equalled 119,000. Let us suppose t to have the greatest possible value, or $t = 10^{-6}$, then RC^2 will have as its least possible value 119×10^9. Two inches length of such a bar of iron will weigh one pound, and will have a resistance

$$R = \frac{1}{254 \times 10^3} \text{ ohms.}$$

$$\text{Therefore} \quad \frac{C^2}{254 \times 10^3} = 119 \times 10^9;$$

whence $C = 176 \times 10^6$ ampères, and thus $Q = Ct = 176$ coulombs.

Thus we have estimated the quantity of electricity in that particular flash as 176 coulombs.

REMARKS.—To raise a pound of iron 1° Fahr. requires the heat equivalent of 87·8ft.-lb. of energy. To raise it to a red heat requires, therefore, 87,800ft.-lb. 87,800ft.-lb. exerted in one second corresponds to 160H.P. But the lightning did this in one millionth part of a second; then the lightning exerted 160 million H.P. for every pound of iron which it raised to a red heat. We are not told how long the bar was, nor how much of it was raised to a red heat; but we see that for every pound of its weight—that is, for every 2in. of its length—160 million H.P. were exerted by the lightning.

If E be the electromotive force exerted in driving the flash through the 2in. length of the bar, we have—

$$\frac{EQ}{2} = 119 \times 10^3 \text{ volt-coulombs (at least),}$$

$$\text{and} \quad Q = 176 \text{ coulombs,}$$

$$\text{whence} \quad E = 1{,}300 \text{ volts (at least).}$$

176 coulombs would raise a conductor whose capacity is one farad to a potential of 176 volts. The capacity of the earth, regarded as a conducting ball isolated in space, is only 1-1,400th part of a farad. 176 coulombs would therefore raise the earth to a potential of 250,000 volts. If we regard a thundercloud and the ground immediately below it as the two plates of an air-condenser, one being at zero potential, we may, so long as the length and breadth of the cloud are large compared with its height above the earth, apply the formulæ which relate to two conducting plates, opposite and parallel to one another, the distance between them being small compared to the linear dimensions of either, one being to earth, the other insulated and at potential V. We have then—

$$\sigma = \frac{V}{4 \pi d}$$

where σ is the superficial density in electro-static units per square centimètre of cloud surface, V is the potential of the cloud in electro-static units, and d is the height of the cloud in centimètres above the surface of the earth. Turning this into more convenient units we have σ^1, or density in coulombs per square mètre $= \frac{\sigma}{3 \times 10^5}$; and V^1 or potential in volts $= 300\,V$; and d^1 or height in mètres $= \frac{d}{100}$; whence—

$$\sigma^1 = \frac{V^1}{36 \pi \times 10^9 d^1}$$

If therefore we have density σ^1, we shall have an average E.M. force per mètre thickness of air represented by $\frac{V^1}{d^1}$, and this is the force which tends to rupture the air and produce a flash.

It was found by De la Rue and Müller that when V^1 was 10,000 volts, and d^1 was ·0137 mètres the force tending to produce rupture was just sufficient to transmit a spark. The experiments of Sir W. Thomson and of Riess lead to the supposition that at greater distances far less difference of potential per mètre will suffice to produce a spark. We shall, therefore, be well within the mark if we assume that a density $= \sigma^1$ on the surface of a cloud, will be enough to produce a lightning flash, provided that—

$$\sigma^1 = \frac{10{,}000}{36 \pi \times 10^9 \times \cdot 0137} \text{ coulombs per square mètre.}$$

176 coulombs will produce this required density if spread over a cloud surface of—

$$\frac{176}{\sigma^1} = 176 \times 36 \pi \times 1{,}370 \text{ square mètres.}$$

$$= 6{,}600 \text{ acres}$$

$$= 10\tfrac{1}{4} \text{ square miles.}$$

If 176 coulombs were spread over a cloud-surface of 10¼ square miles, the consequent potential would suffice to send a lightning flash through air, and would almost certainly be far more than sufficient to send a flash through any considerable distance, because the potential increases in to the distance which separates the clo earth, while the air resistance does no increase nearly so fast. Moreover, regions of the air are more rarefied tha which all the experiments which quoted were made, and rarefied air o resistance to the passage of a spark air; and, again, the vapour in the up will greatly reduce the resistance. Th 176 coulombs for a lightning flash is possibly correct; but it must be reme we arrived at that number, 176, by n hypothesis which is certainly not quite which may be very far from the truth.

GOLD: ITS OCCURRENCE EXTRACTION.

[28998.]—ALLOW me, through the your columns, to thank those of your have furnished me with specifications ings of various patent processes for th of gold, and to whom, owing to press other causes, I am unable to write and sonally. With very few exceptions, cesses are various forms of the mercury tion scheme of which I should like words further on. Several of them tried upon ores from these very mines, success.

April 27th, letter 28670.—I should b your correspondent, Mr. Sam C. Dea particulars of his process. He says: would cost about £1,000 on the spot." him if his process is patented? Beca should think at that price it should universal use. I have great faith i purely chemical as opposed to simple a with mercury. It is known that all dissolve gold, chlorine, with the fluorine, being the most powerful. isolated only just lately, and its vario ascertained, is not at present, on acco properties, likely to be useful in gold believe that a chemical process must, t ful, be capable of disintegrating all pa have passed through a 30-hole screen holes to the square inch). Mr. Dean silicious matrix; and if he has been al "every atom" of gold therefrom, he of the problem, because most gold i quartz or silicious matrix. Exceptio of course. Spanish and other ores so as high in sulphide of iron, or antimon as 75 per cent. I hardly fancy the sili would be marketable here; but while letter I occasionally look out upon tailings, probably containing 8,000 to which, by Mr. Dean's process, shoul ounce to the ton. Fuel, if needed, very scarce.

With regard to mercurial processes sample of rather high grade ore, the obtained of the gold was 64 per ce treated in the following way:—Cru battery, passed through screens of 30 h 1,000 holes to square inch), over 80 sq. gamated copper plates and riffles, over 70 yards of blanketings, changed every t over another set of amalgamated riffle the buddles. The stuff from buddles was to the Californian pan—the pulveriser at 60 revolutions a minute. Here the ground for two hours, and at the end of a dried sample had the consistency of w flour. Steam at a pressure of 10lb. to t inch was then let into the pans (in the C processes all grinding is wet), and at the a large quantity of mercury-settlers were up and agitators put to work. The mullers on the pans were raised half a that grinding should cease, and to preve of mercury as much as possible. Th mixture was very soon boiling, and t muller mixing at the rate of about 67 re per minute. This was kept up for Then, by the usual pan methods, amalga covered as it settled in the well-kno well" of settler, &c. During the whole of rigid sampling and assaying was going the clean up at the end of the month t showed as follows:

F

From mortar boxes ....
From plates ....
From pans (including treatment blanketings therein) ....
Slimes (which in cases assayed up 22dwts. per ton *cased* gold) ....

The reason that the assay of slimes is high is because, during the various everything tends to concentrate them. slimes often represents as much as four o of the original ore. I firmly believe th no more rigid course of mercurial tre if the valve lifts before the seams weep, you can safely work at half the pressure to which the valve has been loaded. T. M. F.

[65492.]—**Dyeing Leather.**—What is "tan-coloured" leather? However, it cannot well be dyed white or buff, and as to a paint that won't crack—well, that would be very useful to many. I am afraid "Old Subscriber" will not get the kind of answer he would like. NUN. DOR.

[65582.]—**Foreign Meat and Borax.**—Considerable quantities of both borax and boracic acid are used in the United States for preserving meat, and many farmers in this country use the latter chemical for keeping butter sweet; but I never yet heard of any ill effects following the consumption of provisions so treated. During the last 40 years I have visited nearly all the districts in the world where the raw product is collected, and have discussed its merits with thousands of people of all classes, but so far have not met a single person who complained of any inconvenience from its use. As for myself, I have for years past taken a little borax several times a day, and am always in good health; and although I have visited many towns and cities in North and South America where yellow fever and cholera have been raging, I never caught either. Moreover, a short time since I paid a visit to Sasso and Castelnuovo, and other places in Tuscany, where boracic acid is manufactured from vapour rising from the bowels of the earth, and was assured that no case of cholera had ever taken place in the neighbourhood of these fumeroles. ARTHUR ROBOTTOM.

[65589.]—**Hymns and Bands.**—"G. R." must arrange his parts for his band somewhat as follows:—1st cornet and clarionet, treble; 2nd do., alto; 3rd do., write a part to agree; 1st horn, alto; 2nd do., write a part; 1st baritone, tenor; 2nd do., write a part; 1st trombone, tenor; 2nd do., write a part; euphonium, tenor, or bass, or melody; bombardons, bass. "G. R." will find it effective in some places to give the melody to the 1st baritone, and let the second baritone take up the tenor part. If he will send me a hymn and his instrumentation, I will score it for him, and he will get a better idea how to proceed by a few minutes' study of same than could be given in a page of "Ours."

Rugeley. 1, ARMITAGE ROAD.

[65619.]—**Tinning and Cleaning Copper.**—The method I have adopted for several years of cleaning and tinning copper stew pans and such like articles—and they have been many—is, first having brought your pans together, light a coke fire, similar to a blacksmith's fire, with air blast attached, and when it has burnt up clear and bright, put your pans on one after another, and burn all grease off, and with a pad of tow wipe all tin off that may be there; next fill the pans with a solution of sulphuric acid to loosen all dirt, pickling them for about an hour or so, and then scouring them with sand and water, to clean all dirt off (insides only of course); rinse them in clear water, and if properly cleaned will take the tin very readily with chloride of zinc as flux or powdered salammoniac, and wipe surplus tin off with wisp of tow. BRAZIER.

[65671.]—**Voicing Organ Pipes.**—The nicking in the languids of all flue pipes should become finer and closer to each other as they ascend the scale—the nicking in the open diapason at CC should be about $\frac{1}{10}$in. deep and $\frac{1}{8}$in. apart. The nicking on tenor C would need in some cases to be only $\frac{1}{16}$in. deep and $\frac{1}{8}$in. apart; whilst in other cases it might be the same depth but very slightly nearer. The closer the upper lip is to the lower one the finer the nicking needs to be. The hole in the foot of CC would be about $\frac{1}{4}$in., tenor C $\frac{3}{8}$in., top G $\frac{1}{8}$in., height of mouth one-third the breadth. WM. ROBINSON.

[65692.]—**Negative Varnish.**—The following is a good recipe:—Orange shellac, 2oz.; gum juniper, 1½oz.; camphor, ¼oz.; methylated spirit, 1 pint. AN OLD LEYSIAN.

[65692.]—**Negative Varnish.**—Mix together half a pint of good white hard varnish and half a pint of methylated spirit. I use this and find it good, and think "H. C. M." will also like it. AMATEUR.

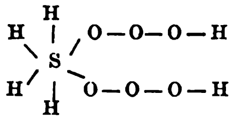
[65692.]—**Negative Varnish.**—See "Abney's" instructions, p. 66. If you get a gill of best white "hard" at the oilshop and dilute it with a similar amount of methylated spirit, you will have a varnish that will meet your requirements. When poured on the plate, the varnish should run freely. If it does not, add more alcohol. ROBT. BUNTING.

[65694.] — **Screw Propeller.**—Rather vague. Description of screw you want depends on size and H.P. of boat. You had better have boat as sharp in bows as possible, and engine and boiler as powerful as you have room for. Screw is better than radial paddle for deep immersion, but not in shallow.

Leamington. C. ANDREW.

[65695.]—**Valency of Sulphur.**—At 1832° F., sulphur follows the rule that under similar conditions of heat and pressure, atomic weights (in grammes, grains, &c.) of volatile elements, occupy equal volumes of vapour. Its formula then is S_2, and molecular weight 64; but at 932° F. its density is three times as great, making its molecule S_6. Hence, sulphur has two valencies, diad and hexad, its diad form being more frequent—*e.g.*, H_2S, K_2S, KHS, C_2H_6S. J. A. HOGG.

[65695.]—**Valency of Sulphur.**—I thank Mr. Grey and others for their replies to this query. I have been able to construct graphic formulæ to satisfy all the oxygen acids of sulphur as a diad, except the hypothetical and unstable acid H_6SO_6, the tri-hydrate of SO_3. This one appears to demand a hexatomic central atom:—

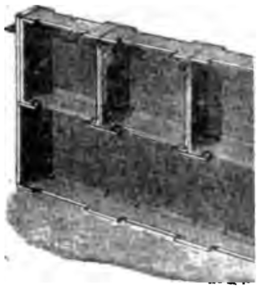


Wurtz (in "The Atomic Theory") inclines towards the hexad condition, remarking that although he formerly considered that in the higher acids of chlorine and the sulphur compounds the oxygen atoms might be united in the form of a chain, for various reasons he had been obliged to relinquish these ideas, and adopt the higher atomicities for chlorine and sulphur. One of his reasons is that in the chlorine acids the stability increases with the number of oxygen atoms (page 229, foot-note). But as Mr. Grey remarked, the whole of the laws of atomicity are involved in great confusion, and although we may use the terms, "bonds," "points of attraction," and the like, they are, after all, mere names given to conceal our ignorance upon the subject. YOUNG ANALYST.

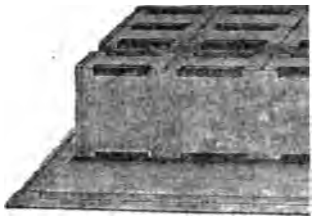
[65698.]—**Breathing of Plants.**—In contradistinction to the process of assimilation, which takes place only in cells containing chlorophyll, and only under the influence of light, all living parts of plants at all times absorb oxygen and give off CO_2. This process is called respiration. The reason why plants increase in weight while these two processes proceed is that assimilation is very rapid, while respiration is slow. A plant kept in an atmosphere free from oxygen dies. Oxygen taken up in respiration is necessary for the vitality of the protoplasm and for the oxidation of the nutrient matter produced in the plant. The reason respiration is not noticed during the day is that it is covered by the process of assimilation. It is possible that odours of plants might to some extent influence persons of delicate organisations; but it must be seen that many thousands of plants would be required to give off sufficient CO_2 to prove injurious. J. A. HOGG.

[65699.] — **Animal Heat.** — The statement quoted by "Zero" is correct. The heat of the body is the result of the oxidation of the tissues, and not of the food, the constituents of which are absorbed and transformed into the various complex compounds of which the tissue is composed. These compounds sooner or later break down, being wholly or partially oxidised. A small part of the energy thus set free appears as work, internal or external, done by the body; the remainder appears as heat. There is therefore no burning up of waste effete matters to any extent, these being the result of previous oxidations, and they are passed out of the body by means of the lungs, kidneys, &c. It is considered that little or no oxidation takes place in the blood. The muscles form a large proportion of the body, and they are constantly in action: hence they are the source of nearly all the heat; but wherever tissue is, in the exercise of its function, breaking down, there heat is generated. KENSINGTONIAN.

[65708.]—**Bee Hives.**—To "SILKE."—Outside walls may stand at any convenient height above frame tops if other dimensions of body are the same as I gave. I have made outside walls of 11in. stuff without inconvenience. A super is really anything that is placed super or above the frames. "Indian" must decide on size of sections, and make a case (open top and bottom) to contain them. Sections usually adopted are 4¼in. by 4¼in., and 2in. broad. The sections rest on narrow strips, which also form a space over frames for passage of bees. I inclose cut of a super I designed, which allows of placing sections in hive-body or as a super, and, at same time, provides separators for insuring flat faces to the combs and protects sections from being soiled. These are made by Messrs. Abbott, of Southall. Sections are also removed singly from any part of super with ease, and if started in hive-body they may be placed on top without disturbing the adhering bees. A case of 4¼in. by 4¼in. sections will comfortably go inside top of hive, and the projecting ends of frames below case should be covered with strips of cloth or wood. The super may, however, be made of any convenient form, and, instead of 4¼in. sections, larger boxes may, with advantage be placed above. They should be shallow in shape, so that bees have not to commence on foundation too far from bro
again, the super may consist of sh
hanging in a plain box. The hive co
deep enough to accommodate at lea
cases, one above the other. After va



SHOWING TWO DIVISIONS OF SUPER,



SHOWING SUPER MINUS THE AL

found the roof recommended to sta
weathers. It is made of "weather"
board, *i.e.*, board sawn with one edge d
as the other. I rabbet out ¼in. of th
so that when the thin edge of the a
is inserted in rabbet and closed up
tacks, the underside of roof is in or
needs no "zigzag" cutting to bed
omit painting joints in roof, &c., bef
capillary attraction will draw in w
bare joints, however well painted o
paint for joints is priming made of
little red lead, and linseed oil. The hive
when fixed in place, should not be
manipulations can best be done i
"Indian" wishes to make the super a
hive, he must construct a much sma
take, say, 10 frames only, but the a
small hives are very doubtful. The o
their favour is that they are comparat
On the other hand, they are unsteady
up; there is no room for shifting fr
spreading beyond the fixed number
They are too hot in summer, too damp
The better plan is to have a large wea
hive, and place simple super cases or
inside. I never lost a stock in the hives
p. 161, 1887, and never experienced a
rotting with the floor boards there show

[65709.]—**Transparency Making.**—
colour is probably due to oxalate of li
by the use of ferrous oxalate deve
washing with hard water. All this will
if you immerse the positive in an acid s
citrate of soda, rubbing the solution in g
a piece of cotton wool. The oxalate ha
colour by reflected light, but dirty brown
mitted light. Another plan would be t
with hydrokinone. Of course this is for d
AN OLD LE

[65713.]—**Differential Feed Motio**
cannot patent principles, but their applic
specific purpose. You will therefore r
patent its application to each machine
for similar purposes—thus, for a lathe,
machine, &c.

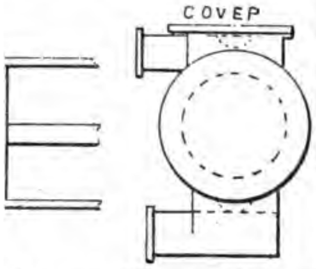
Bristol.

[65721.]—**Dynamo.**—TO MR. BOTTO
dynamo is a series-wound machine, wou
10lb. c.c. wire, No. 16. I have tried the
to run right-handed, and it gives current
good spark, when two wires are brought
at the points. Run at about 800 revs. per
Will I have to disconnect the F.M. wires
gives current right-handed? It is coupled
same as the hand dynamo in your book, as
machine. Will the speed be too great
give? I have some 16c.p. lamps of 43 vol
they do to use? Will you kindly tell m
quantity of No. 18 or 20 c.c. wire it will
convert it into a shunt machine?

Liverpool.

[65722.]—**Ants.**—I would suggest pain
stems with oil or paraffin, or so applying
the insects can only reach point by passin
barrier.

r-Pump.—You cannot hope to get
. vacuum unless everything is very
:tical pump if possible; but if you



:al, have as little space (clearance)
;er and valves as possible. Use
ind guards.

T. C.

on-Conductor.—You do not give
iculars as to your requirements.
stand contact for any length of time.
ve a metal, wrap a piece of spun
the part you require the flame to
ROBT. BUNTING.

ynamo.—I strongly recommend you
;e boiler for this purpose, so as to
eserve of steam, as small engines,
p ones, run away with a lot of steam.
vorking seven 10c.p. lamps, plain
. by 1ft. 6in.; engine 2¼ bore, 4in.
nning at 220 revs. per min.; dynamo
liam.; engine, 15in. diam.; dynamo
round bands.

C. ANDREW.

reserving Stonework.— Brown-
ive solution is the material which
l on Cleopatra's Needle and the
liament. It is supplied separately
r made up with paint, by the Inde-
it Co., Cannon-street, E.C.
ROBT. BUNTING.

reserving Stonework. — Sodium
e glass) made by fusing silica or sand
of soda, and digesting in water, is
g buildings to preserve them. By
air in contact with stone it becomes
le, and thereby forms an impervious
J. A. HOGG.

New Algebraical Symbols.—
repliers (p. 423). Will they kindly
leaning of another symbol I have
Chrystal's work (p. 244, sixth line)?
e parallel lines with two dots over
F. S. S.

efining Gold.—Take 2oz. silver and
nce of your gold; place in a crucible
; borax as a flux. When the alloy is
t in a deep basin of cold water,
nd it will become "granulated."
a Florence flask, and on it pour
acid and two of water; let it remain
s. When the chemical action ceases
at: the nitric acid will then have
lver, &c., the gold remaining at the
into a dark brown mass. Pour off
d wash the gold in hot water (add
een liquid); then dry, and mix with
and fuse in a crucible, and pour in
iape. To recover silver put a piece
in the green liquor; in a short time
l deposit on the copper; adding a
e silver will become piecipitated in
inute crystals. To know if all the
itated, treat some of green solution
drochloric acid; if silver is still in
will be a white precipitate; if other-
t to throw the remaining solution
E. WARD BUSSELL, A.E.E.

ard Beard.—Unless you are in a
shaving is compulsory, the remedy
Let it grow long; it will be scrubby
en it gets very long it will improve

B.Sc.

ccumulators.— Mr. Chandler will
rmation if he refers to No. 1205,
W. PERREN-MAYCOCK.

nproving Old Flute.—In reply to
tone of his flute should be as good
ovided that the head is correct. No
re-bored. His flute keys are not
fact of it being difficult to produce
his. VULCANITE.

lectric - Bobbin Winding. — In
ire is guided by hand alone.
W. PERREN-MAYCOCK.

ilway Gauge.—The narrow-gauge
in was not the result of any scien-
or theory, but originated with the coal trams of the North of England, among which was born George Stephenson, the father of railways. When laying out the Liverpool and Manchester Railway he adopted the gauge he was most accustomed to, and afterwards, for the sake of uniformity, kept to it. No doubt he foresaw the present system of interchanging stock. If "survival of the fittest" is true as regards railways, 4ft. 8½in. must be the fittest, as the others have gone to the wall, notably the Eastern Counties and Blackwall 5ft.; the 5ft. 6in., first used on some of the Scotch railways, and the Great Western broad gauge, is following. In 1846 it was enacted that all railways in Great Britain (except the G.W.R.) should henceforth be 4ft. 8½in., and all in Ireland 5ft. 3in. J. H. B.

[65758.] — **Railway Gauge.** — The present 4ft. 8½in. gauge of railways is not (as some persons contend) the result of any scientific calculation, for there can be no doubt that the usual width of the ancient wooden and cast-iron tramroads practically determined the gauge of our railways; and when, about the year 1630, Mr. Beaumont, at Newcastle-upon-Tyne, placed his wooden continuous planks at a distance of 5ft. apart outside—that is, including the width of the two planks, or rails—*he* established a precedent which other engineers have followed. As long ago as 1789 Mr. William Jessop, when constructing a railroad at Loughborough, Leicestershire, decided to abandon the flat wheels and plate-rails, and introduced the edge-rails and flanged wheels. Mr. Jessop saw no reason to depart from the gauge then in use, of 5ft. outside; he consequently retained that width for the Loughborough line. The Jessop rails were of cast iron, having a single head with a flat top 1¾in. in width, and the reason for the 4ft. 8½in. gauge will be clearly seen from the following figures:—

	ft.	in.
Width of line outside rails	5	0
Width of two rails (1¾in. each)	0	3½
Leaving width between rails	4	8½

Attempts have at various times been made to account for what some writers consider the "odd half-inch"; but it is quite unnecessary to build up reasons for the present gauge, as it is perfectly clear that in the early days of railways the gauge was measured from the outside, and now it is measured between or from the inside of the rails. Therefore, to answer the first question of "Platelayer," Mr. Jessop 99 years ago placed his rails 4ft. 8½in. apart, and 5ft. outside, and your correspondent may be interested to know that, in the early days of railways, Acts of Parliament stipulated a limit both for outside and inside the rails. The 4ft. 8½in. gauge having been thus established, Mr. Stephenson saw no reason to alter it, and consequently the Stockton and Darlington, Canterbury and Whitstable, Liverpool and Manchester, Leicester and Swannington, and other early lines were constructed upon what has now become the national gauge. The great "battle of the gauges" was fought out fully forty years ago, consequently it is now practically useless to reconsider the merits of that battle; but to answer the second question of "Platelayer," it will, I think, be generally admitted that a few more inches in width would have been a very great advantage in locomotive construction, both as regards width of firebox, diameter of boiler, and thickness of crank-webs. CLEMENT E. STRETTON,

Consulting Engineer, Associated Society
of Engine-drivers and Firemen.

Leicester, July 6.

[65759.] — **Scotch Express Trains.** — The accelerated E.C. Scotchman, both up and down trains, only stop ten minutes at York, as against thirty minutes hitherto. The other ten minutes is made by quicker running through the N.E. from York to Edinburgh, and the same gained by the G.N. vice versâ with same stoppages as before. The longest continuous run is done by the Tourist Express from Newcastle to Edinburgh, 124 miles. With respect to North Western and Midland I am not in a position to give any information.

W. R.

[65761.]—**Dissolving Sulphur.**—Sulphur dissolves in many oils without giving a bad smell. It is doubtful whether such a solution could be advantageously used as a lubricant, as the sulphur would probably attack the metal. There might be some practical value in the solution in skin diseases, &c. S. BOTTONE.

[65762.] — **Dynamo.** — TO MR. BOTTONE.— Diameter of shaft ½in., except when it rests on the bearings, where it should be ⅜in. Length of commutator 1¼in., diameter 1¾in. S. BOTTONE.

[65763.] — **Boiler.** — Try this. Firebox 18in. diam., 24in. high, shell 4ft. high and 2ft. diam., flue 5in. diam. and straight. Make of ¼in. iron, and don't omit mud-holes.

Bristol. T. C.

[65765.]—**Small Electric Light for Shop.**— One-man power = ⅙H.P.; 1H.P. = 746 watts. Reckon 3½ watts per candle-power; then you get ⅙th of 746 = 124 watts, and this, divided by 3·5, gives 35 candle-power as the highest that can be got from one-man power engine. In practice you would get nicely six five-candle power lamps of about 8 ohms cold resistance to work well with a well-made, shunt-wound dynamo. The dynamo would light one or six at will. Small gas-engines consume about 35c.ft. of gas per horse-power per hour. Good lamps will run 1,000 hours; some have been known to last 5,000 hours. I have sent you one of my lists by post to the address advertised.

S. BOTTONE.

[65765.]—**Small Electric Light for Shop.**— No: your one-man gas-engine will not do the work you require. Your description of the lamp is vague; but I suppose they are 20c.p. nom. In that case, for six lamps your engine should be capable of working up to 2I.H.P. Of course, each light can be used separately, if fitted with separate switches. For very small machines do not allow more than five or six lamps of 20c.p. to each brake horse-power, and double the power thus found for I.H.P., and allow a margin for steady running; for gas consumption allow something like 35 to 40c.ft. per brake horse-power, i.e., if you use a fairly economical type. Lamps will last about 1,000 hours or so. If you use a gas-engine drive by a long band, somewhat slack, with a heavy fly-wheel on dynamo shaft. If your one-man engine gives that power on the brake, you could perhaps light up four or five lamps of 5c.p. Mr. Bottone, or Cuttriss, of Leeds, could tell you prices of machines. Of course, you are aware that the cost will be infinitely greater than that of any other illuminant.

Govan. ENGINEER.

[65767.]—**Mechanics.**—TO "STATICS."—An examination of the diagram (65767) must show that A B and A D are in tension, and lines B D and C D in compression. The point A has to support the tension due to the pull from both B and from D. DESIGNER.

[65767.]—**Mechanics.**—A B and A D will be in tension, and B D and C D in compression. Drop a perpendicular from D on to A B and call it E, and consider E D to represent half W, then E B will represent pull on A B and thrust on C D; also B D will be thrust on that strut, and A D pull on that tie.

Bristol. T. C.

[65768.] — **Dynamo.**—TO MR. BOTTONE.—I am unable to suggest anything else without seeing the machine. It would be useless to attempt to coil the F.M.'s with soft iron wire, as you would lose more by the imperfect magnetic contact than you would gain by the increased thickness. Are the heads of your armature of iron? If so, that accounts for the mischief. If you cannot get it to work, and like to send it to me, carriage free, I will look over it and tell you what is wrong, free of charge. S. BOTTONE.

[65769.]—**Photography.**—Your portraits are both under-exposed and under-developed. Double your exposures and develop till you don't see any of the picture except by transmitted light, and I think you will succeed.

Plymouth. B.Sc.

[65769.]—**Photography.** — Your experience is very like my first attempts; the following hints gained from experience may be useful:—If the detail appears to come out well and not too quickly, you have got the right exposure, but are wrong in the development; leave the plate in the solution till you can scarcely see anything on it but mere blackness. Place your "friend" rather near a window, so that there is plenty of light on the face. If you use pyro. you will probably get better printing negatives; but the development should not be allowed to go so far as in ferrous oxalate (mind you don't mix the two, or a black compound like ink will be formed). I find that adding a little sulphurous acid solution to the developer keeps it clear, also using carbonate of potash in place of ammonia. AN OLD LEYSIAN.

[65769.]—**Photography.**—Go systematically to work, and then you will surely conquer your difficulty, which is evidently "correct exposure." See that your solutions are all in good order, your developer bright orange-red, no sediment, your water clean, your alum-bath clean, your fixing solution fresh, and not smelling of rotten eggs. See also that your dark room is dark, and only the proper red light admitted. Now get a patient, sympathetic sitter, and expose on him or her six plates in succession, beginning at one second (if indoors) and ending with six seconds. Develop carefully, always leaving plate in the developer, until you can faintly see the image through the back. Wash; pass into the alum-bath, again wash, and fix. One of the six should have a correct exposure. If they are all still too thin, try again, beginning at six seconds and ending at twelve. Please report results for the benefit of other beginners like yourself. Further instructions [illegible] given of the above are not sufficiently explicit. S. BOTTONE.

[[illegible].]—**Pitch of Screw.**—The pitch of a screw is measured by the distance between any two of its threads. W. PERREN-MAYCOCK.

[[illegible].]—**Pitch of Screw.**—The "pitch" of a screw is the linear distance apart of the successive threads in any scale adopted for the purpose of measuring the same; and so it is the reciprocal of the number of threads per inch. Thus, for instance, it is said that a screw of 1in. pitch has 1 thread to the inch of length, and a screw of [illegible] [illegible] threads to an inch is said of [illegible] pitch; and of other screws in like manner reciprocally [illegible] an inch is [illegible] pitch: 5 to an inch is [illegible] pitch. If the screw has more than a single thread—as, for example, a double or triple thread—then the pitch is the distance between the successive turns of the same thread: so a triple thread cut with a screw-tool of 5 to an inch would be of [illegible] pitch. J. K. P.

[[illegible].]—**Wood-lice in Cucumber-Frames.**—Wood-smoke is a very good means of driving away wood-lice. The best way of obtaining it is by burning freshly-cut boughs with plenty of sap in them. ALICE HOLT.

[[illegible].]—**Wood-lice in Cucumber Frame.**—For years past I have had a toad or two in all my glass structures, and have found much pleasure in watching their insectivorous habits. The wood-louse is a favourite bit of food with them. They used to be sold at market-places for this point of utility, price one penny. EOS.

[[illegible].]—**Galvanised-Iron Roofing.**—I would advise for cheapness and coolness "whitewash," only instead of mixing with water, use sea or salt-water—the former preferred. Coal-tar will preserve, not destroy; a sprinkling of sand is also beneficial. W. D. V.

[[illegible].]—**The Movements of the Heart.**—One or two deep inspirations will cause the heart to beat very slowly for a short time; hurried and short breaths will quicken the heart's action. Very slight causes will quicken or slacken the pulse with nervous people, and the mere fact of being told that your pulse is beating quickly will sometimes quicken the pulse by 10 or 15 pulsations in a minute. S. BOTTONE.

[[illegible].]—**The Movements of the Heart.**—The movements of ordinary respiration do not affect the frequency of the heart-beat. It is almost impossible to judge correctly of one's own respiratory movements. The act of fixing the attention being generally sufficient to modify them. One beat of the heart would be insufficient to set a bedstead in motion, but the continuous equal-timed beating would probably be sufficient to do so. I therefore think the tapping was caused by the rhythmical beating of the heart, but that the apparent differences of rate observed were due to unnoticed irregularity of rate of beating. It is a different matter when entrance of air is obstructed. In this case the insufficiently oxygenated blood would act upon the nerve centres and lead to a slowing of the heart-beat. KENSINGTONIAN.

[65781.]—**Magnet for Magneto Machine.**—To MR. BOTTONE.—Make a bobbin of wire that will slip easily round one pole of the magnet. Put on it about 2lb. No. 20 d.c.c. Send your current round this, passing the magnet through the coil (or the coil over the magnet) backwards and forwards until the full magnetisation has been obtained. The machine should light well a 4 ohm 2½ c.p. lamp. S. BOTTONE.

[65783.]—**Repairing Flute.**—To make steel springs, take some common sewing needles of proper size, pass them slowly, one at a time, through the flame of a spirit lamp till they are of a pure blue, leave a minute to cool, they can then be fitted. Flat springs are made from old watch-springs, and the temper can be reduced by heating a moment the place required, until the violet becomes a greenish blue; but one should always use springs as hard as practicable. No other material than steel is of any use, except gold alloy. VULCANITE.

[65783.]—**Repairing Flute.**—It is not necessary to have your springs of brass, German silver is better, but I think steel better still. I have had many years' experience in the repair of the instruments of a regimental band. It was only in the common flutes of the drums and fifes that I saw brass springs. In the flutes of the band the springs as a rule, were steel. I used ormoline steel mostly. I found it answer well. I harden and temper steel springs as follows: I hook the spring on to a piece of wire, make red hot, dip into a cup of cold water, then pass over the flame of lamp, gas or fire to dry, and make the spring just warm, and then dip the spring in oil or tallow; now hold it over the flame, keep moving it about, up and down right and left, until you see the oil take fire. Remove at once, still keeping it on the wire over the lamp or gas, when the oil ceases to blaze your spring should be tempered. There are many other ways and methods of hardening steel springs. I have given you the one I have followed, and it gave satisfaction to all concerned. As a matter of fact, you will now and then have a mishap, such as having the spring too hard, or making too soft in the tempering. Don't cool the spring after the blazing—let it cool. Before going to the trouble of riveting the spring on the key, try it in a vice or a pair of pliers, place it between the jaws, gently press until spring is straight, then if it comes back you will know it is all right. If too soft it will not come back, if too hard it will break. In either case you may save yourself trouble. I know of only one way to harden brass and German silver. Simply hammer the metal—you can't hammer too much, provided you watch that the brass does not crack. I have made good springs from brass wire; sheet brass answers just as well. Both brass and German silver seem to lose the elasticity given to them by hammering after a year or two. Let me mention that small screws are far better than rivets for instrument keys of any kind. It is a great bother getting out rivets. ARMOURER.

[65785.]—**Type Metal.**—Bismuth is sometimes used in type metal, but not very often. Your process of extracting bismuth from the alloy is fallacious; the white mass which was obtained is no doubt lead chloride, which is soluble in boiling water (1 part in 33 of water), but is scarcely soluble at all in cold water. This is especially the case if there is a trace of hydrochloric acid present, it being then practically insoluble: the concentrated acid, however, dissolves it readily. The two tests described (H_2S and reduction) are both tests for lead and bismuth. The following process will be the best:—Break up the metal and boil it with nitric acid, which will dissolve the lead, bismuth, &c, and leave the tin and antimony (if any) as a white powder (metastannic acid, $H_2Sn_5O_{11}$, 4aq., and metantimonic acid, $HSbO_3$); filter into an evaporating dish, and evaporate the excess of nitric acid. The solution is now to be poured into a large quantity of distilled water, when a precipitate of basic bismuth nitrate will be thrown down; this may be dissolved in a little diluted HNO_3 and tested thus:—H_2S, a black precipitate; KI, a brown precipitate, soluble in excess; and K_2CrO_4, a yellow precipitate, soluble in dilute HNO_3. The iodide reaction is a very good one. PRINCIPIA.

[65786.]—**Accompaniments on the Banjo.**—Most accompaniments have variations in the minor, or in another key to that which they commence; it follows, therefore, that your chords must be in accordance. W. PERREN-MAYCOCK.

[65787.]—**Gums and Gum Resins.**—*Gum Tragacanth*, the only one of the series inquired about which is a true gum and affected by water, is the produce of a leguminous plant known as Astragalus verus. It closely resembles gum-arabic in its general properties and uses. *Frankincense* is the produce of the Abies excelsa, Pinus abies, or spruce fir. It exudes both naturally and on puncture or on excision of the bark; exists in two forms—in tears, when it is known as Thus, or Olibanum, and in large irregular lumps (incense), insoluble in water, completely soluble in alcohol. It consists of two resins united by oil of turpentine. It is scarcely ever now used internally, but is irritant and diuretic. Externally it is a rubefacient, and enters into the composition of many plasters. *Copal*, from Rhus copallinum, one of the hardest and most insoluble of resins, makes the best and hardest of varnishes, with the aid of turpentine as a solvent. Principal use, for making the best carriage varnish and finest hard lacquer. *Mastic* is a resin extracted from the trunk and branches of the Pistacia lentiscus by incision. The tree grows in the Levant, especially the island of Chios; consists of two resins; one is soluble in dilute alcohol, the other is not. Both are soluble in absolute alcohol, ether, and turps; used in making varnishes and as a stopping for carious teeth. *Sandarach* is obtained from a fir-tree known as Thuja, and closely resembles frankincense in general properties. *Asafœtida*, from the roots of Ferula asafœtida, a Persian plant, and *Ammoniac*, from Dorema ammoniacum, both valuable medicines, the former as an antispasmodic, the latter as a valuable expectorant. S. BOTTONE.

[65787.]—**Gums and Gum Resins.**—*Mastic.*—Botanical source, Pistacia Lentiscus: natural order, Anacardiaceæ; habitat, S. Europe, Africa. Preparation: The bark is cut crossways, the mastic then exudes. In the island of Scio this operation is performed in August and September. Composition: 90 per cent. resin soluble in alcohol, 9 per cent. insoluble in alcohol, and 1 per cent. volatile oil. Uses: Employed by dentists, for varnish, and as a masticatory. *Copal.*—Bot. source, uncertain. Preparation: Exudation from stem. Composition: Gum resin soluble in oil of eucalyptus. Uses: For varnish. *Frankincense.*—Bot. source, Pinus palustoris; natural order, Coniferæ; habitat, S. Europe. Composition: A concrete turpentine or oleo-resin. Uses: Principally for plasters. Sandarach.—Bot. source. Callitris quadrivalvis: natural order, Coniferæ: habitat, S. Europe. Preparation. Exudation. Composition: A resin, going by the name of gum juniper; it resembles mastic in appearance, but the tears are longer and the odour a different. Uses: Varnish. *Olibanum.*—Bot. source, Boswellia species; nat. order, Amyridaceæ: habitat, India. Composition: Gum, resin, and volatile oil. Uses: Medicinally in leucorrhœa, gleet, and hæmoptysis. *Tragacanth.*—Bot. source, Astragalus verus; nat. order, Leguminosæ; habitat, Asia Minor. Preparation: Natural exudation. Composition: Tragacanthin and bassorin. Uses: Pharmaceutically and by shoemakers. *Ammoniac.*—Bot. source, Dorema ammoniacum; nat. order, Umbelliferæ; habitat, Punjaub. Preparation: Inspissated natural exudation. Composition: Gum, resin, and volatile oil; unlike asafœtida, it contains no sulphur. Uses: Medicinally as expectorant and discutient. **Asafœtida.*—Bot. source, [illegible] asafœtida; nat. order, Umbelliferæ; habitat, Punjaub. Preparation: Exudation. Composition: Gum, resin, volatile oil, and sulphur. Uses: Medicinally, anti-spasmodic. Pure asafœtida is known under the name of "hing" in Bombay, and the impure by "hingra." FREDERICK DAVI[illegible]

[65787.]—**Gums and Resins.**—[illegible] fully described in our pages some months [illegible] *Copal* is distinguished in commerce as "African" and "East Indian"; the latter is sold in Eng[illegible] as "Gum Anime." It occurs of all shades of [illegible] between pale green and deep yellow. I have [illegible] some of the more choice lumps sold as "amber" [illegible] the Indian markets, for working into beads; [illegible] this resin is so brittle that it soon ends in fra[illegible] for I have tried it. On the Malabar Coast [illegible] Vateria Indica (a stately tree belonging to the Dipterocarpeæ) supplies this exudation; [illegible] fresh it is utilised as "pine varnish," when [illegible] is dissolved in drying oil by gentle heat. By [illegible] addition of a little camphor, this resin will [illegible] *hot* alcohol, forming a good spirit varnish. C[illegible] were made by the natives, burning brightly, [illegible] little smoke, perfuming the air, and consuming [illegible] wick without snuffing; but that was long [illegible] "African copal" of the best quality is fo[illegible] a fossilised condition, and is dug from [illegible] earth. "Hymenæa copal" is produced by [illegible] South American forest tree, H. Co[illegible] When in a sickly state it yields the W[illegible] Anime. The first clue to the tree yi[illegible] the "true copal resin" was obtained by [illegible] Benastre finding a flower of Hymenæa imbe[illegible] in a polished and transparent fragment of the p[illegible] duct. It is frequently adulterated with [illegible] It is readily detected by the difference of sol[illegible] in alcohol. In this fluid, too, the surface of [illegible] becomes adhesive and soft, by which it is dis[illegible] tinguished from "amber," which does not [illegible] in the least in alcohol. Copal is difficultly sol[illegible] in alcohol, ether, and the essential oils: it dis[illegible] in alkalies, forms tannin with nitric acid, and [illegible] insoluble in fixed oil; by means of camphor [illegible] turpentine copal is dissolved in spirit, and [illegible] softened by heat is taken up by the oils. The [illegible] of this resin it exclusively for the preparation [illegible] varnishes, for which it is chiefly esteemed [illegible] account of its brilliancy, hardness, and [illegible] parency. *Male Frankincense.*—From the ear[illegible] ages incense has been used in religious ceremon[illegible] the product of two different trees in the bal[illegible] order—"Terebinthaceæ," Arabian and Indi[illegible] Of the former I know nothing; the latter is yielded abundantly by Boswellia thurifera, a common tree in the hilly tracts of Hindos[illegible] with its congener, the Amyris, producing the myrrh-like gum Bdellium of Dioscorides. "East Indian *Olibanum*" is the commercial designation of the Boswellia resin, sold cheap in every little drug shop of the East, in dense, opaque, brittle mas[illegible] heavily adulterated of late years with dammar and other substances. It is much employed to expel mosquitoes from rooms, a lump being placed on live charcoal and the doors closed. Another form of the resin is in great demand—soft, ductile, opaque, greenish, and white; the odour balsamic and resinous, especially while heated on a metal plate. It is one of the most healing ungents with which I am acquainted, either for man or cattle. A farthing's worth is sold on a green leaf to meet the requirements of a poor man. It is a favourite flux with tinworkers, for which purpose I often used it, the odour being so delicious. However, this incense has been rapidly superseded by benzoin, imported from Java and Sumatra, an exudation of Styrax benzoin, highly priced, and therefore, only used by the richer class of Europeans and natives. This is the chief incense, I believe, of the R.C. Churches in India. Gum *Sandarach* is produced by one of the Coniferæ, Callitrix quadrivalvis, an evergreen tree of N. Africa. In Sweden, too, the [illegible] same gum is exuded by a Juniperus, but I h[illegible] [illegible] have not seen a specimen. On the authority of Fe[illegible] [illegible] it is even found in the common "junipers." "[illegible] pure sandarach" is sold in [illegible]ound or elongated tears, whitish or pale

yellow, brilliant, transparent, and limpid;
under the teeth, burns with a clear
soluble in alcohol, difficultly so in
tine; agreeable odour in burning; taste
is, slightly balsamic, used in varnishes.
yore the powdered gum called "pounce,"
ted ink from spreading through the badly-
ctured stationery of the period. *Tragacanth*
yielded by four leguminous shrubs: the
ali, A. gummifer, of Mount Lebanon; A.
s, of Crete; and A. aristatus, of Cyprus.
ts browse greedily on this numerous family,
nt on the Himalayas and elsewhere, this
may have been so named by the old Greeks.
us, of Asia Minor, furnishes the largest
t in commerce. The gum exudes, during the
nths, through the bark in slender threads,
lly increasing to tears and worm-like pieces.
ter it swells very much, and forms a soft
ge. If the water be in excess, it does not
e this mucilage, which remains in a separate
One part of this gum renders water as
as 25 parts gum-arabic. An old analysis
es tragacanth to consist of 57 parts of gum
oling gum-arabic, and 43 of a principle
bassorine, a scaly mass of dirty white appear-
eadily reduced to powder, insoluble in cold
—dissolved in boiling water,—unaffected by
l or ether, dissolving freely in alkalies or
tic acid. This gum is used medicinally in
ions, lozenges, and styptic powders; in the
s an ingredient in dye-stuffs, besides glazes
licoes and silks. The large and frequently
ous legion of Umbelliferæ, nearly 1,000 in
er, also contain some nearly-related indi-
s of great value to the physician, as Opoponax,
enum, Ammoniacum, Anethum, Galbanum,
m, and Asafœtida. I will only describe the
rugs requested by "Principia." *Gum Am-*
cum is obtained by making incisions in the
na A. It occurs in two forms—voluminous
s of yellowish colour, including white almond-
ears, the whole of plastic consistence, and
mpure; secondly, in tears of irregular form,
or yellowish, opaque, rather solid, aggluti-
or distinct, compact, brittle, of glassy frac-
free from impurities, odour faint and peculiar,
sweetish and then bitter. Braconnot's
lysis" states 100 parts to contain—gum 18,
70, bassorine 4, water 6; sp. gr. 1,207. Par-
soluble in water, ether, alcohol, acetic acid,
lkaline solutions. Medical effects similar to,
ess powerful than, asafœtida. Used in
cases, and in the chronic catarrhs and asthmas
d persons; also, externally, in stimulating
rs. The whole supply comes from the dry,
lains of Persia. The stem and fruits both
this gum abundantly. *Asafœtida*—that gum
with the evil odour, long known in Europe as
il's Dung"—arrives annually in N. India
the caravans from Herat, Beloochistan, and
Hindoo Kosh, its habitat being at 7,000ft.
tion, where, in the proper season, the growing
of A. ferula are incised; a milky juice
s, which dries rapidly into a fœtid, pasty,
, and pungent mass. Asafœtida is difficultly
ed to powder, unless triturated with carb.
nia. Brande's analysis gives 974 parts
tida contain—resin, 472; gum, 194; volatile
6; resinoid matter, 16; tragacanth, 64; re-
ler saline earthy matter and water; specific
y, 1,327. It yields its active principles to
l and to water, and affords essential oil by
ation. Asafœtida occurs in commerce in
less masses of waxy consistence, with small
arent brittle and white tears. The fracture
eous; at first white and passing to red by
t with the air, a property distinguishing it
ll other gum resins. A more valuable kind
etimes met with in India, though rarely,
mmands a high price from ready purchasers.
in tears, or semi-transparent granulations,
rom all impurities, and of most powerful
European druggists value this kind as
readily reduced to powder. Medical Uses.—
tida is a powerfully carminative and stimu-
nic, devoid of acrid and irritating properties.
duces a sensation of heat and increased secre-
in the alimentary canal, with eructation.
ache and giddiness are often experienced, and
rinary organs are sometimes affected. It is
y used in hysteria, hypochondriasis, flatulent
arising from dyspepsia, in chronic catarrh,
asmodic asthma, unconnected with disease of
art or lungs. In worm affections, too, it is
employed with benefit. Dose, 5gr. to a
e in pills, or with ammonia in the fœtid
of ammonia. In Asiatic cholera of natives,
ourite pill is compounded of asafœtida,
, and pepper. Every Hindoo family keeps a
tin case or bottle of asafœtida in powder to
he overloaded stomach in digesting the large
s of vegetable food swallowed by each in-
al at the chief meal of mid-day. The
mmedans, too, enjoy a minute addition of
tida to their wonderful meat dishes, and in the
of years I brought myself to like it on
ons of hospitable entertainment. I have
t, too, as a medicine for man, animals, and
poultry in gastric disorders, and consider it should find a place in every veterinary chest. EOS.

[65791.]—**Angle Rings.**—When I have made model boilers I have not used rings, but flanged the tubes and plates, which is much easier and saves a lot of rivets and joints. The best plan, perhaps, to make rings would be to make an ordinary ring, say 2in. wide, and place on a mandrel 1in. wide in the lathe, then spin down each side and cut in two. You may also manage it with a wooden mallet.

Bristol. T. C.

[65792.]—**Gramme Dynamo.**—Wire armatures, as I have on many occasions stated, are rarely satisfactory. Except for the matter of heating, a cast ring is better; best of all, laminated cog rings. The field-magnets are much too thin in substance. They should have been at least 1½ in diameter. The two magnets side by side very seriously vitiate each other's action. It would be far better to have one F.M. on each side, of 2in. diameter, 6in. long; since the proximity of the similar poles in the present arrangement militates against the best results. I should strongly advise you to change your present F.M.'s for a single pair of stouter ones in wrought iron. Wind these with 12lb. No. 22; connect up in shunt with the brushes, when you should get sufficient current to light six 10c.p. lamps of about 20 ohms cold resistance—that is to say, you will get 6 ampères, at 20 to 25 volts pressure, at about 2,500 revs. per minute. S. BOTTONE.

[65794.]—**Spermaceti.**—Spermaceti is obtained from the right side of the nose of the sperm whale, Physeter macrocephalus, an inhabitant of the Pacific Ocean. Pure spermaceti is white, crystalline, semi-translucent, insoluble in water, does not melt below 100° Fahr., and is used principally for ointments. FREDERICK DAVIS.

[65794.]—**Spermaceti**—Is a concrete, fatty substance of a pearly white colour, obtained, mixed with the oil, from the head of the sperm whale. It is separated from the oil by filtration and pressure and afterwards purified, and consists of nearly pure cetyl palmitate. It is insoluble in cold spirit, soluble in ether and chloroform. The melting point is from 100° to 120° F., and it is employed for making ointments and cerates.

W. E. POND.

[65794.]—**Spermaceti.**—This is prepared from the spongy mass found in the head of the spermaceti whale by the following process:—The oily mass is dug out from the cavity of the head, and the oil separated from it by dripping; the mass is then put into hair bags and pressed between plates of iron in a screw press until it becomes hard and brittle. It is then broken in pieces and thrown into boiling water, where it melts, and the impurities, rising to the surface, are skimmed off. After being cooled and separated from the water, it is put into fresh water in a large boiler, and a weak lye of potash added to it by degrees. This part of the process is thrice repeated, after which the whole is poured into coolers, where the spermaceti concretes into a white semi-transparent mass. Its specific gravity is 9,433. It melts at 120° F., and at 500° F. it evaporates. It is soluble in hot alcohol, ether, and oil of turpentine, but concretes again as the fluids cool. By oxidation by nitric acid it yields a large quantity of succinic acid. It is saponified with great difficulty. It has a composition of—Carbon, 79·9; hydrogen, 13·6; oxygen, 6·5; total, 100·0. Spermaceti is demulcent and emollient. It is used in dysentery and irritations of the alimentary canal. CIRCE.

[65794.]—**Spermaceti**—is a fatty substance which occurs in certain cavities in the head of the sperm whale. During the life of the animal it appears to be kept in solution in the sperm oil, but separates out in the solid form after death. It is a white, somewhat brittle, solid, neutral to test papers, inodorous, and almost tasteless; specific gravity ·934 at 15° Centigrade. The chief constituent of spermaceti is a fat called cetin, having the composition $C_{32}H_{64}O_2$—i.e., cetyl palmitate. On boiling for some time with caustic potash, it is decomposed in the usual way, yielding cetyl alcohol and potassium palmitate—

$$C_{16}H_{33}C_{16}H_{31}O_2 + KHO = C_{16}H_{33}HO + KC_{16}H_{31}O_2.$$

Cetyl alcohol is a white crystalline substance which melts at about 50° Centigrade. Cetin itself decomposes if heated rapidly, yielding palmitic acid and a hydrocarbon of the olefine series called cetine, $C_{16}H_{32}$. Some chemists regard spermaceti as a mixture of different sorts of fats, and Heintz asserts that cetyl alcohol prepared as above contains other alcohols having 12, 14, and 18 carbon atoms. WM. JOHN GREY, F.C.S.,

Analytical Chemist, Newcastle-on-Tyne.

[65794.]—**Spermaceti**—Also called cetaceum, a fatty matter obtained from the whale known as Physeter macrocephalus, which is generally met with in the South Seas, but occasionally also upon the coast of Greenland. The spermaceti occurs chiefly in the head. During life it is in a fluid state, and on the head being opened the spermaceti has the appearance of a clear white oil. On exposure to the air, about one-quarter crystallises or congeals from the more fluid portions. The solid portion is separated from the fluid oil and put into barrels. The head of a whale 64ft. in length yields on an average 25 barrels of solid spermaceti and 75 to 100 barrels of fluid oil. When brought to England the spermaceti has not a white, shining, silky appearance, but a yellowish colour, owing to the presence of some oil. To separate this it is filtered, pressed, and subjected to various operations. When perfectly pure it is known as cetine, consisting of $C_{32}H_{64}O_2$ and belonging to the ethylene group. Spermaceti possesses the properties common to fatty matters. It is bland and demulcent, with considerable nutritive qualities when taken internally. It was formerly much used in colds and coughs, united with mucilage or syrup, to shield the throat from the irritation of the air; also in dysentery. Saturated with sugar-candy, and having warm milk added to it, it is a mild, nutrient article, fit for children or the old. It is largely used in the preparation of ointments and in the manufacture of candles. Paraffin is largely replacing it. S. BOTTONE.

USEFUL AND SCIENTIFIC NOTES

Poisonous Nature of Animal Exhalations.—The exhalations from living and dead animal tissues are known to be deteterious to the health; the evils of overcrowding and bad ventilation being chiefly attributable to the devitalising influence of a contaminated atmosphere. Dr. Brown-Séquard has been studying very carefully the material substances on which depends the poisonous nature of pre-breathed air. It has been known for a long time that, besides carbonic-acid gas, the expired air contains small quantities of very powerful poisons, to which chiefly the unpleasantness of a stuffy atmosphere is due; the effect of the poison on the brain which is supplied with contaminated blood is to depress and even to pervert its activity. Dr. Brown-Séquard has devised an apparatus for condensing the vaporous part of the breath of animals, and he finds the liquid so obtained to be powerfully poisonous even when obtained from animals in a state of health. The liquid injected into the veins of sound animals produces much distress from the action of the poison on the nerves and brain. Moreover, the nervous apparatus of breathing is disturbed in its rhythm, the animal generally taking many fewer respirations than usual; the surface of the body grows cold, and the pulse-rate is quickened. Micro-organisms do not exisit in expired breadth, and, besides, the liquid remains after boiling as poisonous as before. It is quite possible that a man excretes from his lungs and skin in twenty-four hours more poison, though in a more diluted form, than a snake manufactures in the same time. Dr. Brown-Séquard also proves that this vitiated air is specially harmful to consumptive patients. Rabbits, which are notoriously prone to become consumptive, can throw off consumption or tuberculosis if the general health is maintained by proper food and fresh air, whilst their fellows succumb if placed in unhealthy surroundings.—*Lancet.*

Trebizond Anchovies.—The British Consul at Trebizond, in a report just published, states that in fisheries anchovies stand out prominently as the speciality of Trebizond. They are sold at 1s. 2d. the cwt. as food for the indigent and manure to the cultivator. The hauls during the earlier months of the year are often wastefully abundant, so much so that the obnoxious stench of the putrid fish may be said to pervade land, water, and air, impregnating not only the town and its environs, but its houses, streets, and fields, and even its very poultry. The pursuit of porpoises last year engaged fleets of small craft, which turned out for days to follow the chase. When plentiful, 40,000cwt. a year is netted or shot, and melted down to the extraction of about 20,000cwt. of oil used for lighting purposes in the neighbourhood, and for machinery in Europe. It may be added that Mr. Longworth notices a great decrease in cotton goods imported to the Trebizond district from the United Kingdom, and also in woollen goods, owing to the increasing importation of Russian stuffs. A stout Russian cotton cloth known as Pomszeh is gradually replacing among the natives English cotton and flannel goods. The prints coming from Russia, known as Saidetz, are also in favour, owing to fastness of colour and tastefulness in design. Usurious rates of interest have lately been prohibited, and the legal rate has been reduced from 12 to 9 per cent., while the compound interest is not to be charged beyond the amount of the loan.

Engineers' Catalogue.—From Bell's Asbestos Co., Limited, we have received a neatly got-up catalogue of their Engineers' Stores Department, which can be carried in the pocket without inconvenience. It contains a large number of illustrations of machines and tools, and will often be found useful.

ich is on a much higher level than the s a bulb tap to the cistern, and it is not .—P. C. THOMAS.

ıstitute for Lignum Vitæ.—I have ı is fitted with a number of spring boards. ne is in use these boards have water con- over them and are subjected to a certain ure and friction. The machine is some- three weeks. It will then, perhaps, be idle ıe. I am about to fit the machine with The present boards are made of lignum ı. thick, and, of course, rather expensive. spondent kindly tell me of a cheaper wood nswer the same purpose? The boards .—SPRING BOARDS.

ınd N.W. Compounds.—Would some r other correspondent acquainted with ve me (1) principal dimensions and weight ompounds out—City of New York, &c.? nt to those of that class first built, Titan, c.? (2) The weights and dates built of Marchioness of Stafford. (3) How are the erally considered to be running now on ıre they a success as compared to the new ther principal English express engines? nsumption running the new fast Scotch understood they had superseded the old ass altogether, nd that nothing but Com- be built in future, but was surprised when end of May to see the Scotchman arrive wn by a new "Precedent" engine, 237, uilt last January. Are these, therefore, as well as compounds?—BANSHEE.

cycle.—My cone pedals have taken to ach down stroke. Machine by first-rate about two years and well looked after. ones and well cleaning stops it for very ever find cones very dirty. Oiling on the Squeak only slight, but disagreeable; not , but on slightest uphill. Have adjusted Are the cones worn out, or can I do any- —M. B., Pontesbury.

ectric Bells.—I have a set of these ry of three Leclanchés. A little time back out, and I purchased new cells. Having M" a method of treatment by $KMnO_4$, I he old battery works well. I am working he old battery now, and want to keep the o connect up in case of failure. The new d with AmCl solution, and the porous pots cells, but without the zincs, which hang h and dry. Will the contents of the porous m being kept in AmCl?—M. B., Pontes-

pola Furnace.—Can any of "ours" ggestions how best to obtain an increased a small cupola furnace? The cupola om door to centre of the tuyeres, and 27in. the tuyeres to hearth. It is 18in. internal an air belt (supplied by a 4in. pipe) with 1½in. I have a Root's blower capable of t. of air with 400 revs. per min.; but have nly to drive it at 150 to 160 revs. per min., essure up to 10oz. per square inch. The s been sensibly increased by adding two tuyeres of 1½in. intermediately between the hearth, but it is not yet sufficient. I yed, but without success, a blast heated to neral becomes pasty and semi-fused at the ll not run, and in consequence the furnace . The necessary fluidity is easily attained a plumbago crucible, placed in a coke fire ith a blast.—H. B. F.

chimedean Screw Pump.—I am an Archimedean screw pump. I hear that y used in America. I intend fitting the al to work at a speed of about 600 revs. What height will same throw water to? formula, if any, to calculate such a pump? to know of a book that treats on this sub- x.

ıcient Village or Market-Place —Can any of your readers help me in constructing above in a schoolroom over d about 10yds. wide? How should the amework be fixed, and what material should overed with in order that it may be painted in the neighbourhood of Oldham or Man- ee pictures or models suitable?—DUFFER.

icycle.—Would it be against the law to ngine in a tricycle to be worked in con- he pedals, so as to ease the work especially l? It is said that a coach and six can be any Act of Parliament. Will not this be it through the one forbidding motive power he highway except under traction engine What would be about the probable cost of e tricycle with engine and high pressure o be heated with oil? Could not a tricycle ccumulators and dynamo, so that some of uired in going down hill should be used to cumulator? Will Mr. Bottone or anyone ?—DUFFER.

action Engine.—I am working a , and I find several of the stays inside the , and there appears to be short cracks in pping down from the stays about ⅛in. be- the stay. Could any fellow-reader give me stop them? I thought of drilling and at the bottom of the cracks and carefully g in e. . The plates are all level and ⅜in. ACCUM.

ıgine.—W ld any of "ours" work out out algebra) the indicated H.P. that would oupled compound condensing beam-engine right angles, h.p. cylinder Corliss valves, ves, cut-off in h.p. cylinder to be 4-10th of I want to know is, What amount of back here be on h.p. cylinder, and also initial v, and what will be point of cut-off in low- er? The following are particulars:—Diam. 16in., diam. of l.p. cylinder 32in., stroke r min., with 90lb. on piston.—A. C.

[65840.]—**Worm-eaten Furniture.**—I have a carved oak bookcase, which I have just discovered to be worm-eaten. There are numerous small holes, and in some places the wood is powdering to dust. Can any of your readers tell me how to stop this spreading? There is not much damage done at present, but in time the mischief will be great if not prevented.—LIBER.

[65841.]—**Polariscope.**—Is it possible for a reader short of cash to construct one of these, to be used by a student of organic chemistry. I have never had the good fortune to examine one, but have seen descriptions in the "E. M." for use with the microscope. Is there any difference? I am pretty handy with tools, and have made a lot of scientific apparatus—nothing so delicate as a polariscope, though.—J. H. B.

[65842.]—**Sun Observations.**—The other day I turned my 9in. reflector upon the sun, with full aperture, and a power of 50 with a Kellner eyepiece. Almost immediately my sun glass (over e.p.) was cracked. I should be glad to hear from some one the best way to observe the sun with due regard to the instrument and also my eyes. —HELIOSTAT.

[65843.]—**Gun Locks.**—To "ARMOURER."—Will you kindly state and, if not asking too much, give rough sketch of tools used in engraving gun lock-plates and hammer? Also how is the chequering on the hammers done? Also is there any means of strengthening weak springs—main?—T. G.

[65844.]—**Polish.**—Will any reader please say how the polish is given to the tool handles that are sold at the tool shop? Are they polished in the lathe? If so, what kind of polish is used and how, and what polish would be best for a walking stick turned from ash? Should like it a very dark-brown.—HARRY SCOTT HOMER.

[65845.]—**Heat.**—I shall be obliged if Mr. Grey or any of your chemical readers would kindly inform me where I can obtain the fullest information with regard to the amount of heat developed by the chemical combination of substances? I do not mean in the sense of the combustion of H and O, but rather as in the case of a gas being dissolved by water. I have Deschanel and Tilden, but they do not treat the subject in the manner I want.—BERTRAN.

[65846.]—**Indiarubber Collars.**—Will any reader help me out of the following difficulty? I have for some time worn the Composite Indiarubber Collars, but find the button-holes so soon break out, making them useless. Instructions to renew the same would oblige.—CAPTAIN CUFF.

[65847.]—**Grease.**—What are the properties required in a sample of palm-oil to be used in making yellow grease? Should an oil containing much free fatty acid be preferred to one containing little or no fatty acid?—HYDROGEN.

[65848.]—**Celluloid.**—I want to mend an imitation tortoise-shell comb. It has small balls along the back, one of which has come off. Would some one kindly tell me what cement to use to fix it on with? I believe it to be made of celluloid. It is a light and springy material.—A. Z.

[65849.]—**Specific Gravity.**—Will any of "ours" be kind enough to give a table of the quantities of KHO and NaHO (respectively) contained in solutions of different densities? Parts in grammes required as 8grm. KHO and 92grm. H_2O give a solution whose sp. gr. is so-and-so, &c. —PRINCIPIA.

[65850.]—**Block-Tin Castings.**—Will any friend inform me how I can prevent my small block-tin castings, for siphon taps, from sticking to the brass mould? After I cast one or two the mould gets tinned, and I cannot remove the casting without melting it off.—S. B. P.

[65851.]—**Cutting Stencil Plates.**—Will some one kindly inform me how to cut zinc stencils, so as not to spring or buckle the letters? Also the best substance to to cut them on, and the tools required.—IGNORAMUS.

[65852.]—**Lathe Attachment.**—Will any reader describe a simple attachment for use in a 6in. plain foot lathe by which I can drill a shackle or any short metal work? Sketch will greatly oblige.—HARRY SCOTT HOMER.

[65853.]—**Developer.**—Can anyone give me a concentrated form of the hydroxylamine chloride and pyro developer, described in the number for July 6? I mean one that could be used for travelling?—AN OLD LEYSIAN.

[65854.]—**Geology.**—How can I distinguish glacial gravel? Are there any beds of it in Essex? Are fossils to be found in London clay?—F.

[65855.]—**Telephone Appliance.**—Having noticed this in the issue of 22nd ult., I should be glad to know if there is any short ear-trumpet that could be similarly fixed.—HARD OF HEARING.

[65856.]—**Wire.**—Can any reader give the breaking strain and truest of the various sizes of improved patent plough wire, such as the best quality wire-ropes are made of?—E. BUCKLEE.

[65857.]—**Dynamo.**—To MR. BOTTONE.—Will you kindly advise me the correct way of winding the field-magnets, with gauge of wire, &c., for dynamo mentioned in query 65721, so that it shall light ten 48 volt 10c.p. lamps?—J. H. G., Kennington.

NOTICE TO SUBSCRIBERS.

Subscribers receiving their copies direct from the office are requested to observe that the last number of the term for which their subscription is paid will be forwarded to them in a PINK Wrapper, as an intimation that a fresh remittance is necessary, if it is desired to continue the Subscription.

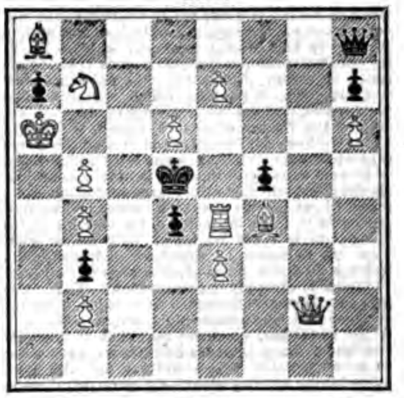
Holloway's Pills.—These excellent Pills correct all irregularities and weaknesses. They act so kindly, yet so energetically on the functions of digestion and assimilation, that the whole body is revived, the blood is rendered richer and purer, the muscles become firmer and stronger, and the nervous and absorbent systems are invigorated.

CHESS.

ALL communications for this department must be addressed "CHESS EDITOR, ENGLISH MECHANIC, 332, Strand."

PROBLEM MCV.

Black.



White. [13 + 7

White to play and mate in two moves.]

SOLUTION TO 1,103.

White.	*Black*
1. P-Kt 5.	1. B-Q sq or K 2 (*a*).
2. Kt-K 5.	1. Anything.
3. Mates.	
	(*a*) 1. B takes P (*b*).
2. R-Kt 4, &c.	
	(*b*) 1. B elsewhere.
2. P becomes Kt, &c.	

NOTICES TO CORRESPONDENTS.

CORRECT solutions to 1,103 by W. Jay, R. G. Briscoe, A. Dean, G. Wilson, and T. H. Billington; to 1,102 by J. Bryden, J. Palmer, and G. Wilson.

W. J. K.—Thanks for sui-mate. We shall not be able to use it until the Tourney is concluded.

IN Zukertort's two-move problem given in last number the W K should be at Q B 5.

J. G. HANKEN.—If in 1,103, 1. $\frac{\text{K-K 6}}{\text{B Kt 4}}$, 2. $\frac{\text{Kt-K 5}}{\text{B takes P}}$.

A. DEAN.—Two of the solutions to 1,102 that you send are incorrect. It 1. $\frac{\text{P-Q 8 (Kt)}}{\text{B takes Kt}}$, 2. $\frac{\text{Kt-K 5}}{\text{K-K 2}}$, and there is no mate. The same holds if 1. P-Q 8 becoming Q.

THE St. George's Chess Club has removed to new premises at 63, St. James's-street, London, S.W., over the newly erected Meistersingers' Club.

THE Champion Cup at the Bristol Club has been won by Mr. H. L. Leonard, who won 20½ games out of 24 played.

SUSSEX defeated Surrey at Brighton in a match played on Saturday, June 30th, by 11½ games to 3½. Three games were recorded against Surrey through absences.

THE lady members of the Sussex Association are competing among themselves for places on the Ladies' Record. There are twelve competitors, the first place being held at present by Mrs. Dunhill.

THE annual meeting of the Scottish Chess Association is to commence on the 16th instant at Glasgow.

ANSWERS TO CORRESPONDENTS.

⁂ *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

⁂ Attention is especially drawn to Hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it

The following are the initials, &c., of letters to hand up to Wednesday evening, July 11, and unacknowledged elsewhere:—

W. G. PENNY.—E. B. Fennessy.—J. Francis.—Hypo.—J. R. M.—W. P. Maycock.—G. H. G.—F. E. A.—Vooght.—Rustic.—Dan.—It.—David Booth.—B A. C.—Nemo.—A Technical Chemist.—W. B.—Dr. Royston Pigott.—E. Ward Russell.—J. J. Rathbone.—A. M.—B.Sc., Plymouth.—Silver String.—A. Csplatzl.—Robert Scott.

G. P. (Presumably you mean connect an electric bell to a clock, not "fasten" the former to the latter. If so,

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

65203.	Looking Glass, p. 222.
65220.	Battery. To Mr. Hamilton, 222.
65223.	Rounding the Edges of Punched Brass Blanks, 223.
65228.	Pneumatic, 223.
65233.	Ventilation of Churches, 223.
65236.	Medico-Electrical Apparatus, 223.
65241.	Carbon Tracings, 223.
65244.	Toy, 223.
65251.	Loom Strap Forks, 223.
65260.	Fan for Blower, 223.
65261.	Taper Rolling, 223.

65446.	Bending Copper Tubing, 314.
65460.	Great Western Railway Brake, 314.
65463.	Potential, 314.
65478.	Distilling Sea-Water, 315.
65480.	Locomotive Power, 315.
65489.	Engineer's Lathe, 315.

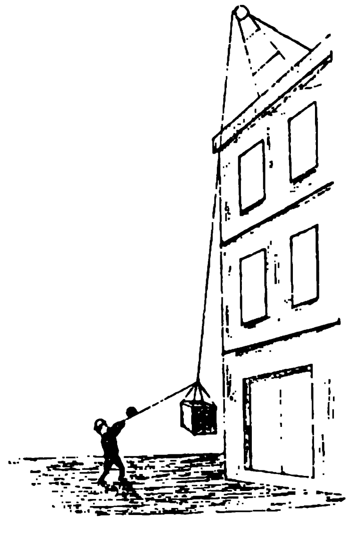
QUERIES.

[65795.]—**Tinning Brass.**—Would any of "ours" kindly inform me how to tin brass wire, by the simplest and best galvanic process?—W. T.

[65796.]—**Proportional Compass.**—Can any reader kindly tell me the size and how to make a pair of proportional compasses capable of dividing a circle 1ft. 6in. diam. into from 20 to 60 divisions?—X. Y. Z.

[65797.]—**Preserving Lemons.**—Can anyone tell me a good way to keep lemons? I buy them by the 100, but find a great many go mouldy before they are all used.—CONFECTIONER.

[65798.]—**Statics.**—I should be very much obliged if some fellow-reader would aid me in solving the following problem. A crane is used to raise a weight and a man pulls the weight by a rope to keep it from the wall. Show how to determine the direction and magnitude of the pressure on the pulley of the crane. I send a rough sketch.—ASHTON-UNDER-LYNE.



[65799.]—**Ruling Machines.**—Will any reader kindly give me an idea of how pen slides are made for ruling machines? How are the pens held in place and the ink conducted to them?—COUNTRY STATIONER.

[65800.]—**To Mr. Bottone.**—I am making a dynamo, 50c.p. laminated armature. What number wire and what quantity should the armature be wound with, and what number and quantity for field, and what power would be required to drive it?—ELECTRO-DYNAMICS.

[65801.]—**Satellites of Jupiter.**—I am west of Greenwich 8′ 53″. The 1st satellite of Jupiter should have reappeared from its eclipse on July 3 at 9h. 52m. 25s. at Greenwich (*Nautical Almanac*). Here, therefore, it should have reappeared at 10h. 1m. 18s. (Greenwich time). Its observed reappearance was 9h. 58m. Is my time wrong?—W. J. S., Stroud.

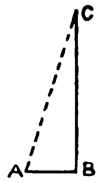
[65802.]—**American Gallon.**—Does the gallon of the United States of America differ from the British Imperial gallon, and, if so, how many cubic inches is contained in each?—JACOB HANNA.

[65803.]—**Electric Shock in Bath.**—TO MR. BOTTONE.—I am anxious to produce electric shock in bath, but am at a loss to gain such effect. Would you kindly instruct me how to make connections from coil? The bath is on second floor. I possess coil and all necessaries.—ELECTRIC PUZZLE.

[65804.]—**Recordon's Electro-Magnet.**—Will Mr. Bottone or any other kind reader answer the following? I have a Recordon's electro-magnet. Size of bobbin (iron) between flanges 2in., diameter of flanges 1¼in., hollow core ⅛in. thick, wound with s.c. copper wire about No. 30 B.W.G.? How many Leclanché cells should I use to develop its full power? I want it to work for a few seconds every hour. Also state if any other cell than the Leclanché is better suited for such work?—EDWIN LONG.

[65805.]—**Circular Saw.**—Is there a self-feed circular saw bench in the market to take in timber from ⅛in. thick to 9in. deep? I am well acquainted with rope feed motion, and star wheel feed. What I require is a motion to take in any thickness of timber, and to be as easily set as the present saw fence, and no waiting for travelling backwards to feed again.—E. JACKSON.

[65806.]—**Trigonometry.**—Will feel greatly obliged if one of your correspondents will supply me with the acute angle and hypothenuse in each case of the following right-angled triangles—viz.—



(1) Base A B = 10ft. Perpendicular B C = 7,500ft.
(2) " " = 10 " " = 6,000
(3) " " = 10 " " = 4,500
(4) " " = 10 " " = 3,000
(5) " " = 10 " " = 1,500
(6) " " = 10 " " = 300

A worked out example would be an additional favour.—STRAIGHTEDGE.

[65807.]—**Lathe Driving Wheel.**—I want to make a pattern for the above to drive a 4½in. back-geared lathe, to be about 60lb. weight, 4 speeds fast, 1 slow speed, for a gut band, 23½in. diam. Full particulars, with a sketch, if possible, and dimensions, as an engineering friend has promised to cast and fit the lathe patterns for me.—ALEXANDER HALL.

[65808.]—**Boots.**—I am one of those unfortunate individuals with awkward feet, and cannot get a pair of boots to fit me. Either I must have them several sizes too long or else I am pinched across the joints of the toes and hobble about in misery. It is of no use trying to have boots made. The bootmaker will not close the uppers, but buys them ready made from the wholesale manufacturer, and dabs on the soles. If I grumble he hints that he will not make an ugly pair of boots—it is no credit to him. But, like the bad-tempered old gentleman in *Punch*, I object to plane down my feet to fit his boots, especially after paying for a fit. Amongst the many thousands who read the "E. M." there must be many last and bootmakers capable of undertaking rational bootmaking at moderate prices. Whoever will do so, and will advertise his address will, I feel sure, get plenty of work, especially if he resides in London or its suburbs. First of all, we want a last maker who will make a last exactly the shape of the foot. My foot, for instance being as nearly as possible the shape of Fig. 1, in plan, when traced on the floor by a pencil, and my weight on the foot. Fig. 2, as seen at side of great toe. The ordinary bootmaker will look at this when I explain, and say all right, but makes up the materials over a last the shape of the dotted lines in Figs. 1 and 2. By this it is easily seen that after the boot is finished the foot has to accommodate itself to it, which entails a lot of suffering on some, is the cause of permanent crippling in others, and a fruitful source of corns and bunions to all. I expect the bootmakers will condemn my idea, but I would ask how a foot the shape I have shown is to find room in a boot made on a last the end of which is thinned off as in Fig. 2. Another cause of much pain is the long fronts now used for the sake of appearance. In all lace-up boots the front should end where the dotted lines cross in Fig. 1, or the arrow is placed in Fig. 2, in some instances nearer the end of the toe even. This would enable the wearer to relieve the pressure by easing the laces; as at present ease the laces as much as we please we cannot take the pressure off the toes and allow them to spread when the weight of the body comes on them. To make a boot after this idea the maker must be prepared to cut out and close the uppers and shape the soles himself. It cannot be done by using slop-made uppers and machine-cut soles.—W. R. C.

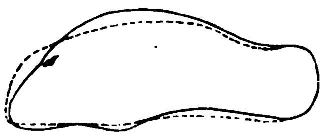


FIG. 1.

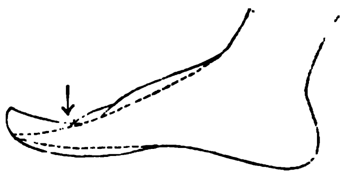


FIG. 2.

[65809.]—**Cleaning Plate.**—What is the best way to clean silver plate?—THORNFIELD.

[65810.]—**Silas Lapham.**—In what romance is there a character of this name?—X. Q. Z.

[65811.]—**Cleaning Skulls.**—What is the best means of cleaning skulls?—ALICK HOLT, Belmont.

[65812.]—**Iron Planes v. Wooden Planes.**—Will some of the readers give their experience in the use of these in different kinds of work, and say which they prefer to work hard and soft woods?—LIGNUM.

[65813.]—**Variation of the Compass.**—What is the present variation of the compass? I wish to erect a weather vane (20 miles S.W. of London). I presume this can be done with sufficient accuracy with an ordinary compass (divided to degrees) if I know the variation.—D. O.

[65814.]—**Varnish Flock Paper.**—Can you inform me what preparation I must use to stick flock on wall paper?—J. R. K.

[65815.]—**Gum Arabic.**—If I dissolve gum arabic in boiling water is it necessary to use anything to keep it from going bad? If so, what?—J. R. K. [A little acetic acid.—ED.]

[65816.]—**Power for Dynamo.**—I have a steam engine, 2in. bore, 5in. stroke, flywheel 12in. diam., V-grooved. Also plenty of steam at 35lb. to 40lb. What size Gramme dynamo had I better make for such an engine to charge accumulators, and what number of 16c.p. lamps would it light direct?—A. P.

[65817.]—**Lathe Centres.**—Will some one kindly inform me the best way to true up my lathe centres without removing them from the poppit and chuck? Also the best tool and form of cutter to point ⅜ rods of soft wood with a slow motion.—W.

[65818.]—**Check Valves.**—TO "T. C., BRISTOL," OR OTHERS.—I am fitting up a vertical steam boiler, [illegible] high by 17in. diam. Will you kindly let me know the best place to fix the check valve?—W. BATH.

[65819.]—**Brilliantine Powder for Polishing Brass.**—Will some of your readers kindly give me a recipe for making brilliantine powder cheaply and without any admixture of oil? I want it for polishing ornamental brass work.—HELMET.

[65820.]—**Greasing Planes.**—Can any reader suggest something better than grease for wood planes to make them run smoothly over the wood? Dry black lead is excellent, but dirty and quite unsuitable for white work.—Z.

[65821.]—**Telegraphy.**—Can any reader inform me how to work a Morse sounder circuit so that I use a two-way switch, to be put to left for sending and to right for receiving? I may also mention that I have an earth instead of return wire. A sketch would greatly oblige.—C. J. C., Telegraphist.

[65822.]—**Carlsbad.**—I have been advised by my doctor to take the waters at Carlsbad. Can any of "ours" give me any information relative to this watering place? Is there any book published about it, and which is the best way to get there? I presume there are physicians at Carlsbad who can speak English. Information re hotels, cost of living, neighbourhood, &c., will be very acceptable.—H M.

[65823.]—**Artists' Modelling Wax.**—Would any one who has had experience in making modelling wax inform me of a good mixture for same? I think that dark grey seems to be the best colour. I have some red wax which does not work smoothly and sticks to the fingers. I have been a constant reader of the "E. M." for some years past, but have not seen this subject treated, although it must be of interest to many besides—COG.

[65824.]—**Photo. Enlarging.**—Will some kind reader give me a little information on the above? I have the necessary apparatus and understand how to project the picture on the screen, but what I want to know is what paper to buy and how to use it, so as to produce enlargements from ¼ to ½-plate negatives direct.—PHOTO.

[65825.]—**Abbe Condenser for Microscope.**—I shall be glad if some of the users of this piece of micro. apparatus will favour me with any information as to its capabilities and advantages, as well as any hints in its manipulation. Zeiss claims for it that—"It gives *every modification* of direct and oblique illumination with transmitted light by merely changing and moving the diaphragms. . . . It gives also dark ground illumination with *modifications up to 600*, and can be *conveniently used with polarised light*." I have italicised the assertions which makes the condenser all that can be desired by the ordinary microscopist, and shall be glad if the experience which this query will no doubt elicit confirms them.—RHOMBOIDES.

[65826.]—**The Microsphaira.**—Will "F.R.A.S." kindly refer to Vol. XXXVI., p. 281, R.A.S. notices, and say if I am right in supposing "the link free at the other extremity and graduated with a scale of chords" is a straight bar? I copied sketch and description at the British Museum. Will he further oblige by showing how the instrument could be used for the purpose of finding, say, Jupiter and Saturn on August 5th next? I have tables of logarithms, and times, tangents, &c. May I remind "F.R.A.S." that he alluded to the above instrument on p. 390 of Vol. XLVI., "E. M."?—J. C. L.

[65827.]—**Magnetic Variation.**—I should be glad to be informed of the exact magnetic variation for this and next year for this country, or within 100 miles from Greenwich.—J. C. L.

[65828.]—**Wood Net Work.**—I deal in a commodity of small articles to be spread out to dry and get as much of the sun as possible, and to be removed at the very appearance of wet or damp. To do so by hand is both slow and expensive. Can any fellow-reader help me to devise a net work of wood in sections to run on rails or pulleys to cover an acre of ground with receiving and distributing sheds, so that the whole affair could be quickly run out and in between and after showers? A drawing would be most acceptable.—J. H. S.

[65829.]—**Bath.**—I wish to place a bath (with hot and cold water taps) in the same room as the cistern which supplies the house, so that the bath is on the same level as the cistern. The water would first have to go down to the boiler in the kitchen to be heated, whence it goes to a cylinder on the second floor and thence to the bath on the top story. Would the water from the cistern feed the bath with hot and cold water? The water comes from you will find several methods described in back numbers—even recent ones. See pp. 13, 96, this volume.)—A. P. (Has not the question been answered over and over again? A Leclanché battery is not suitable, as it will run the motor for only a few minutes at a time.)—R. M. (We could not insert such a query, because the replies must necessarily be advertisements.)—YOUNG CYCLIST. (If the tire is so loose as you imply, you had better get a new one fitted, as no cement can be really trusted unless the tire also tends to stick to the rim by its own tension. Any cycle maker or dealer will, however, supply the cement generally used.)—X. Y. Z. (Any bookseller can procure you a work treating of the diseases of poultry. Cassell and Co. publish a work on the rearing, &c., of poultry, which contains notes on their diseases, and we think a work of the kind is published at the *Bazaar* office, 170, Strand, W.C.)—RAILWAY. (We have not the slightest idea of the percentage of wholesome drinking water with which England is at present supplied. England is only a small island, no doubt; but still it is rather large to find out the percentage of wholesome drinking water.)—SARDEGNA. (Strychnine is used, we believe, for sobering drunken people; but it must be taken only under medical advice. As to making a drunkard dislike alcohol (by which you no doubt mean alcoholic beverages) extract of red bark is strongly recommended.)—Y. Y. (Many things have been recommended—for which, see indices; but a good tool smith uses plain water.)—W. G. (No test for sewer-gas, as sewer-gas; but if any smoke blown into a drain or sewer finds its way into a house, it is proof positive that sewer-gas can also get in. Liquids having a strong odour—*e.g.*, pennyroyal, peppermint—are also employed for the purpose.)—RAZOR. (If the emery wheels are to be used, you had better purchase them from a responsible manufacturer; but you will find all the information you require in back volumes.)—AMATEUR BANJOIST. (Information about the banjo in Nos. 976, 980, 989. Perhaps you mean Nos. 1125, 1129. The price of numbers is 2½d. each, post free.)—BRAZIER. (Several papers on Gas-engines in Vol. XXXIII. Perhaps the best book on the subject is Clerk's "The Gas-Engine," published by Longmans and Co.)—F. A. M. (Have we not given all the useful information about petroleum engines? Several years ago we illustrated Brayton's hydrocarbon engine; and on p. 231 we illustrated the most important parts of another make. See p. 98, No. 1079.)—THOS. CASSON. (Could not say without examining the rule.)—W. D. V. (It is quite practicable to drive a dynamo by means of an electric motor; but, as you surmise, scarcely profitable, as the dynamo might be driven direct. 2. We think the ordinary plan is the cheapest—a mixture of ice and salt.)—IGNORANT. (They are rather more difficult to "get used to"; but when that is accomplished they are better than the ordinary tall machines because the "fall" is not so great.)—ZANONI. (The name is that of an imaginary character. 2. The underground locos are simply tank engines, with a valve to shut the exhaust off from the chimney and compel it to go into the tanks, where the steam is supposed to be condensed.)—PSYCHOLOGIST. (We are afraid you have not made yourself clear. Questions must be put in a definite form, and it is also just as well to write in such a manner that what is written can be read.)—J. H. B. (We do not know of any paper that will suit you for that purpose. 2. Allen's "Commercial Organic Analysis" is published by J. and A. Churchill, New Burlington-street, W., in two volumes. We think the price is 14s. each volume. 3. It is difficult to advise without knowing what branches of chemistry you wish to study. Get Churchill's catalogue, and Macmillans'; also Lockwood's.)—BELLRILAP. (If you will kindly tell us when the moon "changes," we shall be able to understand what you mean about her changes "effecting" the weather. The moon has certain recognised phases; but she is "changing" every day in the ordinary sense of the word.)—G. R. POSTLETHWAITE. (Your long letter does not touch the point in dispute at all, and is inadmissible. You might learn to write English and get up a knowledge of ordinary scientific facts before occupying space uselessly.)

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ADVERTISEMENTS in EXCHANGE COLUMN—for

	s.	d.
Twenty-four words	0	3
For every succeeding Eight Words..	0	3

ADVERTISEMENTS in the SIXPENNY SALE COLUMN.

	s.	d.
Sixteen words	0	6
For every succeeding Eight words	0	6

⁂ It must be borne in mind that no Displayed advertisements can appear in the "Sixpenny Sale Column." All advertisements must be prepaid; no reduction is made on repeated insertions, and in cases where the amount sent exceeds One Shilling, the Publisher would be grateful if a P.O.O. could be sent, and not stamps. Stamps, however (preferably halfpenny stamps), may be sent where it is inconvenient to obtain P.O.O.'s.

The address is included as part of the advertisement, and charged for.

Advertisements *must* reach the office by 1 p.m. on Wednesday to insure insertion in the following Friday's number.

OUR EXCHANGE COLUMN.

The charge for Exchange Notices is 3d. for the first 24 words, and 3d. for every succeeding 8 words.

Planing Machine, to plane 13ft. by 3ft. 6in. square, two tool boxes, and set of Busses governors, perfect. Exchange good machinery.—RIGBY SMITH.

Lathe, 18in. centres, 36ft. bed, two saddles and rests, screw-cutting complete; shaping machine, 14in. stroke, two tables, equal new. Exchange.—RIGBY D. SMITH.

Slotting Machine, 14in. stroke, self-acting in all cuts, Macles and March steam pump, 4in. ram, complete.—RIGBY SMITH, 107, Granby-row, Manchester.

Wanted, Chuck (Universal), suitable for 6in. lathe; also Screw-cutting Lathe. Exchange SAFETY BICYCLE and cash —30, Howson-road, Brockley, S.E.

Organ, bellows, chests, odd pipes, an excellent 12 tune Organette and about 200ft. choice Rosewood and Mahogany Veneers.—JOHNSON, 12, Moxley, Wednesbury.

New hand bench **Drilling Machine,** with turned flywheel. Wanted 6lb. No. 18 and 14lb. No. 20 double cotton-covered wire.—R. H., 18A, Queen's-road, Bayswater.

Good Value Offered (cash or instruments) for all kinds of Scientific Appliances.—CAPLATZI, Science Depot, Chenies-street, near British Museum. Estab. 1862.

Stocks and Dies (Whitworth thread), ⅝in., ¾in., ⅞in., 1in.; Gas Stocks, ⅛in., ¼in., 1in. Exchange offer.—16, Riley-street, Bermondsey, S.E.

Miniature Camera and Lens for plates, 1¼in. square, rack and pinion, 12 dark slides, shutter, all complete, dimensions over all, 2½ by 2 by 1½in. Exchange good Drawing Instruments, including T-square, or offers.—A. TAYLOR, Public Buildings, Penzance.

Lancaster's ¼ **Camera,** stand, lens, Le Merveilleux. Will exchange Mason's Hygrometer, and a Maximum and Minimum registering Thermometers, both absolutely accurate and in good condition.—Dr. KERR, Crawshawbooth, Manchester.

A dozen and half **Lawn Tennis Balls,** never been used, cost 18s. Exchange Induction Coil or anything useful.—P. MUCKLE, Abbygate, St. John's-green, Colchester.

Will exchange Seal's **Hot-Air Engine,** which cost 12s. 6d., for Microscopic Slides or offers.—J. KISLL, High-street, Barnstaple.

Wanted, old Colonial **Postage Stamps** used before 1860, also Collections of Stamps. Good exchange.—E. W. DRURY, 125, Coltman-street, Hull.

Portrait Lens, ¼ plate, with stop and rack; also Studio Camera, 5 by 5. Offer.—E. CHICK, 24, Woodbridge-street, E.C.

Pocket Accumulator, 4 volts, 1¼ ohms; large Grip Vice wanted; also Model Marine Engine, £2; also Electric Motor. Offers.—HANS, 105, Adelaide-road, Hampstead.

"English Mechanic," 32 volumes, unbound, 1870 to 1886, one vol. wanting six numbers; "Science for All," complete, new, 60 parts. Exchange Books, Novels, &c.—H. VALTERS, 6, Cornmarket, Louth, Lincs.

Singer's Hand or Treadle **Sewing Machine,** good working order. Exchange offers. Steel Letters and Figures wanted.—FREDK. POYNTER, Eton College, Windsor.

3½ centre **Lathe,** face-plates, centres, all metal, new. Exchange Safety Bicycle, value £5, or offers.—FREDK. POYNTER, Eton College, Windsor.

I wish to exchange my front-steering **Tricycle** for Model Engine and Boiler, Musical Instruments, or Bicycle.—WM. JONES, 54, Castle-street, Stockport.

2½in. **Lathe,** with tools, circular saws, grindstone, buff wheel, &c. Wanted, Dynamo or offers.—C. G., 5, Winton-terrace, Stoke-on-Trent.

Wanted to exchange, **Double Cylinder Engine,** 2in. by 4in., nearly completed, also ¼-plate Camera, professional's, splendid thing, cost over £6; also a Burnisher for burnishing and rolling photographs up to 12in. wide; for a good Lathe, or any good Engineering Tools.—A. W. NURSE, 38, High-street, Lewes, Sussex.

Pair **Tricycle Wheels,** 48in., steel hubs, butt spokes; good Fletcher's Foot Blower. Exchange for large sized Slide-rest.—J. KIRKWOOD, 236, Leith Walk, Leith.

Good exchange given for **China Transfers,** about two dozen.—T. CHRISTELOW, 12, Stratford-avenue, Stratford-place, Birmingham.

Dynamo (experimental), about 100c.p., well made. Small Lathe wanted. One Electric Bell, 4in., plated and well finished. Offers to value of 5s., anything.—Below.

Wimshurst **Influence Machine,** 7in. spark; anything Mechanical or Electrical wanted; electric bell parts, frames, coils, and armature. Offers to value 1s. wanted.—SMITH, 12, Barkerend-road, Bradford, Yorks.

Compound Wimshurst, 6 plates, in perfect order, 4 Leyden jars, improved movable brushes, brasswork, lacquered. Exchange to £2.—LORD, Victoria-street, Radcliffe, Manchester.

Wimshurst **Influence Machine,** 15½ glass plates, Wanted, Field Glasses, Microscope, or offers.—J. SMITH, 1, Cholmeley-road, Reading.

Three-cell **Bichromate Battery,** ebonite, with 2½ candle-power lamp, wire, &c. good condition. Exchange Revolver or Carpenter's Tools.—FENTON, 122, Roman-road, Bow.

Wanted, back-geared **Lathe,** about 3in. centres, with accessories. Exchange seven guinea English Concertina.—SAM MIDDLETON, 57, Southampton-street, Camberwell.

¾H.P. **Vertical Boiler,** fittings complete, and in good condition and working order. Will exchange for good 50in. Bicycle.—74, Stanley-grove, Longsight.

Horizontal Boiler, 30in. by 15in., double riveted, with fire tube, dome, safety valve, also Vertical Engine. Want Tricycle or Facile.—HOY, Kingsley-street, Sunderland.

Pair of 10in. **Lathe Heads,** with bell chuck, to be sold, a bargain, £3, or exchange.—64, Westminster Bridge-road, S.E.

Lady's silver Geneva **Watch,** will exchange anything to value of 16s. Opera Glasses or Shocking Coil preferred.—Address W. GLEDHILL, Knowl Top, Mirfield.

5in. stroke **Shaping Machine,** by Ambler and Dickinson, Keighley, vice, countershaft for power, excellent order, cost about £40. Exchange offers.—9, Wellington-place, Bowdon.

Lathe Heads, single speed, 5in. centres, slide-rest; small Lathe, 2½ centres, brass heads, triangular bed. Exchange Electric Lighting Material.—J. TURPIN, Drighlington, Yorkshire.

Electro-Motor, "E. M.," April 6th, has been worked, but requires a better commutator. Exchange value 30s. or offers.—CROSS, 42, Parliament-hill, Hampstead.

¾ horse-power **Engine and Boiler,** working order, in exchange for 2H.P. Boiler with fittings, in good condition.—A. HALLS, 59, North Quay, Yarmouth.

Steam **Launch Hull.** Exchange anything useful.—A. HALLS, 59, North Quay, Yarmouth.

Horizontal **Iron Boiler,** loco. type, 5 tubes, water space round fire box, strongly made, tested to 100lb. Exchange Model Engine.—20, Windmill-road, Croydon.

Wanted, Corliss Engines, by Uhland and Tolhausen. Exchange Cullen on Turbines, 12s. 6d.; Hall's Integral Calculus; Colyer on Pumps, 12s. 6d.; Zeuner on Valve Gears, 12s. 6d.; Appleby's Handbook of Machinery, 3 sections, 9s.; Nautical Astronomy (Ever's), 1s.; Details of Machinery (Campin), 3s. 6d.; Chambers' Algebra, 2s. 6d.; Engineering Drawing, 3s. 6d. (Weale's Series); Combustion of Coal (Williams), 3s.; Recent Improvements and Catechism of Steam Engine (Bourne), 12s.; Modern Workshop Practice (Winton's), 3s.; Theoretical Mechanics (Twisden), 7s. 6d.; Popular Physics, 2s. 6d.—G. COUPE, 15, Gladstone-terrace, Grantham.

"Grosvenor" Convertible **Sociable,** a capital machine in perfect order, with ball bearings throughout, has not been much used. Exchange. Offers invited.—CAM, 50, New-street, Worcester.

Water Motor, 1 to 2 horse-power, to drive ventilator, Wheeler's make of Preston wanted. Exchange gas engine and cash.—HARRISON, Exchange Chambers, Liverpool.

Exchange "**Modern Machine Shop Practice,**" by Rose, M.E., 20 parts, cost £1, for a 6in. to 8in. lathe.—WILLIAM SHELDON, Marple, Cheshire.

Will exchange "**English Mechanic,**" Vols. XX. to XXVI. (first and last incomplete); XXX. to XXXVIII., Nos. 1,113 to 1,179, for camera, microscope, or telescope.—ROBT. LINDSAY, 7, Clarendon-street, Partick.

Powerful 5-cell **Battery,** complete, with porous pots, &c., in polished teak case, also powerful electro-magnet with moveable coils. Will exchange for drawing instruments by Stanley; must be in good condition.—E. H., 25, Percy-road, Shepherd's Bush, London.

Electrical Machine, well-finished mahogany stand, brass conductor, quart Leyden jar, inch spark complete. Exchange to value 8s.—PEARSE, 16 Thanet-street, London, W.C.

THE SIXPENNY SALE COLUMN.

Advertisements are inserted in this column at the rate of 6d. for the first 16 words, and 6d. for every succeeding 8 words.

Fretwork.—Catalogue of every requisite, with 400 illustrations, free for 6 stamps.—HARGER BROS., Settle, Yorks.

New Illustrated Price List of **Screws, Bolts, and** NUTS for Model Work, drawn to actual size, sent on receipt of stamp.—MORRIS COHEN, 132, Kirkgate, Leeds.

Billiards or Bagatelle, or Requisites for ditto, or Billiard Work.—HENNIG BROS., High-street, London, W.C.

Foreign Postage Stamps.—A few specimens many rare, for disposal at following rates:—25, 4d.; 50, 7d.; 100, 1s. 1d.; post free.—PHILATELIST, Lady Cross, Harrow. Below.

Above Packets include specimens of the following varieties, every one being guaranteed genuine.—Below.

Antillas, Bahamas, Barbados, Ceylon, Colonies, Egypt, Gibraltar, Guiana, Jamaica, Japan, New Zealand, Tasmania, Transvaal, Sandwich Islands, Western Australia.—Above.

Woollen Cloths for men's and boys' suits, direct from the manufacturer, thus saving intermediate profits.

Woollen Cloths.—Patterns of new season's goods, fancy coatings, trouserings, hair lines, &c., post free on application.

Woollen Cloths—Any length cut. Write for patterns to CHARLES ARROW, Woollen Manufacturer, Piece Hall, Halifax.

Carbon Plates, best quality, cut and moulded, and capped; quality cannot be surpassed.—GEO. G. BLACKWELL.

Pebble Carbon.—Graphite for Leclanche cells; splendid conductor; price very low.—GEO. G. BLACKWELL.

Manganese Oxide specially prepared for Leclanche batteries; high strength and purity, greater E.M.F., constant action; been in use 15 years with immense satisfaction; 7, 14, and 28lb. packets. Prices on application.—GEO. G. BLACKWELL, 26, Chapel-street, Liverpool.

Milnes's Lathes are now on view at 17, Bear-alley, Farringdon-street, E.C. Inspection invited.

Malleable Castings by our improved process. Sharp, sound, and strong as steel.—DRONFIELD CASTING CO., Sheffield.

Lathe Castings, &c.—See T. Taylor's advertisement in ENGLISH MECHANIC every other week. Established 18[illegible]

Telephones.—By erecting telephonic communication between the different departments of works, factories, offices, hospitals, and wherever communication is desirable, much valuable time is saved.

Gillett's **Telephone** is simplicity itself. Will work on ordinary electric bell wire; the same instrument can be used as transmitter and receiver. Price £1.

Telephones.—We supply every description of Stores used in telephony, wire, insulators, batteries, &c. List.—ELECTRIC TELEPHONE COMPANY, 26, Red Lion-square, W.C.

Photographic Printing, enlarging, &c. Write for Tear and Son's new list. Low prices.—12, Clapham-road, London.

Matt surface **Sensitised Paper,** artistic tones from chocolate to platinotype. Sample sheet free, 9d.—MEDLAND Brough.

English Mechanic
:LD OF SCIENCE AND ART.
'RIDAY, JULY 20, 1888.

COPICAL ADVANCES.— XXXVIII.

.OYSTON-PIGOTT, M.A. Cantab.,
F.R.A.S., Memb. Roy. Coll.
s; Fell. Cambridge Phil. So-
ormerly Fellow of St. Peter's
Cambridge.

in High-Power Definition— ;ed Lines, Circles, and Dots.

:MATICAL lines and dots have
breadth. But lines are more
dots of the same breadth. There
ous nerve impression. Parallel
till easier. Imagination begins
vision; and, besides this, false
of the eyeball itself may intro-
rable errors in the picture formed
a. This organ is subject to innu-
fects even in health. I have
ervers incline their heads to obtain
t vision, so that without this feat
ld not act. This is caused by
. Besides, when we come to
minutiæ of nature, requiring
t accuracy of sight, nature im-
lemands condition, training, and
ty, penetration, and transparency
.l parts; and, above all, *mens sana*
:no. Miss Airy could distinguish
s in the Pleiades; Dawes, the
markings on Jupiter's satellites.*
ied eye detects minutiæ in vain
y the untrained. Dr. Dallinger,
mplished fifty measurements of
or whips of the Monadinæ, which
at 1-200,000th of an inch thick.
seen them before.
enuated lines abound microscopic-
the minutest hairs. Two black
off to advantage a fine thread of
it. A gossamer thread is ex-
d for study. It forms cylindrical
) glance at some of these natural
as—

The Fairy Fly.

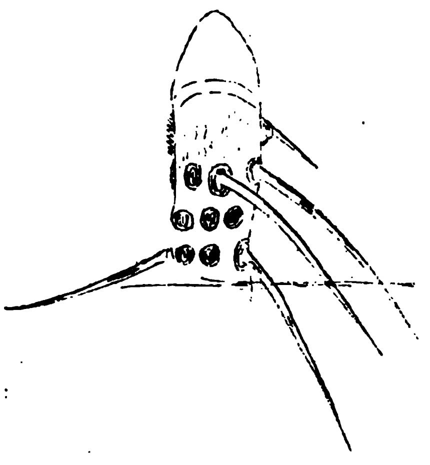
ture possesses no ordinary wings,
:s or paddles, carrying wonderful
airs, and hairlets studded upon the
sembling the markings on the
es. As for its eyelets, while the
consists of convex lenses one
of an inch broad, the Fairy Fly
nany times smaller and brilliantly
So are the hairs; and their
ns are surely delicate enough for
stidious.† Very few glasses are
curately enough to enable you to
lack-test margins right up to the

Plumules and Cilia.

the phenomena attainable by
crossing hairs present a high
nicroscopical beauty. Lozenge
they are longer or shorter
of intersection is more or less
drops are frequently inclosed
eir tubular form, and much more
Marginal lines at last coalesce,
in extreme tenuity.§
ng animalculæ invested with ex-
cate membranes, their foldings
iest glasses exhibit jet-black lines
and margins of extremest tenuity and precision. A single glance is then sufficient to decide optical excellence. In the older glasses these outlines are haunted with a bright burr.

Plumed Gnats.

The attenuated lines discoverable in the hairlets of these gnats seem to pass all microscopical experience; hundreds of bosses or cups project tapering hairs displaying two black margins, and around these bosses extremely minute bulbs or bosses glitter, and, carefully treated, reveal forests of cilia or hairlets of most astonishing attenuation. They are best seen at the insertions of the antennæ into the head of the gnat, where they are slightly coarser, and throughout the internal tube of the attenna are closely sprinkled.* They are best seen by daylight illumination. Their size is appallingly small for estimation.



A new kind of micrometer has, however, been designed and constructed, which I hope to describe in the next article. It reads to the half-millionth of an inch under a power of 2,000, and it will, I hope, surpass spider-line micrometers, as it measures on a dark field—destroying glare on a new principle. Measurements will now be attempted of bodies hitherto baffling all investigation in the minute world.

Polyommatus Bœticus. ♂ (Longtailed azure blue).†

Amazing tenuity may be discovered in the spear-like extremities of the long battledores. The edges of the spearlet are intensely black, attenuated lines, meeting in a minute point. It appears like a veritable weapon, and is rich in fluid contents—whether or not poisonous I cannot say.‡ All along the snake-like stem carrying the spear, multitudes of crossbars possessing double attenuated margins appear to be interwoven crosswise, to strengthen this stem, besides supporting strong ribs incorporated up to the very extremity. These scales are surprisingly long, and towards the quill extremely expanded in a rounded form. Besides this, the spear-end is serrated, like many other stings. The hairs of many caterpillars possess also venomous stings. And, after all, one of these stings is in nature an expanded, balloony, and extended hair. The ribs advancing from the quill to suit the strange shape of the scales (battledore-balloons) stop suddenly, and so reduce their number gradually, till one or two only are left to support the spear. But all along they preserve exactitude in size, and exhibit magnificently attenuated jet-black margins, testing any fine glasses severely. A drawing will be attempted. Very delicate attenuations are seen in the margins of gnat-lancets and in the saw-like serrations of the blades, also armed with a very surprising system of heckles. Watching mosquitoes at Glion, I have seen them erecting themselves, holding tightly on by means of their claws as fulcrums, and quickly sawing their stings into the skin,* which, however, they easily withdraw, unlike those of the wasp, which are barbed, holding the stings firmly in place while poison is instilled. The creature can close the barbs at the instant required. What capacity for deadly design!

(*To be continued in October.*)

REVIEWS.

Standards of Length. Edited by GEORGE M. BOND, M.E. Hartford, Conn.: The Pratt and Whitney Company.

SOME time in the centuries to come our manufacturers will copy the practices of the Americans, and devote themselves to business—to both sides of it, we mean, for there is another side beyond the ledger. Here is a useful work published by the Pratt and Whitney Company, which contains a résumé of the methods employed by machinists and others in the production of standard gauges to insure "uniformity and interchangeability in every department of manufactures." A few years ago such an idea was unheard of in English shops—except for their special patterns,—but since the growth of the cycling industry the importance of "standards" has been brought home we might almost say to the multitude, and "interchangeability," as it is called, often determines the choice of a machine. The Americans have carried out the principle of interchangeability in many of the most important machine-constructions, and it is not a little remarkable that they have done so without Government stimulus. The work before us contains the reports of Prof. W. A. Rogers, of the Committee of Standards and Gauges of the American Society of Mechanical Engineers, of the Committee of the Master Car-Builders' Association, and of the Special Committee appointed by the Franklin Institute. But it is quite unnecessary for us to inquire into the reasons for the recommendations contained in these reports; it is sufficient to point out that the necessity for "standards" and for interchangeability of parts has been recognised for years in America, and that much of the success which has followed the operations of American manufacturers is due to the fact that in all important machines "uniformity and interchangeability" are the chief considerations, after the suitability of the machine to do its appointed work. In bringing about so desirable a state of things the Pratt and Whitney Co. have played no insignificant part, and they are now reaping their reward. The frontispiece to this work is the Rogers-Bond "Universal Comparator," which we illustrated in No. 1,026, p. 254, and we have only to refer to that, and to the fact that the Pratt and Whitney Co. make such a feature of it to show what importance is attached in America to the comparison of standards of length and to the measurement and reference of working gauges. The volume contains a variety of papers on the subject, and includes an article from the *Railroad Gazette* commenting on "some very large-sized and strangely erroneous statements" in *Engineering*. It is, whatever difference of opinion may prevail, a book in which much is to be found of interest to mechanics and to a nation of machinists.

:rs' "Astronomy," 1867, p. 114.

of Holloway, mounted the specimen I am

: of thin glass rods in close duplex layers
ffects to the greatest advantage. Placed
, the optical image is a square, brilliant
:ing under acuter integration.

s of peculiar perfection was selected (a
10s., by this remarkable test.

* An accidental rent revealed the interior surface.

† The sign for a male is ♂—Mars: for a female ♀—Venus. The males only possess these extraordinary battledore scales.

‡ The sting of the Tetse fly emits a red, deadly poison, capable of destroying an ox in a minute of time. Livingstone declares about 20 of these flies killed 43 oxen in about as many minutes—a fact almost inconceivable.

* My brother-in-law returned from Nice so painfully disfigured, he declared nothing would induce him to go again. He was cured by dilute prussic acid in a very short time—a very valuable remedy.

Stair Building. By JAMES H. MONCKTON. New York: John Wiley and Son; London: Trübner and Son.

THIS work may be recommended to carpenters and joiners as describing a simple and rapid method of setting out handrailing. As will be understood, it is made up of plates and explanatory text; but it also contains a number of plans and designs of staircases, newels, balusters, &c., which may be useful to American builders, but which we should hope no one will copy in this country, except those taken from old work. It is noticeable and remarkable that while works of this kind published in America are admirable from a practical point of view, the original designs are execrable from an artistic point of view. That, however, does not detract from the merits of this work, which depends on the system of setting out handrails, stairs, &c., on a geometrical plan known as the one-plane method, in which only one plane of projection is required. Any carpenter who masters this work will find little difficulty in carrying out the practical details of the most intricate plan of staircase and handrailing.

Cotton Manufacturing. By C. P. BROOKS, M.S.A. Blackburn: The Author; London: E. and F. N. Spon.

HERE we have, in a comparatively small compass, a work which deals with the various processes of manufacturing cotton goods in such a manner that it forms a textbook for the pupil at technical schools, and will also be found useful by not a few of those who are employed in mills. It would be impossible within less than 200 pages to give a description of the rival machines used in the manufacture of cotton; but the author has contrived to introduce many, and has succeeded at all events in making the routine processes comprehensible by the average reader. Weaving occupies a considerable portion of the available space; but the chapter on sizing is of importance, for that process or art is really at the foundation of success in any mill, and opinions differ as to the "honesty" of some of the practices adopted. It will probably astonish some to learn that the amount of size on cotton warps varies from 3 to 200 per cent., but it is only fair to mention that when the proportion exceeds 50 per cent., the goods are known as heavily sized. It is necessary to size cotton, or it would be difficult to weave; but there is a medium in all things, and although it is no part of the author's business to dilate on the "honesty" of sizing, the facts he puts forth may be useful to technical students and to the public generally. The work is illustrated with plates showing machines, and a number of small blocks showing details of machines and of the work executed by them. It may be recommended as a practical work well adapted to the wants of those who, besides competing in the technological examinations, are desirous of learning the technicalities of the art of cotton weaving.

We have also received *The Fundamental Principles of Chemistry*, by ROBERT GALLOWAY, M.R.I.A., F.C.S. (London: Longmans), the plan of which is, according to the author, "more in harmony with the laws of thought than the chemical textbooks that are in use in schools." As a rule, it is advisable to lift the student up to the level of his work by teaching him to think, and that is Mr. Galloway's object. Whether he will succeed in attaining it is another matter, for every F.C.S. thinks he could write a better textbook than any of those which have served as primers to our leading chemists.——*Granites, and Our Granite Industries*, by GEORGE F. HARRIS, F.G.S. (London: Crosby Lockwood and Son), is a readable little treatise of the popular kind, though it is quite scientific enough for most readers. It is, however, intended for the use of those who work or deal in granites and are presumably interested in learning something more about them than comes within the "ken" of the average business man.——*Practical Microscopy*, by MAURICE N. MILLER, M.D. (New York: W. Wood and Co.) is a course of normal histology for students and practitioners of medicine, written by the director of that branch of medical study in the Loomis Laboratory, University of the City of New York. Although there is much in the work to interest many microscopists, it is purely a treatise for the histologist; but as such it must take high rank, the illustrations being photographic reproductions of Dr. Miller's pen pictures.——*A Higher Arithmetic and Elementary Mensuration*, by P. GOYEN (London: Macmillan and Co.), has several features to recommend it, the most important of which is perhaps that the student who uses it is taught to observe and think, which is really the highest aim of education. It is an excellent "arithmetic" also, for the simple reason that most of the examples chosen are of a really common-sense character.——*Outlines of Qualitative Analysis*, by GEO. W. SLATTER (London: Thomas Murby), may be useful to teachers of classes, as the author found his notes (expanded into this textbook) most valuable in his classes at the Salt Schools, Shipley.——*Electric Instrument-Making for Amateurs*, by S. R. BOTTONE (London: Whittaker and Co.), is the second edition of a work tolerably well known to our readers, the utility of which is, perhaps, best indicated by the fact that a second edition has been rendered necessary so soon. The author has taken advantage of that fact to add a short chapter on the telephone.——*A History of Photography*, by W. JEROME HARRISON (Bradford: Percy Lund and Co.; London: Trübner), is an interesting résumé of the progress that has been made in the art of sun-printing, written as a "practical guide"; but we must confess we do not like the style in which it is got up. That, however, does not detract from the merit of the matter. There is an immense amount of information in this work.——*Historic Towns: Colchester*, by Rev. E. L. CUTTS, B.A. (London: Longmans), is another of the series edited by Dr. Freeman and the (late) Rev. W. Hunt—a series which gives, in a concise form, all the more interesting facts in connection with the historic towns of England. Colchester, we need scarcely tell our readers, is probably the oldest town in the country. It was certainly the first the Romans built, and consequently it has an exceptional interest for antiquarians and historians.——*An Elementary Textbook of Practical Metallurgy*, by A. R. GOWER (London: Chapman and Hall), is a work that will be found very useful in the metallurgical laboratories that are now springing up, because it is written by a man who has had a practical training, and knows exactly what is wanted. It is freely illustrated where advisable, and an index renders it complete as a textbook so far as it goes.——*Management of Accumulators*, by SIR DAVID SALOMONS, Bart., M.A. (London: Whittaker and Co.), is the fourth edition, thoroughly revised, of the only practical manual on accumulators and their use. Strange as it may seem, those who sell accumulators know very little of their behaviour when they have been in use some time, or if they do know all their defects, they take care to conceal their knowledge. Sir D. Salomons has had quite an extensive experience with them, and his work may be commended to the attention of all who want to know what can be done with secondary batteries.——*Mechanics and Experimental Science*, by E. AVELING, D.Sc. (London: Chapman and Hall), is the volume devoted to Chemistry especially adapted to the matriculation examination of London University, and in some respects the matter is treated in a novel manner. The examination questions and examination papers will be useful to the student.——*Plotting or Graphic Mathematics*, by R. WORMELL, D.Sc., M.A. (London: Waterlow and Sons), was originally written for the preliminary training of pupils preparing for a technical college; but it has been found to possess attractions for a wider circle of students. We commend it to the attention of our mathematical readers.——*Lessons in Elementary Mechanics*, by W. H. GRIEVE (London: Longmans), is specially adapted to the requirements of the Revised New Code, and is so written and so illustrated as to interest while it instructs.——*Watt's Dictionary of Chemistry* (London: Longmans) is the first volume, revised and entirely rewritten, of the well-known work by the late Henry Watts. The revision has been intrusted to H. Forster Morley, M.A., D.Sc., and M. M. Pattison Muir, M.A., assisted by eminent contributors. The work is to be completed in four volumes; but chemistry is progressing so fast nowadays that we should not be surprised to find that a supplementary volume is deemed necessary. The matter has been condensed, and there can be no doubt that the work will be the standard dictionary of chemistry—at all events in the English language.——*The Mutual, Friendly, and Provident Institutions of the Working Classes*, by Rev. J. FROME WILKINSON, M.A. (London: Diprose, Bateman, and Co.) is a pamphlet by a clergyman who is not only a member of the best of the Friendly Societies, but who is also well acquainted with their history and workings. We commend it to the careful perusal of all interested in the subject of friendly societies and provident institutions.——*First Elements of Experimental Geometry*, by PAUL BERT (London: Cassell and Co.) is a work which commends itself by the very name of its author, for no school-books have been so successful from the point of view of both teacher and pupil as those written by the late Paul Bert. This book is nicely printed, is freely illustrated, and is admirably adapted for use in schools.

SOME NEW DRAWING INSTRUMENTS.

IN the new edition (the sixth) of "Mathematical Drawing and Measuring Instruments,"* by Mr. W. F. Stanley, several new instruments and appliances are illustrated and described. It is ten years, we believe, since the last edition was issued, and the work still remains the best of its class, as well as the only original work of the kind. We have from time to time illustrated or described some of the more useful of the new instruments, and will now make some notes on those which we have not.

The Oograph,

as its name implies, is an instrument for drawing egg-shaped outlines, and was designed by Mr. Stanley for an oologist who desired to represent the eggs of birds with accuracy in their natural sizes and proportions. A circle is generated by the sling piece (Fig. 1), shown at one end of the instrument, moving round its axis and carrying with it one end of a light bar, the other end being guided by a stud against which the bar is pressed. In proportion as the egg to be drawn is of circular form, the little beam-head sliding on the bar and carrying the pencil is made to approach the sling piece, or if the egg is of long, oval form it is pushed towards the sliding end. The egg is thus drawn elliptically in proportion to the greater distance apart of the sling piece and sliding stand, or is more sharply pointed in proportion to the approach of those parts. An extra sling piece, it will be seen, is provided to work closer to the sling when small, roundish eggs are in process of delineation.

Elastic Scale.

In Fig. 2 is illustrated an elastic proportional scale for enlarging diagrams and other sketching purposes. It consists of a kind of

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* London: E. and F. N. Spon, and the Author.

FIG. 1.

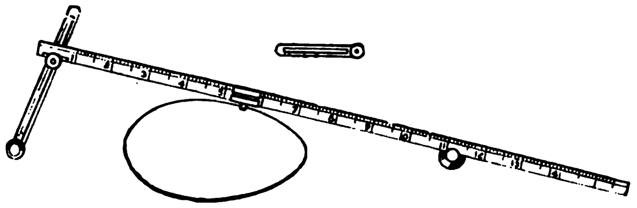


FIG. 2.

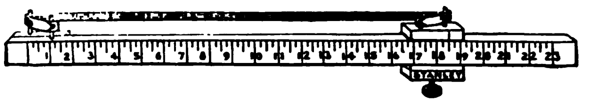
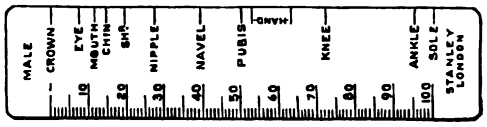


FIG. 3.



ass, having one movable head, flat ıce on one side, which carries a flat ood indiarubber which will stretch y two points within the range of its Marks are made on the rubber band 't lead pencil, and the head then d to the position which will give size the contraction or expansion of will give the proportional positions arks.

Human Scale.

n idea of the dimensions of parts— of doorways in buildings, say—the ın frequently introduces human unless he has studied figure drawıt to draw the parts of the forms out ion. Mr. Stanley has accordingly scale shown by Fig. 3, adapting it ıall's work, "A Rule of Proportion man Figure." The proportions for s are on one side, those for female the other. If the drawing or the o be examined is large the scale is en it and the eye, while proportional an be brought into requisition when smaller than the scale has to be

Improved Protractors.

otractors subtend the lines which d quite up to the angle. There is no t about the centre, so that near drawing are left open and clear to al observations of the work. The le forms a ring on the face of the

FIG. 4.

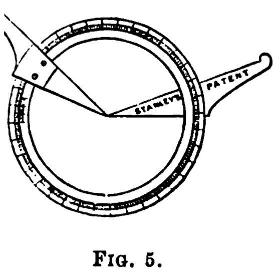
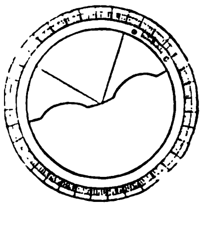


FIG. 5.



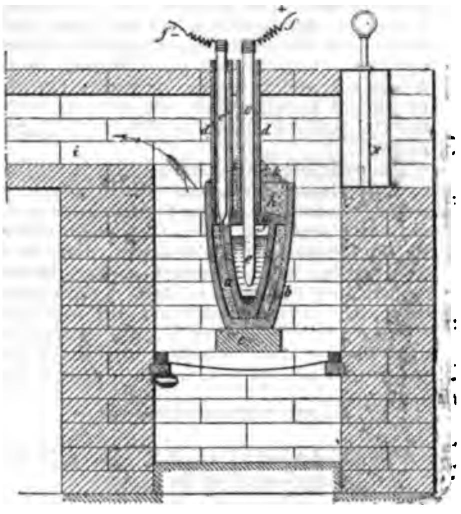
(Fig. 4), and the vernier being on is in best possible condition for ading. Fig. 5 shows a smaller size ket, and is without extended arms; ines with the protractor a goniometer solids, crystals, angles of cleav-

not say anything here of the rest of the work—Stanley's Drawing Instruments is a well-known textbook—the first edition was issued twenty-two years ago; but those of our readers who want to know what mathematical drawing and measuring instruments are available for their use cannot do better than procure this new edition.

HEROULT'S PROCESS FOR OBTAINING ALUMINIUM BY ELECTROLYSIS.

A METHOD of preparing aluminium and alloys of that metal by means of electrolysis has been patented in this country on behalf of M. P. L. T. Héroult, of Paris, by Mr. A. C. Henderson. In connection with a crucible of agglomerated carbon a positive electrode or anode is provided, the crucible itself forming a negative electrode or cathode; cryolite in the crucible forms a bath into which dips the positive electrode, which is of carbon. With this combination, alumina being placed in the crucible and a current of low tension being employed, the alumina is decomposed, the oxygen passes to the positive electrode or anode with which it is burnt, while aluminium settles upon the walls of the crucible, forming the negative electrode or cathode, and also on the bottom of the same in a metallic form or mass. The bath of cryolite remains constant, and may be used in a continuous manner, alumina being fed in as required; combustion will take place of the positive electrode or anode, whereby polarisation will be prevented, and a constant energy and uniform action of the electric current will result, care being taken to renew the electrode from time to time as required. The combustion of the positive electrode by the oxygen disengaged from the reduced oxide diminishes the quantity of electrical energy required to heat the bath, and causes the production of an electric current in the same direction as the principal electrolysing current, thereby further economising electrical energy. In the engraving a is a crucible containing the bath of cryolite (natural fluoride of aluminium and sodium); it is formed of very dense and well conducting agglomerated carbon. It is placed within another crucible b, made of graphite or plumbago, and resting upon a circular or other base plate or support c of any suitable material interposed between it and the furnace grate. e e^1 are pencil-shaped agglomerated carbon rods, of which e serves as the positive electrode or anode. The positive electrode is arranged centrally within the crucible a and dips into the bath. The carbon rod e^1 is in direct contact with the crucible which serves as the negative electrode or cathode. The carbon rods e e^1, which are insulated from each other, rise above the arch of the furnace, and are protected from the action of air and fire by stoneware tubes d d^1. A conductor f is connected to the positive electrode or anode e, and a conductor f^1 is attached to the carbon rod e^1; these conductors f f^1 are connected with an electric generator of suitable power and low tension. The crucible a is closed by a lid g made of a refractory material, such as calcined magnesia or of clay, through which the positive electrode or anode e passes. Over this cover is placed a layer of grout or fire clay h, which is finally covered with a mass k of suitable material, such as vegetable mould or loam; i is the flue, and x the charging flue of the furnace, by which the crucibles a and b are heated. When the cryolite, to which alumina has been previously added, is in a molten state, an electric current is sent through it, and the alumina electrolysed. The oxygen evolved from the alumina unites with the positive electrode or anode e, which, being brought to a high temperature, combines with the oxygen and forms oxide of carbon, which escapes through the tube d. The tube d^1 is kept closed to prevent the entrance of air. The aluminium reduced from the alumina passes to the cathode, that is to say, to the internal walls of the crucible a, where it first settles and then falls to the bottom of the crucible, where it finally forms a metallic mass. The cryolite remains unchanged. To render the production of metal continuous, alumina must be added from time to time as required to replace that previously decomposed.

For the successful and practical carrying out of this part of the invention, a current of three volts has been found sufficient; this results in a considerable saving of electrical energy as compared with the processes at present in use, and which invariably require currents of at least ten times greater tension. The reason for this is that in M. Héroult's process the carbon of the positive electrode e, while it burns, yields an amount of heat which is not necessary to be supplied by the electric current. For three equivalents of positive carbon electrode consumed, two equivalents of aluminium are obtained. When an alloy of aluminium is to be produced according to this invention, a suitable metal, such, for example, as copper, is employed to form the negative electrode, and by electricity both it and the alumina to be reduced are fused, the alumina being at the same time electrolysed. In order to reduce alumina and to produce an alloy, for example, aluminium bronze (for the manufacture of which this process is well suited), granulated copper is first placed in the carbon crucible in such quantity as to be lightly in contact with the positive electrode, and a current is passed through it, thereby melting the copper and making it ready to serve as the negative electrode. Then alumina (Al^2O^3), powdered or granulated, is placed in the crucible, and melts therein, and is decomposed by electrolysis (that is to say, by the action of the electric current upon the alumina) into its constituent elements in such a manner that the aluminium alloys with the copper, and produces aluminium bronze, and the oxygen combining with the carbon of the positive electrode carbonic oxide is formed. Satisfactory results have been obtained by using a current of large quantity and low tension as follows:—that is to say, in a crucible having an internal depth of 20 centimètres, its top being 14 centimètres in diameter, with a carbon 5 centimètres in diameter, a current of 400 ampères and from 20 to 25 volts.



[illegible]

TELEGRAPHIC COMMUNICATION WITH LIGHTSHIPS.

[illegible] of the conductors of the cable is led to a metallic plate submerged on one side of the rock at such a distance from it as to be in water deep enough for it not to be affected by waves. The other conductor of the cable is similarly led to another metallic plate or mass similarly submerged at a distance from the opposite side of the rock. There are two submerged metallic plates or masses upon the rock, respectively opposite to the plates, and insulated conductors lead from the plates to a lighthouse or signal station on the rock. To communicate from the shore to the lighthouse an interrupter or reverser and battery are connected to the shore ends of the two insulated conductors, and the telephone in the lighthouse responds to the repeated makes and breaks or reversal of the current so that communication can readily be carried on by the Morse alphabet.

If a vibrating interrupter or reverser be used a more or less continuous sounding of the telephone can be obtained by a contact key held down for short or long intervals. A more convenient way is to use two finger keys, one of which, by a series of teeth on its stem or in other more convenient way, produces a few breaks or reversals of the current, whilst the other key when depressed produces a greater number of breaks or reversals. For communicating from the lighthouse to the shore the battery and make-and-break apparatus are coupled to the insulated conductors on the rock and the telephone to the shore ends of the two submerged insulated conductors. As the strength of the signals sent will depend upon the electromotive force employed, it follows that any known call can be used and any code of signals employed.

In the same way communication could be carried on from the shore to a vessel at a distance from it, if the vessel were in the vicinity of two submerged plates or anchors each having an insulated conductor passing from it to the shore, and if two metallic plates were let go from the vessel so that these plates might be at a distance apart from one another. The position of the two submerged plates along with the submerged insulated conductors might be indicated by buoys. In this way communication might be effected between passing vessels and the shore or between the shore and a moored lighthouse or signal station. A similar result might be obtained with a single insulated conductor from the shore by the use of an induction apparatus with the ends of the secondary winding coupled by insulated conductors to submerged plates at a distance apart. The submerged plates or masses may be of any suitable form, as an anchor, chain, wire rope, or simply the bared ends of the insulated conductors may be used. Transmitting and receiving instruments of other kinds than those above mentioned might also be used.

PROTECTION OF BUILDINGS FROM LIGHTNING.—IV.*

By Prof. Oliver J. Lodge, D.Sc., F.R.S.

(Continued from page 430.)

Experiment of the Recoil Kick.

It will have been noticed that in the experiment of Fig. 6 the spark obtained at B is longer than the spark at A. And the question arises, Why this should be so? Plainly what is happening is this: the discharge at A sets up electrical oscillations, and the charge of the jars is rapidly reversed. The difference of potential of the inner coats changes from, say, + V to nearly − V, and back again; the difference of potential of the outer coats changes therefore from 0 to nearly 2 V, and hence the B spark may be expected to be nearly twice as long as the A spark: and so it is.

These electrical oscillations are of considerable interest, and have sundry practical bearings; let us proceed to make them more conspicuous. Fig. 7 shows a couple of long leads, L and L′, reaching across the room, No. 18 wire in two 95ft. lengths, insulated from one another and from the earth, but attached to the two poles of a machine, the machine having also a couple of Leyden jars attached to it in the customary manner supplied by the maker. A discharger, B, can be arranged to bridge the gap between these leads either near the machine, as B, or about the middle, as B₂, or at the far end, as B₃. Now, of course, sparks can be obtained either at A or at any one of the B knobs, and all about the same length; but on allowing the A knobs to be brought nearer than the B knobs, the spark would be expected to occur at A only. Nevertheless, on trying the experiment, one finds that every time a spark occurs at A, a longer spark occurs at B: it is, as it were, precipitated with a rush! and the longest spark of all is obtainable at the far end—viz., at B₃.

Here are some figures, in the obtaining of which, however, for convenience of manipulation, the B length remained constant in each position, and the least length of the determining spark A was the thing observed:—

Nearest Position.

Spark length A	3·20	4·15	[illegible]
Corresponding spark length B_1 ...	3·22	4·80	[illegible]

Middle Position.

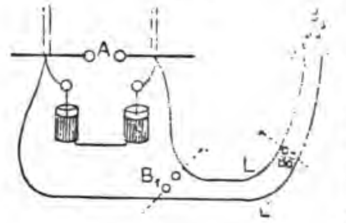
Spark length A	1·92	2·37	[illegible]
Corresponding spark length B_2 ...	3·22	4·80	[illegible]

Furthest Position.

Spark length A	1·60	2·2	[illegible]
Corresponding spark length B_3 ...	3·22	4·80	[illegible]

The electricity in the long wires is surging to and fro, like water in a bath when it has been tilted; and the long spark at the far end of the wires is due to the recoil impulse or kick at the reflection of the wave. Evidently there are some quantitative relations to be specified here, and there will be some best capacity of the jars corresponding to a given length of conductor, and to a given arrangement of main discharge circuit A. The nearer the length of the conductors corresponds to a half-wave length, or some multiple of a half-wave length, of the oscillations produced by the discharging jars, the more perfect will be the synchronism between the pulses, and a longer recoil kick may be expected. The arrangement may, in fact, be compared to a resonant tube excited by a tuning-fork or reed to Melde's experiment with vibrating strings, or to any other case of forced vibration.

The following numbers will just serve to show some difference of effect caused by different sizes of jars. Using two pint jars in series, and fixing the A spark at 4·5, the B_3 spark at the far end just ceases when the knobs are pulled out to [illegible] But, replacing the pint jars by gallon jars, the B_3 spark does not cease till the knobs are separated [illegible] 10·9, the corresponding spark in the position [illegible] being only a trifle longer than the A spark—[illegible] 4·7.



It is not to be supposed, however, that by increasing the capacity of the jars still farther a still better effect will be obtained; for on replacing the two gallons jars by the very large condenser of alternate glass and tinfoil sheets, we find the spark at B_1 fails when the knobs are only 5·9 tenths of an inch apart, the length of the A spark remaining 4·5, as before.

There is, as I say, a quantitative relation; and it is a relation which the modern theory of electricity makes known. I cannot go into it here, but I may just say that, very approximately, the wave-length of the electrical oscillation of a discharging jar is 2π times the geometric mean of the static capacity of the jar and the electro-magnetic inertia of the discharger.

The capacity of the two gallon jars in series (this being the capacity which gave the best result with 95ft. of leads) was about ·002 microfarad, or, say, 1,800 centimètres; hence, supposing the wave length of their discharge through the A knobs to be something like 190 or 200ft. (twice the length of the leads), we should calculate the self-induction of the circuit formed by the jars, short connecting wires, and A knobs, as something like five mètres, which is a reasonable enough value.

Repeating the experiment (Fig. 7) with the two gallon jars in series, but insulated this time from the earth, a still longer spark at B_3, the far end of the long wires, can be obtained—viz., A = [illegible], B_3 = 14; and even when the knobs of the discharger are separated beyond this distance, a brush still passes between them for every spark at A.

Removing the discharger altogether, and making the experiment in the dark, a very interesting effect is seen; the further end of each wire glows

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* Extracted from the Dr. Mann Lectures before the Society of Arts.

* Since the delivery of the lecture, a great number of quantitative observations on these lines have been made. Evidence of electro-magnetic waves 30 yards long has been obtained. I expect to get them still shorter.

brush light; showing the exceedingly
al to which they are raised by the re-
t see the effect with thick No. 1 wires,
o. 18 wires it is very marked. The
h of the two wires is independent of
of the other; thus, if the connections
o that the wires run opposite ways
he room from the machine, the distant
nsulated, it is still the end of each
m the machine that glows, although
arated from one another for most of
by the whole width of the room. With
on jars the wires glow over fully three-
ir entire length. With jars of much
ch smaller capacity the length of glow
ly less.

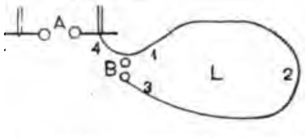
small pint jar to the ends of the wires,
effects cease. The increase of static
uces their potential below the brush-
Arranging the jar so as to leave an air
en it and one of the wires, a spark
t at each A spark; but the jar is not
rged afterwards, proving that the spark
ne, first in and then out of the jar, a
f a reflected pulse; hence it is also
earance of the brush is the same on
s—one is not able to say which is the
which the negative wire, for each is

ment of the Surging Circuit.

ned to me, when I first made it, a
ration of these electrical surgings or
going on in a conductor which is being
charged at one end, is afforded by the
tremely simple experiment.

end of a long insulated wire to the
l connect the other pole of the machine
rs connected up also to the machine
but they are unnecessary. The wire
lly constitutes one coating of a con-
hich the walls of the room are the
The wire is made to form a nearly

Fic. 8



t, aud its further end brought within
of the near end, as at B (Fig. 8).

se circumstances one would at first
t a spark at B was absurd, for the two
tallically connected through a stout
hich may be No. 1 wire, and not
any yards long. Nevertheless, it will
t sparks at B can be obtained quite as
not quite as strong, as those at A.
rk is accompanied by a B spark, un-
e, the knobs are too far separated.

urmise that it is the static charge on
ortion of the conductor which, having
rds A, prefers the short path B instead
path *viâ* the wire. But this is not
count of the matter, as can be shown
g high resistance in the conductor at
s—say at the places 1, 2, 3, or 4 (Fig.
cing a quarter of a megohm at the
weakens the B spark very much, and
bout the same whether it be at 1 or 3;
—i.e., the noise and appearance—of
remaining much the same. Intro-
gh resistance at the point 4 weakens
nd the B sparks. Introducing a high
the point 2 leaves both sparks pretty
ng as they were without it.

at B is caused by electrical oscillation
of the charge of the wire to and fro
a pipe. One might liken it to an
umped very full of water, and its end
spring valves. If, then, one end is
ned and shut, a pulse is transmitted
pipe, which may force open the valve
d and let some water escape.

e electrical oscillations, I doubt not,
t for the long spark obtained by the
nter's ring."

xperiment, Fig. 8, however it may be
as an obvious application to the
connecting roof gutters to lightning
It is most desirable to connect them,
s should be connected. If only one is
e far end is very likely to spit off a

see how, when a flash strikes a system,
y goes rushing and swinging about
or no apparent reason, just as water
about in a bath or system of canals
mass of rock had just dropped, splash-
rflowing its banks. Just so with
Bell-wires, gas-pipes, roof-gutters,
flashes in a way most puzzling to
ectricians; and thus gas may get
the most unexpected places, and passengers in a train may feel a shock because a charge has struck the rails. In powder magazines it is apparent how dangerous this lawless sparking tendency may be; for even the hinge of a door may furnish opportunity for some trivial spark sufficient to ignite powder. By no means, it seems to me, should high rods be stuck up to invite a flash to such places. Build them, or line them, with connected iron, barb them all over the roof, connect them to the deep ground in many places, and I don't see what more can be done.

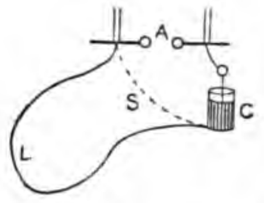
Experiments on Overflow of Jar.

Another way of making these electrical surgings more conspicuous is by their effect in causing a jar to overflow—i.e., to spark round its edge. The overflow of a common jar is, in fact, very much like a lightning flash, for it is a discharge direct between two coatings. That is just what a lightning flash is. There is ordinarily no conductor present except the two coatings—the clouds and the earth. I found a curious remark in Franklin* about the overflow or fracture of Leyden jars. He found that when one broke from overcharging, a great number went together; and also that the spark *in the ordinary circuit did not fail.* He was led by this observation to doubt if the breakage of the jar was really due to a discharge of the electricity through it, and he surmises that it may be due to a sudden expansion of air bubbles in the interior, suddenly relieved of the strain.

No doubt he is wrong there, but the observation of the facts is good and noteworthy. We will repeat the experiment. It is not necessary to burst the jars; overflow round the edge is just as good, and cheaper. The overflow experiment can be put into a variety of forms; perhaps it will be sufficient if I show the simplest.

Fig. 9 shows the arrangement. It consists in nothing but establishing the connection between the machine and one or both of the coatings of a jar, through a long wire instead of through a shor one as usual. If one connects the jar C by the dotted line, it does not overflow until the spark-length A is very great; but with a long lead L to make the connection, a very short spark at A will cause the jar to overflow or discharge round its edge.

Fig 9



Here are a few numbers. The jar is one of the gallon jars, with the glass fully 3in. above the tinfoil, so that, when it overflows, the spark has to strike along fully 6in. of glass. When L is the thick No. 1 copper circuit round the room the jar overflows every time an A spark occurs, even though the length of this A spark is only ·64in. Short-circuit out the long lead, as shown by the dotted line, and the jar refuses to overflow until the A spark-length has been increased to 1·7; and when it does overflow now the violence is very considerable. Remove short circuit again, and the jar overflows in ever so many places at once with great violence, a perfect cascade of flashes leaping round the edge. Bring the A knobs nearer together, and the overflow does not wholly cease till their distance apart is again ·62.

On another occasion one got, for the A spark-length sufficient to cause overflow of jar:—

·56 with the long lead.
1·7 with an ordinary short wire.

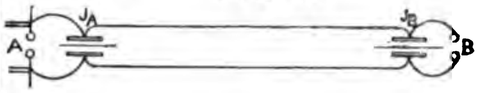
With a small pint jar, and a less height of glass above its coatings, I took the following readings:—Length of A spark sufficient to cause overflow—

·67 with iron wire round room.
·52 with copper „
1·40 with short circuit.

Fig. 10 shows very well, in a diagrammatic fashion, the effect of long leads in causing a jar to overflow, or of course to burst if the glass edges are too tall for the thickness and homogeneity of the glass to stand.

A are the machine terminals, B those of a discharger, and J_a and J_b are two jars connected up by fairly long leads. Now, of course, sparks may be obtained either at A or at B, one as easily as the other, and one of the jars is liable to overflow, but not both. It is the jar J_b which overflows when a spark occurs at A. It is the jar J_a which is made to overflow by a spark at B. It might be thought that if the B knobs were fairly near together, a spark at A might precipitate a spark at B instead of making J_b overflow; but it is not so. The event is not indeed impossible by any means if the B knobs are pretty near together; but it is easier for the jar to overflow by direct discharge between its coatings over a space of some 6in. than it is for it to discharge through the wire and rods of the discharger and an air-space of an inch or even less. It is not easy to help a jar to overflow by discharging tongs; even a foot of conducting wire is a great obstruction to the passage of the flash; it greatly prefers direct discharge through air unobstructed by the self-induction confinement of a conductor.

Fig 10



This is also illustrated by the extraordinary length of insulating surface which is found necessary in the Leyden jars supplied to Holtz and other such machines, and by the fact that such jars often flash even over a foot instead of through a few inches of air space led up to by the proper discharging knobs. Though indeed it must be noticed, as it was by Franklin, that the overflow of a jar by no means necessarily robs the proper circuit of its flash. The two things occur together. It is usually the spark which causes the overflow. Perhaps one may say that the case of discharge direct between coatings without any conductor accounts in some measure for the extraordinary length and unexpected paths of some lightning flashes.

These electrical oscillations and overflows, which it is thus easy to set up in a charged conductor, manifestly explain what is known as the "return stroke." I pointed out in Lecture 1 that the ordinary explanation of the return stroke, the recovery of electrical equilibrium disturbed by static induction, was by no means able to account for effects of the least violence; but this fact, that a discharge from any one point of a conductor may cause such a disturbance and surging as to precipitate a much longer flash from a distant part of it, at once accounts for any "return stroke" that has ever been observed.

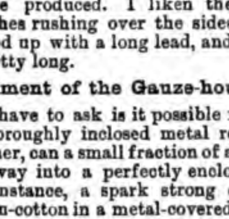
It is for this reason that I think it possible a tall chimney or other protuberance in one's neighbourhood may be a source of mild danger; inasmuch as if it is struck it may be the means of splashing out some more discharges to other smaller prominences, which otherwise were beyond striking distance. It is in this way, also, that I imagine multiple flashes, such as those referred to in Lecture 1, are produced. I liken them to the cascade of flashes rushing over the sides of a jar, when connected up with a long lead, and when the A spark is pretty long.

Experiment of the Gauze-house.

Finally, we have to ask is it possible for the interior of a thoroughly inclosed metal room to be struck; or rather, can a small fraction of a lightning flash find its way into a perfectly enclosed metal cavity; for instance, a spark strong enough to ignite some gun-cotton in a metal-covered magazine which might happen to be struck?

It is not easy, but it can be done; at least under such conditions as are likely to obtain in practice it can be done. My friend Mr. Chattock, to whom I am indebted for much kindly assistance and suggestion, has made the experiment in the form shown in Fig. 11.

Fig 11



A metal gauze cylinder, with tinplate ends, has a couple of conductors, one soldered to each end, protruding into the interior, so as to approach very near each other, and these are the conductors put into the path of the discharge. If both conductors are entirely inclosed in the metal chamber, we have not yet succeeded in getting a spark between them; but if either of them protrude any portion of their length outside the chamber then sparks in the chamber can be obtained.

In Fig. 11 the conductor N M B is shown thus protruding, penetrating the chamber through a small glass tube near M, but soldered to it near N.

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* "Franklin's Works," by Sparks, 1840, Vol. V. p. 475.

E F is a movable arm or radius, making contact with this conductor. If contact is made near M, it takes a very strong A spark to give any spark at B inside the gauze cylinder; but as the contact from F is shifted towards N it becomes very easy to get a small spark at B.

The application of this to powder magazines is that if any conductor (like a gas-pipe) pass out of the building before being thoroughly connected with its walls, it is possible for a spark to pass from something in the interior of the building to this conductor whenever a flash strikes the building. We thus find that the complete and certain protection of buildings from lightning is by no means so easy a matter as the older electricians thought it.

In many cases we may be content to fail of absolute security, and be satisfied with the probable safeguard of a common galvanised iron rod or rope. But for tall and important buildings, for isolated chimneys and steeples, and for powder magazines, where the very best arrangement is desirable, what is one to recommend? I prefer to call attention to principles rather than to advocate any particular nostrum; but inasmuch as my present opinion is not likely to carry any undue weight, there is no harm in my saying that I see nothing better than a number of lengths of common telegraph wire. I think a number of thin wires far preferable to a single thick one; and their capacity must be increased when possible by connecting up large metallic masses, such as lead roofs and the like. But the connection should be thorough, and made at many points, or sparks may result. Balconies, and other prominent and accessible places, should not be connected.

The earth should be deep enough to avoid damage to surface-soil, foundations, and gas and water mains. As to the roof, I would run barbed wire all round its eaves and ridges, so as to expose innumerable points, and the highest parts of the building must be specially protected; but I would run no rods up above the highest point of the building, so as to precipitate flashes which else might not occur, in search for a delusive area of protection which has no existence.

The conductors must not be so thin as to be melted or deflagrated by the flash; but really, melting is not a very likely occurrence, and even if it does occur, the house is still protected; the discharge is over by the time the wire has deflagrated. The objection to melting is twofold. First, the red-hot globules of molten metal, which after all are not usually very dangerous out of doors; and, secondly, the trouble of replacing the wire. I should be content to put up a great number of telegraph wire conductors, and wait till one is melted, before thinking too much of the likelihood of such an occurrence. The few instances ordinarily quoted of damage to lightning conductors by a flash do not turn out very impressive or alarming when analysed.

A NEW ELECTRIC REGULATOR.

AN ingenious electric regulator, which is so simple that any amateur can construct it, and that, too, at little expense, has been devised by Mr. C. Pollak. A few small pieces of wood, some brass, and four wires are all that is necessary for the construction of a regulator which, we hasten to say, in order to meet the objections of sceptics, will operate perfectly well, as we have assured ourselves at the laboratory of the Sorbonne, where several models constructed by the inventor have operated in a very satisfactory manner.

In addition to its great simplicity, this lamp has the advantage of being based upon an entirely new principle that of the expansion of the wires that lead the current to the carbons under the influence of the said current and its variations, the same part serving at the same time for the lighting or formation of the arc, and for regulation in measure as the carbons wear away.

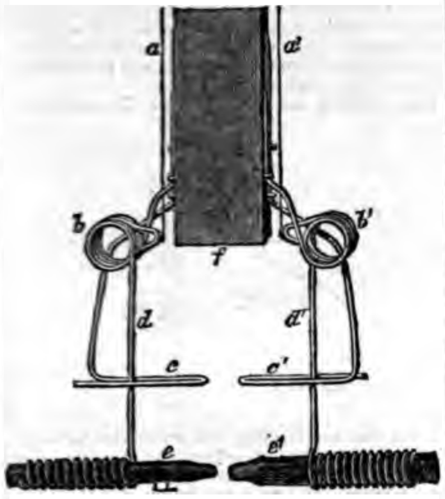
The accompanying figure shows the first of these apparatus that was constructed, and will easily allow the operation to be understood. Along a board f, about 6ft. in length, are stretched two brass wires a a', $\frac{1}{30}$in. in diameter. These are fixed at the upper part to the two terminals of the lamp, and kept taut below by the action of two double spiral springs b b'. These latter are formed of simple brass wire, and are fixed at the side of the board, and form in the centre a lateral appendage, to which is soldered the corresponding wire. At the other extremity they are prolonged by a straight portion d, and a spiral forming a carbon holder.

In order that the carbons may be always kept opposite each other, the displacement of the holders is guided by a bent wire, e e', affixed to the board. The length of the lever arm d, is about 1in., while the distance from the point of attachment of the wires a, to the centre of the spring is [illegible]in., so that the motions are amplified in the ratio of 1 to [illegible].

In a normal state, the distance of the carbon holders is about 1¼in. When the carbons are put in each is made to project 1¾in., so that the holders have to be spaced 2½in. apart, corresponding to an elongation of about ½in. of the wires a and a'. If, at this moment, the lamp be interposed in an electric circuit, the current will pass into these wires and heat them, and the springs being thereby bent back the carbons will tend to separate, and an arc will form. The length of the latter will be determined by the condition that the tensions of the springs and wires balance each other for the corresponding strength of the current, for, as the regulation is made in series and bears on the current, we ought naturally to group these lamps in derivation.

In measure as the carbons wear away, the resistance of the arc increases, the current diminishes, and the wires contract, allowing the springs to carry back the carbons. It is easy to see, and experiment shows it, that the current tends to diminish slowly in measure as the lamp burns. Such gradual diminution in luminous intensity offers scarcely any inconvenience in a lamp of this kind. With the divisions that we have indicated, the lamp will operate for about three hours.

We just gave the diameter of $\frac{1}{30}$in. for the regulating wires, and this is determined by the value of the current adopted, five ampères, and the condition that the temperature of the wire be relatively high (about 120°). If the temperature is too low, the regulation will be effected too slowly, and if it is too high the elasticity of the wire will be destroyed, and the latter will elongate permanently under the action of its spring.



The temperature of 120° has been calculated by means of the well-known formula—

$$d = \sqrt[3]{\frac{4 R i^2}{\pi^2 t h J}}$$

where t is the elevation of temperature, R the specific resistance, i the current, h the coefficient of regulation (0·0002), d the diameter of the wire, and J the mechanical equivalent of heat.

As may be seen, the length does not here figure explicitly, but it in fact determines the current. In order to keep the latter constant by diminishing the length it is necessary to increase by so much the proportion of amplification of the levers, and this has been done in a later model of smaller dimensions. If, with the same temperature, we desire to modify this current, it will suffice to shunt the regulating wires by properly calculated auxiliary resistances.

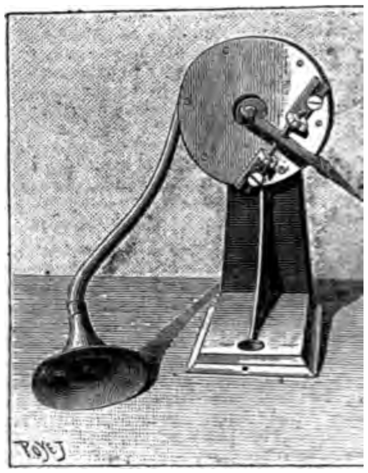
If the reader has grasped the operation of this lamp, he will at once see that the ambient temperature plays an important *rôle*, since it modifies the initial tension of the wires. To get free from this influence, which in certain cases would necessitate a different regulation for each temperature, it suffices to replace the wood by a frame of the same metal as the wires a. We shall simply state, by the way, that Mr. Pollak has likewise adapted his system to lamps regulatable in derivation, with vertical carbons, by making the regulating wire act upon a ring brake that allows the upper carbon to slide.—*La Lumiere Electrique.*

PHONOGRAMME AND THE GRAPHOPHONE.

I[illegible] the members of the Franklin Institute M. Emile Berliner lately delivered a very interesting lecture upon the results of experiments which he has been conducting, to solve the problem of writing and reproducing mechanically the human voice, and all sounds, musical or articulate. These researches are justified by the fact that, in spite of the enormous succes the phonograph obtained at the time of pearance, it never received practical appl in consequence of its numerous imperfectio

Mr. E. Berliner, before explaining his ow tigations, reviewed the preceding studies same object. He described the phonog Leon Scott (1857), the plan of M. Charle presented to the Academy of Science in 1887, which contains in a nutshell all th ciples applied to actual apparatus; and, la phonograph of Edison, who was the practically solve the problem towards the 1887. We shall omit the historical part, to apparatus well known to the reader

FIG. 1.

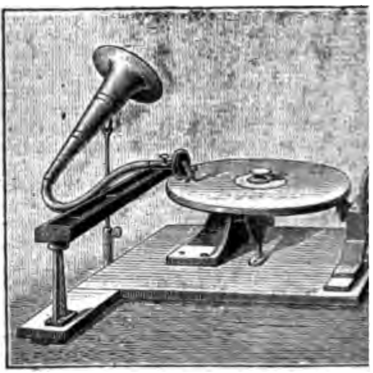


ENGLISH MECHANIC, in order to arrive new and important points of the communica Mr. Berliner.

Among those who believed in a practical for the phonograph was Gardiner G. H the well known patron of the telephone in A who in 1883 induced the Volta Laboratory devote a large sum for the experimental s the phonograph.

Amongst those engaged in these investi were Prof. G. Bell, Dr. Chichester, Dr. A. B C. S. Tainter, and after two years of arduou these experimentalists arrived at the fo conclusions: (1) The embossing point sho abandoned for a process of engraving—tha say, instead of pressing the registering

FIG. 2.

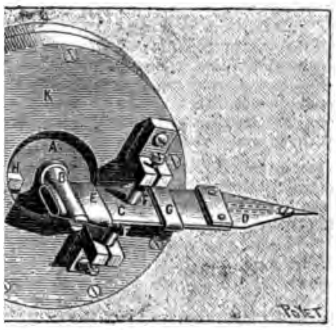


with a style, as in the original phonog outline should be produced parallel to the of inscription. (2) The best substance an all the requirements of the question ra engraving by means of the style, is hardened by paraffin or some other simil stance. (3) To speak in a high tone is unne the ordinary tone giving the best results, a the intensity of the sound produced does n that of the telephone. In 1886, Dr. Chi Dr. Bell, and C. S. Tainter took out a pat engraving the phonogram and for the use and, as a result of their labours, produced spring of 1887, the graphophone, the fir practical apparatus of the phonographic typ was exhibited at Washington. This ins reproduced the voice with the intensity o telephone; but the deformations due engraving were great enough to render t unrecognisable, unless the fancy was exerci one had a previous acquaintance with the The impression was obtained upon a ca

ered with wax. As soon as the grapho-
me known in America, Edison, en-
by the results obtained with this
, recommenced his experiments with
graph, and after having tried the
point anew, abandoned it for the
thus confirming the accuracy of the
of Messrs. Bell and Tainter. The
e and the new phonograph of Edison
n to be practically the same instrument,
ng in form and the nature of the motor

ulties which the embossing point pre-
ld disappear, as Prof. Thomson observed
urnal of the Franklin Institute of
88, if a surface could be found whose
to the embossing point was exactly pro-
to the depth of this embossing. Every
ned these conclusions, for the more one
speak loud the more indistinct becomes
tion. It is necessary, then, to trace the
as in the old phonautograph of Scott,
d not perpendicular to the sheet, and to
minimum the resistance offered by the
ngraved. Mr. Berliner observed that
was impracticable and insufficient, but
the greyish deposit of lampblack pro-
kerosine flame, gave a finer line than
ark deposit produced at the top of the
, and this observation led him to pre-
se the registering surface by applying
rinting ink or oil paint by the aid of a
rush. The smoke then gives a deposit
appearance, and of such a consistence
touched with a style a free line is pro-
out any blister, even when examined
roscope. The phonautogram obtained
hanically engraved chemically or photo-
After numerous attempts, Mr. Berliner

FIG. 3.



at a process by which a reproduction can
in less than an hour (even in 15 or 20
necessary), and which can afterwards be
indefinitely by the electrotyping pro-
M. Berliner calls the art of engraving
voice with aqua-fortis, and which we
imply phonogravure. The registering
(Fig. 3) consists of a case K, which
upport the whole. The centre of the
A carries a small brass cylinder B
t, and divided in front. E is a piece of
tube fitted into the division in B, and
the end of the stile C, which is formed
heet of metal vibrating on two steel
. D is a piece of writing-paper
d by a spring plate, the end of which
the tracing point. There is a piece of
tube placed round the stile to control
ns. H is a disc of felt placed between
the diaphragm and the diaphragm
ntrol the superfluous vibrations and
onance. The whole is placed upon a
t (Fig. 1).
ratus reproducing the words of the
g. 2) is constructed on the same plan,
aller dimensions and more rigid in the
rts. The end of the stile consists of
point, to avoid the wear caused by con-
ing with the metal.
etals give a more intense sound than
less resisting or elastic, as indiarubber
f Paris. The hard metals, such as cop-
or brass, speak louder than zinc; but
grinding unless the writing surface is
and polished with the greatest care.
ing is scarcely perceptible on polished
Mr. Berliner hopes, by moulding the
obtain an outline in relief which shall
sounds with a minimum of unneces-

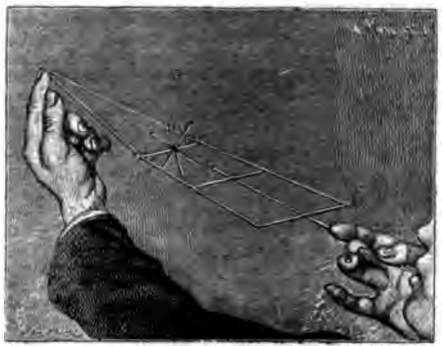
to the application of the graphophone,
r suggests that a number of speaking
hould be on sale identical in construc-
sy of manipulation, and that the pur-
hese should be able to procure an end-
n of phonograms, reproducing writings,
mental solos, orchestral pieces, &c.

There should be, moreover, in each important town, one phonograph at least, with every accessory for the production of phonograms. We shall then phonograph as we now photograph, and instead of sending friends our photograph we shall send a phonogram.

Let us hope that the future will see the complete solution of the problem, and that *autophones*—that is to say, devices which speak *themselves*—will be no more objects of curiosity than the Paris Exhibition of 1889.—*La Nature*.

SCIENTIFIC AMUSEMENTS: STRAW TOYS.

WE have explained, from time to time, how to make a number of toys with things of no value, such as old corks, matches, pins, &c. It is also possible to utilise for this purpose a number of articles usually thrown away—*e.g.*, eggshells, peach, apricot, and cherry stones, nutshells, &c., without forgetting the shells of mussels and snails, which furnish us with cups for water-wheels and turbines. This time it is of *straw* that we wish to speak, remembering that the material can be made into a number of toys and fancy articles, without alluding to its use for mending chairs, mat-making, for hats, baskets—in short, to the manufacture of the thousand and one small artistic trifles of natural straw, dyed or gilt (picture-frames, table-mats, &c., &c.).



Straw, which breaks so easily transversely, presents, on the contrary, a great resistance lengthwise. The problem which we propose to-day is this: to make with straw the little windmill represented in our illustration, only using a single stalk of straw, and without having recourse to any mode of joining—such as pins, gum, or thread.

Cut from the end of a stalk of *rye straw*, which is the most suitable, a length of about 16 centimètres (6¼in.), which will form the air-pipe. Then cut two pieces 7 centimètres (2¾in.) long, which split in 4 centimètres (1½in.) down; raise the parts thus cut perpendicularly, and these will form the wheel of the mill. Now cut a piece 72 centimètres (28¼in.) long, starting from the stoutest end, and bend it at intervals of 15, 25, and 55 centimètres (5·9in., 9·8in., and 21·6in.) from that end. You will thus obtain an isosceles triangle, the sides 30 centimètres (11·8in.), the base 10 centimètres (3·9in.) in length; fasten it by inserting 2 centimètres (0·7in.) of the thin end into the stout end.

The most slender end of the straw will furnish the two cross-pieces; one will serve as an axle for the wheel, which is fixed upon it by placing the two split parts which form the winglets, one against the other, making them (which are eight in number) alternate; the other cross-piece and the base of the triangle split with a penknife will support the air-pipe, through which you will blow to turn the little mill. The extremities of the two cross-pieces are to be fixed into the sides of the triangle by being cut and folded at right angles, the ends being inserted longitudinally in the sides.

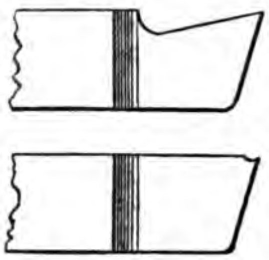
This very simple idea can be varied infinitely, and we shall be glad if some of our readers who are proficient in this kind of work will be good enough to send us designs or models of things of this kind, on the subject of which we may repeat the old motto—Materiam superat opus.

ARTHUR GOOD, in *La Nature*.

ABOUT CUTTING TOOLS—AN ITEM NOT ALWAYS THOUGHT OF.*

IF topics were apportioned in the mechanical journals according to their relative importance to the trade and the promotion of its successful practice, we should have more about the shape and use of cutting tools, even if we had a little less discussion and repetition of methods for computing change gears on the lathe, setting the slide valve, constructing upright drills, &c. I need not say that the shape, adjustment, and permanent maintenance of the condition of cutting tools is one of the most important things that can engage the attention of the practical machinist. It occurs to me to call attention to one point about which, so far as I know, little has been said; but which is of some importance and worthy of consideration. I mean the shape of the cutting tool as affecting the action of the chip after it is actually cut; the propriety of considering the chance the chip has to get away in the easiest and most natural course, and when not flowing away without resistance the reaction of this resistance upon the operation of cutting, and upon the condition of the surface cut. It may surprise the thoughtless, but all the same it does make a difference in the cutting, how, after the chip is cut, it gets away from the work. I mean to say that without the slightest alteration of the cutting edge of the tool by changing the shape back of the cutting edge, the action of the chip can be changed, the resistance it encounters can be increased or diminished perceptibly, the amount of power required to do the same cutting may be changed, also the condition of the surface cut and the endurance of the tool. I think I am backed in this by my experience and observation. Any machinist may try it by taking two cutting-off tools, alike in every particular except the one, and cutting in to a good depth on a clean piece of steel or wrought iron. Have the clearance the same on the sides of each, and have the tool set so that the clearance will be equal on both sides. Have the bevel of the front the same on both, and have the angle of the cutting edge the same; but let the top run back in a straight line on the one, and let it run into the detestable little circular groove on the other.

I have spoken before, once or twice in print, and one or two thousand times with my voice, about this contemptible little circular groove—never mentioning it without an adjective—which the impatient and thoughtless machinist is in the habit of grinding on the cutting face of a tool to give "cut" to the edge. The most prevalent and costly vice of the machine shop, the little bad habit with big and costly bad results, is the careless and ignorant grinding of tools, and the exasperating little round groove is the vilest manifestation of it. Whatever the metal to be cut, there is always a shape that is best for cutting it. It is the machinist's business to know the best shape, approximately at least. And it is his business not merely to know that best shape, but to insist upon having and using it. It is furthermore the machinist's business to maintain that shape right, as much as it is the carpenter's business to keep the shape of his tool right after successive grindings. Now, no one who grinds the execrable little circular groove at the cutting edge of the tool is either giving it the best shape for the present or arranging for a maintenance of that shape in the future. Take the two tools sketched here: one can be ground back ½in. and still be all right; but how can you grind the other back as it wears and maintain the cutting angle? It can be carried to the blacksmith half a dozen times, and then not accomplish what the other tool would do in competent hands. If I have apparently insinuated that laziness is the motive—though laziness is of course a brake instead of a motor—that leads a machinist to mutilate a tool by grinding the diabolical circular groove upon the face of it, I hereby retract and apologise. In many cases he not only does not know any better, but evidently actually believes there is virtue and magic, and all helpfulness, in this device of the evil one. How else can I account for the fact that not long ago I actually found a diamond point disfigured with this confounded little circular gutter at the cutting edge of it? I am confident that the poor simpleton who ground it—I don't know who it was—thought he was doing a glorious thing when he did it. It took a great deal more trouble than it would have taken to grind it in the legitimate way. One of the sterling virtues of the glorious and venerable old diamond point is that it insists upon having its cutting angle formed of three flat, or nearly flat, surfaces. It does not voluntarily lend itself to any nonsense in grinding. The prevalent vice in grinding the diamond point is in not grinding the faces uniformly all over, and thus maintaining the



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* By FRANK H. RICHARDS in *American Machinist*.

[illegible] SOCIETIES.

[illegible]

[illegible]

sheet, the ballot for the officers and council for the ensuing session took place, and the following were elected:—

President, T. G. Elger, F.R.A.S. Vice-Presidents: W. F. Denning, F.R.A.S.; J. Gill, F.R.A.S.; J. Hartnup, F.R.A.S.; Herbert Sadler, F.R.A.S. Editor and Librarian, J. H. Isaacs. Secretary, W. E. Rowlands. Treasurer, W. H. Davies, F.R.A.S. Council: T. W. Backhouse, F.R.A.S.; Miss F. Brown; T. W. Clarke; J. L. Coxon; W. H. Davies, jun.; J. E. Gore, F.R.A.S., M.R.I.A.; George Higgs; Major E. E. Markwick, F.R.A.S.; W. H. S. Monk, M.A., F.R.A.S.; Walter Sang; K. J. Tarrant; and Major H. Watson, F.R.A.S.

While the scrutineers were engaged in looking over the balloting papers, a short conversational discussion took place on Mr. Lockyer's meteoric theory of comets, in which Messrs. Sadler, Davies, and Gore took part. Some general conversation followed with reference to members' instruments.

On the motion of Mr. Herbert Sadler, and seconded and supported by Messrs. Isaacs, Rowlands, and Clarke, a special vote of thanks was unanimously and warmly accorded to Mr. W. H. Davies for his services to the society since its foundation.

Votes of thanks were then accorded to the retiring officers and council, to the scrutineers of the ballot, and to the presiding chairman, and the meeting broke up after a pleasant and most enjoyable evening.

USEFUL AND SCIENTIFIC NOTES.

Technical Instruction.—The *Chemical Trade Journal*, July 14, thus winds up an able article on this subject:—If technical instruction is needed let the public be told definitely of what our technical faults consist, and the means proposed to remedy the defects; but in the name of common sense do not submit to the thinking portion of the British community such an abortion as the Technical Instruction Bill now printed. Is it not a fact that many technical-instruction classes exist at the present time without finding students? and no doubt a Government grant would be a very acceptable windfall for many of those institutions which, in the absence of students' fees, cannot keep their heads above water.

Hygienic Exhibition at Ostend.—This pleasant Belgian watering-place is shortly to enhance its autumnal attractions by an International Exhibition of Hygiene on a very comprehensive scale. Already four hundred members are announced as prepared to take part in it. The Leopold Park has been chosen as the site of the exhibition buildings, and it will be illuminated with the electric light every evening. The opening ceremony will take place under the auspices of King Leopold II., with whom will also be present Queen Marie Henriette and the Princess Clementine. The Royal family indeed will, from the 1st week in July, transfer the Court to Ostend for the space of three months, and so the bathing season promises this year to be an exceptionally brilliant one.

"THE Solution of the Municipal Rapid Transit Problem" was the subject of a paper recently read before the American Institute of Electrical Engineers by Frank J. Sprague. The actual operation of street railroads by electricity is bringing to view the obstacles which are to be overcome, and the success already attained leads Mr. Sprague to believe that municipal rapid transit is to be solved by the adoption of some system of electrical propulsion. It is his opinion that the data and experience obtained in the operation of the Union Passenger Railway in Richmond, Va., proves that electricity meets all the requirements for traffic of that character, while the grades are heavier and the curves sharper than will be encountered in most American cities. The Richmond-road aggregates thirteen miles of track through nine miles of streets, and is operated from a central station, the power being derived from three 125 horse-power engines. The cost of running the cars is 1dol. 98 cents for operating and 1dol. 48 cents for station expenses—a total of 3dol. 46 cents per car per day or eighty-mile run. This does not include executive expenses, taxes, nor general charges of that character. The overhead system he considered the best and most economical, and, if properly constructed, has no objectionable features. For the operation of a similar surface railroad in New York City conductors could be advantageously suspended underneath the elevated railroad structure.

THE survey of the Nicaragua Interoceanic Canal is now practically completed. The line which will probably be adopted is substantially the same as that indicated by the preliminary reconnaissance made in 1885, the changes being slight. The actual amount of excavation required will be somewhat less than had been supposed, and in every respect the result of the survey was very satisfactory.

[illegible]

FIG 1

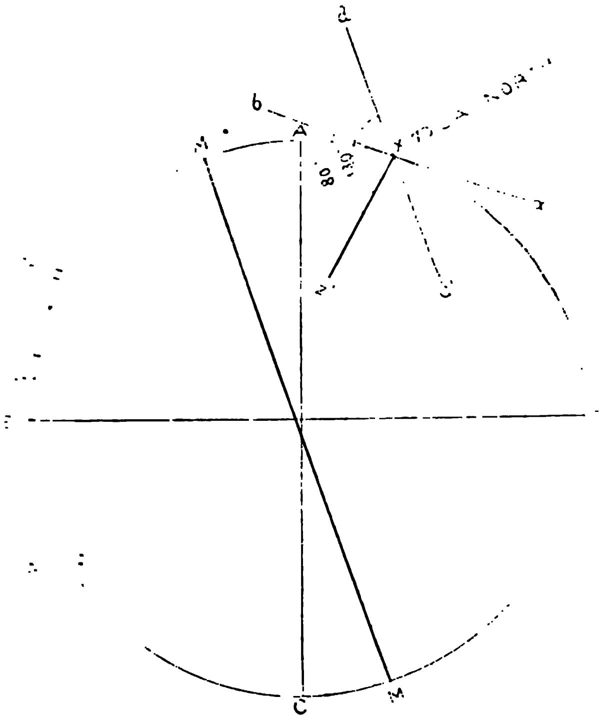
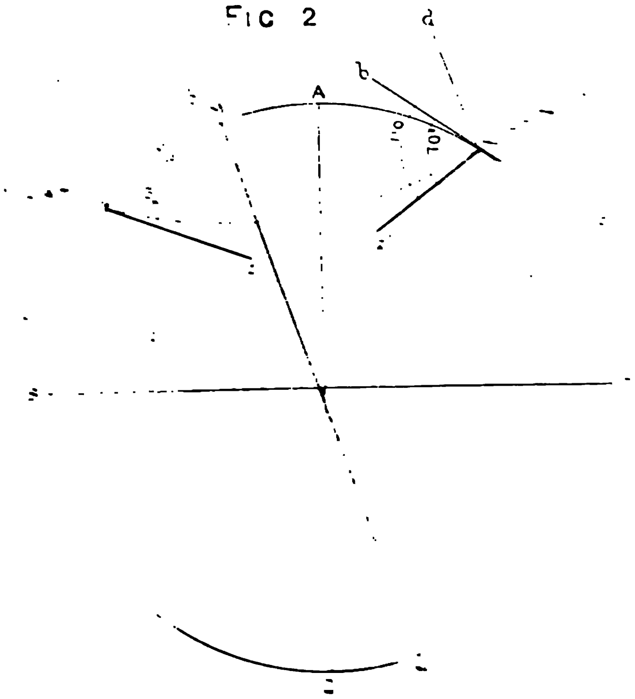


FIG 2



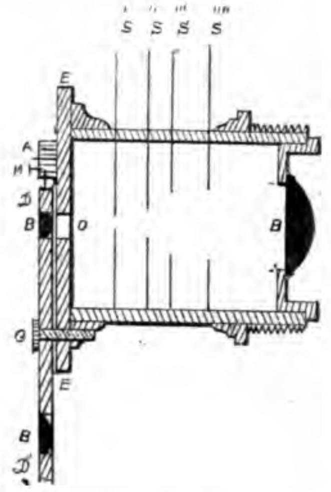
[illegible]

must be moved much nearer to the magnetic pole M before its "dip" will be equal to that of x, the other station. This would evidently make the curve of equal "dip" of 70° much nearer a circle than it is at present.

Of course, these diagrams are rough, and the angles are only approximate; but they are near enough to show what is meant. **R.**

ASTRONOMICAL EYEPIECES.

[29003.]—WILL your optical readers kindly criticise an eyepiece made on the same principle as is shown in the accompanying diagram?



It will be seen that it is made like the revolving disc in front of an ordinary astronomical eyepiece, in which four separate colours of glass are used for viewing the sun. In place of these coloured glasses I propose using lenses of varying focal lengths, so that a slight increase or decrease of power can be used at will, without having to go to the inconvenience of unscrewing and screwing on again higher powers, when an object under observation requires but a little additional power to satisfactorily convince the observer that his impressions are correct. The object may possibly have disappeared whilst unscrewing ordinary eyepieces and putting on another. Thus, a valuable note may be altogether lost. The idea sought is to minimise such a result, and to utilise valuable time to the greatest advantage.

I think the illustration will explain itself. D D is the disc in which are the lenses, and C is the centre on which it revolves. S′ S″ S‴ S⁗ are stops (diaphragms) at the focal distance of the lenses agreeing with them in the disc D D. The lenses are in section B B B. A is a spiral spring to which is attached a pin and milled head. The pin runs in a grove in the edge of D D, and drops into small punched holes whose centres exactly coincide with the optical axis of the lenses. The spring is inclosed in brass, which is screwed on to the face of E E as shown. To turn disc, lift milled head M and turn disc until the required lens is in front of the eyehole O. The pin will drop into the punched hole when the lens is in position. Set the proper stop and focus. It is desirable for the stops to be attached to eyepiece on hinges, so that they will easily drop into their grooves, which require cutting in eye-tube.

I hope I shall not be misunderstood. I do not propose that all the powers of a telescope should be included in this one eyepiece, but that these lenses on the movable disc D D are simply to build up the power from, say, 150 to a little over 200, without keeping a battery of eyepieces for this purpose. In fact, cannot each eyepiece be so made without seriously interfering with theoretical workings of the eyepiece?

26, Servia Mount, Leeds. **David Booth.**

"IN APOGEE."

[29004.]—IN the "Astronomical Notes" for last month it is said that "the sun is now in apogee—in other words, the earth is in that part of her orbit at which she is most distant from him If we assume the solar parallax to be 8·848″, an interval of 93,941,978 miles separates us from the mighty centre of our system."

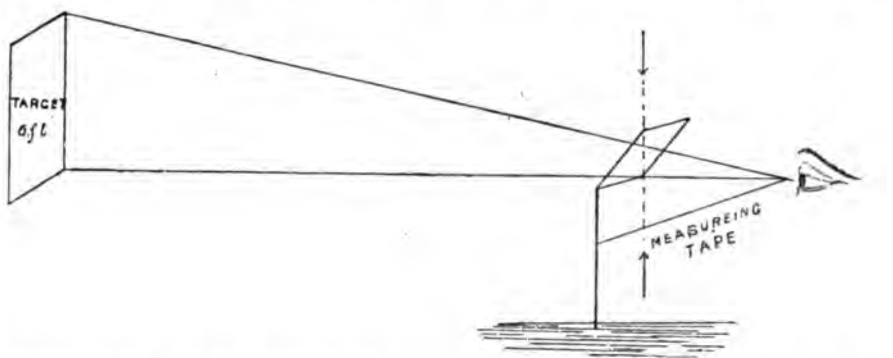
Will "F.R.A.S." kindly inform me how frequently, at a similar period of the year, the earth is at the above distance from the sun? Also, what is her minimum distance at such date? Has the exceedingly cold and cloudy weather experienced of late been occasioned, directly or indirectly, by the sun's position and that of the earth? Can any cause be assigned for the wretched weather we are having? Is it true that on every ninth year we may look for such weather, and, if so, why? I remember reading, many years ago, that the seasons change every three years—that is, that we have three mild winters, then three cold ones, and that the middle one of each three is particularly cold in the one case and hot in the other. I hope "A Fellow of the Royal Astronomical Society" will find time to enlighten me on this point.

A Cherub.

RANGE FINDER.

[29005.]—I SEND you a range finder for any military reader who likes to try it. I invented it about two years ago, and could get good results from it up to about 900 yards, that being as far as I had the chance of testing it. Being so cheap and simple, anyone can try it. Get a parallel strip of sheet zinc $\frac{1}{8}$in. wide, any length, attach this to a stick or anything handy, so that it may be about 4ft. from the ground. The strip must be horizontally fixed. The eye will find a place by going back from the strip where the strip and the object are in line with each other. Then put the tape to the eye, and the farther the object is from the eye the longer will be the measure from the stick to the eye. Commence on the 200 yards and go on to the 900; note the difference at each range, and make your own standard. **J. J. Rathbone.**

White Rock, Penygraig, Rhondda.



THE HAYDON CUTTER BAR.

[29006.]—I WISH to thank the several writers who have noticed my letter; but particularly Mr. Stevens, as the models would be of the greatest possible use to me.

I may supplement my letter of last week by saying that when I spoke of the *convenience* of the bar not being so great as I had been led to expect, I did not forget that it certainly has the great convenience of adjustment for height; but what I found its *inconvenience* was the difficulty of forming a tool for other than straightforward turning, say, facing up the end of a bar or a shoulder—i.e., the forming of a right or left tool. It can be done in some cases by turning the tool sideways; but often this cannot be done.

The angle of 120°, which is the one, I think, most recommended by "D. H. G.," only gives 30° for the slope of the cut, when each edge makes the same angle with the axis of the shaft. It is this angle which, I think, is too great—i.e., of too long a slope. When set with one side parallel, or nearly so, with the axis, the angle is 60°. But why so much at all?

I find no tool removes a shaving with less labour than an old saw-file, ground like a three-sided graver, of the angle of from 45° to 60°, using the *side* of the file which ends at the graver point. The same tool ground to a point like the bows of a boat, of which one edge forms the keel, and using the gunwale at the bows as cutting edges, is almost equally good, but not so simply formed. I use either of these hand tools nearly at right angles to the axis of work being turned.

The forming of a cutter to act in the same way and fit in the bar without turning it round at least 45° on the top plate of rest I have been unable successfully or satisfactorily to accomplish. I have certainly forged tools which will take a cut that my cutters will not look at without breaking, and they leave a surface quite as good as any cutter, while for a time—say a score or so of sharpenings—they will keep their correct height with little or no packing, and their convenience is incomparably greater than the cutters, each one of which has to be adjusted for height every time it is sharpened.

For screw-cutting $\frac{3}{16}$in. does not seem to give at all sufficient stiffness, as mine break at the sling if any catch-in occurs. Heavier steel would no doubt help to get over this. The great overhang of the bar no doubt has something to say to it, too.

When I said I could not get "D. H. G.'s" theory to work, I was not questioning its correctness, but only making known my own awkwardness or want of skill in forming these cutters to act on that theory. Mr. Haydon said, I think, the surface left by his tools, used with soapsuds, was so fine that a touch with emery would spoil it.

Well, if the feed is very fine, I can leave a good surface; but with a 90 feed, unless the cut is a mere scraping, I can form no tool to leave it such as he describes, and unless with chattering, I can leave no surface without ridges—slight ridges, it is true.

Speaking of the cut which I can take, I should have said it was on $1\frac{1}{8}$in. to $1\frac{1}{4}$in. iron, and without using the back gear, which, except for turning a face-plate or the full diameter the lathe will take, I very seldom use, as not only is the noise disagreeable, but I find it a frequent cause of broken tools, whether used for turning or drilling. If any catch occurs, the tool is bound to break, or else the work is shifted in the chuck, or on the saddle as the case may be.

Hence, for ordinary turning up to $1\frac{1}{8}$in., I never use the back gear, which on my lathe is certainly too slow for this diameter.

Quicker speed with lighter cuts I find removes as much material as the slower speed and heavier cut, for *which not many of our amateur lathes are suited*. I find, too, as far as the labour is concerned, it is as long as it is short. The *time* you have to tread the lathe for *one* cut will usually be four that for a cut without the back gear, and if you take four trips in this way to remove the same amount of material, it seems to me you are very nearly where you were; but there is this also—your tool and your lathe in the last case have not been taxed beyond their power. I keep my back gear for what without it I have not sufficient power for, or, if I have power, the speed might be too high.

Fredk. Carre.

[29007.]—AS "O. J. L.," in letter 28973, p. 434, appeals to me to say something, I will say this much—viz., that I use the bar with the tool of plan angle 120° in both the lathe and the planer, and never use any other tool for roughing; but do not use any of the fancy tools that I once sketched for the ENGLISH MECHANIC. I wrote a letter last week on the subject, but did not send it, as I thought it might prove as distasteful to Fred. Carre as it is to me to be asked for my "candid opinion" on any subject, as if I were too much addicted to beating about the bush—from which amiable idiosyncrasy I think the readers of the ENG. MECHANIC will perhaps pronounce me fairly free. Also, I was not directly addressed.

The success, or otherwise, that anyone is likely to achieve with this bar, or, in fact, with any other unless possessing the gift of tool grinding, is due to the method that is adopted for presenting the tool to the face (cylindrical) of the stone. When I first proposed to "D. H. G." to fix a solid horizontal block of wood on the frame of the grindstone, at such a height above the centre of the stone itself that all the under or outer facets of the tool would of necessity come away ground at an angle of about 4° from the perpendicular, he first said that it would not do at all, and then, on further consideration, said that it was the only thing up to that time wanting to make the theory a practical success. See Vol. XIV. p. 434, and there you will find what I then recommended as the way to go about it, and what I have used ever since. To avoid grinding away the sling of the cutter-bar, make the cutter protrude a little higher, and use a lower block accordingly on which to rest it; then for grinding the top facet, reverse the tool in the bar, being careful to have a solid support for the heel thereof, as it is very apt to cant forward from this position and to cut a groove in the stone, if you grind with the stone running *down* towards you, as I suppose is done by most people who use a solid support at all. A small gauge out of sheet steel with notches of 60°, 55°, 85°. 120° respectively on its four edges is useful, also a gauge for replacing the cutter at its c height after grinding. **J. K.**

LATHE MATTERS.

[29008.]—In reply to "F. A. M.," letter 28969, p. 433, if you want a screw tested, you must send screw and nut to a professional. I am not prepared to give the name of the one to whom I go, because, although he will test a screw for me as an old acquaintance, and, in a small way, a customer, I am by no means sure that he would do it for anybody. If you want simply a verification of any scale or measure or weight that you possess, you can have it tested, without charge or fee of any kind, at the office of the Board of Trade, Old Palace-yard, opposite the Great Tower of the Westminster Palace. As to limit of accuracy, I may mention that one of my standard test-bars was returned to me with the report that at 62° Fahr. it measures 11·999968in., and strangely enough, that the same measurement was brought out by the superintendent and his assistant on two different days in August last year, and that they agreed to the last decimal. I have just fitted to my working slide-rest a screw of 20 threads to an inch, with a micrometer wheel nearly 5in. diameter, divided into 250 parts, so as to give readings to 1-5,000in., and easily subdivided by eye to 1-10,000, as the divisions are about 17 to an inch, and abundantly coarse to split in halves again. I have also had two reading microscopes made to fix at any required distance asunder on a bar of wood, for testing the accuracy of various parts, say, any two or three inches of one part of a divided scale against any other scale or any other part of the same scale. Also for examining, in the same way, scales cut from the screw under examination, for each and every part of which investigation arrangements had to be made. The examination of a screw is a very difficult and tedious job. Mr. Wilkinson used to say that you might measure two screws against one another, and ten times you would say A was longer than B, and the eleventh time you would be convinced B is longer than A. So with bars. One of my 6in. bars (marked 1) was pronounced under the mark, and bar No. 2 about as much over. I have measured them fifty times, more or less, and always, except once, made 1 longer than 2; so also did a friend, who can command a measuring instrument of Whitworth's. And yet I saw my No. 2 measure the longer at the Board of Trade. I have come to the conclusion now, I hope finally, after trying all sorts of dodges for half a dozen years, that my leading screw, cut for me by Mr. Wilkinson, is about $\frac{1}{3500}$th of its length short, for about 3ft. of its middle, whilst not wishing to say too much about its first and its latter end. So I have rigged up a train of $\frac{4797}{4798}$ for the purpose of correcting that error in the screw that I mentioned above. Several years ago I used this identical proportion to mark inches on a round steel bar, that I have only recently had measured, with the result that the first 6in. are ·0015in. short, the first 12in. "good," the first 18in. good, and the whole 24in. ·0002in. short.

J. K. P.

[29009.]—I see I was mistaken in understanding that "J. K. P." had commended the internal back gear, and I thank him and "F. C." for correcting me. What do these friends say of the Jewsbury gear? The inventor tells me that the eccentric pinion can easily be balanced, and that there is no noise or jarring heard when the gearing is running as if all in one piece, at the quick speed, such as I supposed might occur. The great advantage of this gear seems to be that, owing to pinion and internal wheel being so nearly of the same size, the wheels work with perfect
sm[illegible] any rattle as in the usual
each other at an angle
observations be of any valu[illegible] tried screw-
in showing the comparative ma[illegible] chucks
these two positions on the earth's s[illegible] im-
horizontal lines from which the measure[illegible]
made, themselves "dip," or incline at di[illegible]chucks at the same time; then divide with a parter
angles towards the magnetic axis (as will b[illegible] the lid is to come off; then rough out both
readily seen from the diagram), for while at x,
the geogr. equator, the line $a\ b$ inclines to the
[illegible] M M' (magnetic axis) about 20° only, at
[illegible] (x'), the line $a'\ b'$ (which represents
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use, probably such bars as Tangye's, or any other requiring but one face of the cutter to be ground, will always be the more popular, although not equal to Haydon's in range of work. The Haydon bar will hold short bits of gouge and round steel, as well as square. Let it always be remembered that in this bar the clearance of 3° alludes to the side faces of the cutter, and not to the front line formed by their meeting. A mistake is often made in this matter.

O. J. L.

[29011.]—Has any reader practical acquaintance with a lathe worked like a bicycle—i.e., with a double crank and an adjustable seat, and also with gearing to the flywheel for fast and slow motion? A son of mine in San Antonio has sent me one of the catalogues of Barnes and Co., of the U.S.—Philadelphia, I think—but I've lent the book and cannot refer to it; and all the lathes, whether screw-cutting or plain, are so made. For fine work, in which a steady hand is needed, I quite incline to the arrangement, for the motion being continuous, is very smooth, and free from jerk; and the power being applied twice in each revolution of the flywheel ought also to be advantageous. The seat shifts sideways at pleasure. For hand turning the plan appears decidedly promising.

Double Edges.—I have looked up "D. H. G.'s" notebook, but all details have been given before. There is, in fact, no great mystery in the double-edge system. A shaving has to be separated in two directions, and it must be either cut in one and torn off in the other—which is not good work, or it must be cut in both directions, which of necessity needs two edges; a point tool or diamond point has two edges, but if it is put end on, it evidently takes out a shaving of triangular section, and leaves the groove it came out of. But give it a wide angle and set it round so that one edge lies nearly parallel to the work, and while the other, which is to be made the leading edge, cuts the shaving from off the shoulder, the second edge acts almost like a turner's chisel, and separates the shaving from the cylinder, leaving the latter smooth, which is the object of turning it. Unquestionably the principle is correct, and the object of the Haydon bar was to facilitate the practice; but a solid tool may be used if preferred without sacrificing the principle. The second edge, if lubrication is used, leaves the work as polished as a looking-glass. No filing or emery is ever needed after the cut has been taken. Of course, uniform feed and perfect rigidity of the tool is needed, as it always is for best work. Practically it will be found that accurate placing of the tool as to position and height of centre is of more importance than grinding to a precise angle. The edge for wrought iron will do well enough from 55 to 60 or 62, but a very minute change in position will affect the cutting. Care, however, in this respect will meet its due reward, for I need hardly tell a turner of the real pleasure afforded by seeing a tool working perfectly, and a shaving curling away bright and uniform, as only a keen tool well directed can make it.

O. J. L.

"EXTRACTS FROM BERGERON": TO MAKE A PLAIN BOX.

[29012.]—The extracts are no doubt instructive in many respects to many beginners; but I would suggest, Mr. Editor, through you to "O. J L." that he should not spread abroad the defects in Bergeron's book.

In giving instructions as to the lid, which he truly describes as to be made out of the same piece of wood (or ivory) as the bottom part, he gives such instructions as will insure the grain of the wood not fitting when the wood of the lid is reversed. For pillboxes and very common work this is not of consequence; but the instructions are the same for fancy boxes. My rule is to chuck the wood in two
body on their own chucks; then cut off the
steash outside of the top and body together.
been t[illegible]n runs right save the depth of the
then th[illegible]. **"The Brae."**
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been gradually but considerably increased; but the speeds of Scotch trains remained practically unaltered. Therefore it will be seen that to a considerable extent the increase has been made by booking the Scotch traffic at a pace equal to that of the Manchester or Leeds expresses; and even at the present time a Manchester express—the Great Northern 4.18 from Grantham to King's Cross—holds its position as the fastest train in the kingdom, with an average of 54 miles an hour.

If further acceleration be necessary in the Scotch competition, doubtless some stops will be taken off. When trains of passengers are ready to start from London for Scotland by either or all of the three routes, it is useless to occupy time by stopping at a number of stations.

It is a well-known fact that if high speed and punctuality is to be attained, it must be by long runs between stations. When a train arrives at its destination "late," it will almost invariably be found that time has been lost at stations, and not by the engine in running; hence the somewhat generally-accepted theory that the chances of punctuality decrease in a ratio dependent upon the number of stops.

Several of the newspapers commenting upon the recent acclerations have fallen into serious errors with regard to the "distances," consequently their estimate of speed has been incorrect.

The facts appear to be as follows:—

LONDON TO EDINBURGH.

Miles.	Route.	Train.	Time on journey.
392½	East Coast	10 a.m.	8 hours 30 min.
400¼	West Coast	10 a.m.	9 hours.
*412¾	Midland ...	10.40 a.m.	9 hours 50 min.

* Note.—The Midland train runs viâ Nottingham and Leeds, thus increasing the distance by 6 miles 68 chains.

LONDON TO GLASGOW.

Miles.	Route.	Train.	Time on journey.
401½	West Coast	10 a.m.	9 hours.
423	Midland ...	10.30 a.m.	9 hours 20 min.
439¾	East Coast	10 a.m.	9 hours 50 min.

LONDON TO MANCHESTER.

Distance.	Route.	Fastest Time.
183¼	L. and N.W.	4 hours 15 min.
*190½	Midland	
203	Great Northern	

* Note.—The Midland 2 p.m. express from St. Pancras runs viâ Nottingham, a distance of 197¼ miles in 4 hours 20 minutes.

Clement E. Stretton,
Consulting Engineer, Associated Society
of Enginemen and Firemen.
Leicester, July 16.

RAILWAYS AND ACCIDENTS.

[29014.]—I have just been shown a model of a railway carriage and section of line in which there is placed a self-acting arrangement of levers, which, on the passing of a train through what are well known as "points," gives a series of blows upon a gong in substitution for explosive fog signals now in use.

My present object in calling attention to this is not so much the importance of the invention (although that appears to be a most valuable application of science), as to put forward the apparent paradox on which its successful action is founded, "that the periphery of a rolling wheel has no motion at the point of contact with the rail on which it runs."

Possibly some of our railway engineering readers will discuss this, and show its truth or fallacy.

Senex.

OBJECT-GLASS MATTERS.

[29015.]—My last letter on this subject seems to assign to rule of thumb and practical skill a greater share than "Orderic Vital" appears to approve of, for he insists again on the importance of calculating the curves and knowing the densities of the glasses. I quite see the importance of these two vital points. My rule-of-thumb worker does not neglect them, but he works them out in a different way. He knows that the curves, as well as the densities of the metals he employs, are expressed in the *image* of the lens.

Dense or heavy flint produces greater refraction and shorter foci; light crown just the opposite, and that is enough for him. By dint of practice he has learnt that with the glass he uses a flint lens of a certain focus (resulting from certain unknown curves) coupled to a crown lens of a certain other focus, results in a colourless compound lens of good definition, and feels confident that by working to the same foci, the result will nearly always be the same. When a fresh supply of glass is required, he will naturally ask for the same kind as he has had before; but will he get it? Probably not, unless it came from actually the same fount as his last. To produce exactly identical glass at different times is beyond the present technical skill—or at all events, beyond the commercial interest of the glass-founder. For, were he even to employ absolutely pure ingredients, the result will be uncertain, for he would still have to contend with their crystalisation, which depends so much on rest, temperature, and draughts. In saying this I am not forgetful of the lately-achieved German improvements in this direction. There are as yet many processes in nature that baffle our methods of control. Every fresh supply of glass entails on the practical optician fresh trials and adjustments of foci, or, as the theoretical man would say, the calculation of new curves suitable to the altered densities and dispersions of the materials,—both tedious operations, and in nine cases out of ten, beyond the worker's power. Instrument-makers will provide us with calipers, spherometers, and other gauges of great precision, indicating differences of a 1-20,000 and less of an inch; but these are but rough tests compared with the optical ones at command. The image thrown is the object which affords to the worker the safest guidance. The figure, the depth of focus, and the colour will tell him whether his corrections are right, over or under the mark, and not the formulæ of the mathematician. All they can do is to point out where he is wrong, and in what direction he must carry his mending touches. Theory, after all, is little more than the generalisation of a perfect practice. Most improvements must start from the study of the image with the naked eye, and armed with means of amplification. When it is considered what goes on in that place of meeting of so many thousands of light-waves, how they wrestle, overlay, and extinguish each other there, one must wonder at the results already achieved, and be prepared for many wonders yet to come.

A. Caplatzi.

ORGANS:

[29016.]—IF "A. W. M. B." (letter 28957), in the concluding sentence, means that the blowing of organs by an electric motor "opens a further field for the enterprise of the modern organ-builder," I have much pleasure in saying that this has been accomplished with the most satisfactory result. I replaced one of Joy's water motors with an electric one, and its performance is all that can be desired. The organ is a large three-manual one, and is used every day in the week as well as for three services on Sunday. It is noiseless, instantaneous in action, and always ready. **J. E. M.**

THE BOEHM FLUTE.

[29017.]—I VENTURE to differ most emphatically from "Vulcanite" in his estimation of the various qualities of wood, ebonite, and silver as a material for flutes. My opinion is based upon a personal experience of 25 years as a flautist, and does not depend upon hearsay. I maintain that the silver flute is easier to sound than vulcanite, and vulcanite than wood; the silver does not need so firm a lip as the other materials, and is thus best suited to those who do not play regularly. Let any beginner on the flute try to sound the lower C and C sharp on three flutes constructed of the three materials. He will probably succeed with the silver, and fail with the ebonite and cocus-wood. Even if he succeeds with all three, he will get a better tone from the silver. When, however, his "lip" is perfect through long practice, the result, as far as tone is concerned, will be very probably reversed. **Sm.**

WHAT IS INFINITY?

[29018.]—IN modern geometry there is one assumed principle which I certainly believe to be a false doctrine leading to erroneous conclusions of a remarkable kind. I refer to the fact that infinity in the abstract is now often treated like any finite and commensurate quantity, and this application of such an intangible and even inconceivable subject has led to a number of false conclusions which in themselves are obvious absurdities or admitted paradoxes, but which are nevertheless regarded as real mathematical truths. I may refer for examples to Townsend's "Modern Geometry," which is one of the class-books in the Dublin University. In the earlier portion of the first volume the author proceeds to demonstrate that every system of parallel lines is a system of lines passing through a common point at infinity, and he declares that "Euclid's" definition of parallel lines, those, viz., "which, lying in the same plane, never meet, though indefinitely produced," might easily be modified so as to express "the preceding most important, and, indeed, fundamental, property of such lines" by the simple substitution of the words "until infinitely" for "though indefinitely." But what sense or meaning could there possibly be in the idea enunciated in this proposition? Infinity can only be regarded in a relative and not in an absolute sense. We can well understand the meaning of the arc and the asymptote of an hyperbola meeting at an infinite distance from the vertex—i.e., that the two lines approach nearer and nearer until at length the distance between them is less than any assignable distance. But let two parallel lines be imagined to be extended the most immense distance conceivable, and yet they won't have approached each other in the slightest degree. The idea of their meeting at infinity is therefore an abstraction without any real sense or meaning whatever, and a senseless form of idea of this kind is no idea at all. No wonder, therefore, that we should have paradoxes and paradoxes in modern mathematics when we have propositions that have no meaning whatever. With regard to Clifford's notion of returning to the starting-point after an infinite journey in a straight line, its demonstration involves infinity in the abstract, and his idea is only an absurd combination of the abstract and concrete leading to a preposterous result. Curiously enough, as if the discussion on four-dimensional space had aroused interest in the matter, I perceive that the *Bookseller* for July announces among the mathematical publications of the month, "Another World, or the Fourth Dimension," by A. T. Schofield, published by Sonnenschein. This is a book which I have not seen; but in any case I could not believe that living creatures could exist in any kind of space except space of three dimensions. **H. T. R.**

NO MORE DEATH.

[29019.]—ALLOW me to ask "M. R." (28992) what, in his opinion, causes the death of a mayfly at the end of the day, of a dog in about 18 years, of a horse in about 35 years, &c.? As to death from old age never occurring, he might as well say that decayed trees or buildings never fall from decay, but are always blown or pushed down. Each grows so weak that at last something happens which ends it; but the real cause is internal decay.

M.

[29020.]—"W. A. W." seems to suppose that the decay of nature is owing to the one cause—that the skin does not properly perform its function of eliminating superfluous matter from the system. The animal body certainly is always making efforts to do this, and if one organ is deficient in doing so, it endeavours to do it by some other. Thus, if the skin is out of order, and shirks its duty, its office, if performed at all, must be done by some other organ, upon which unnatural work is then thrown; the consequence of which must be that it will be prematurely worn out, or become diseased, or something of the kind—all of which tend to reduce longevity; and so he rightly suggests that one means at least of attaining longevity is by keeping the skin in good order. But will not this be better effected by diluted soap than by diluted acid, according to the valuable suggestion of "Doctor of Medicine"? **W. G. P.**

PANCRATIC EYEPIECES—TO MR. PENNY AND OTHERS.

[29021.]—AS Mr. Penny has been dealing with the ordinary eyepiece, I hops he will give us an investigation of the properties of the "pancratics," more especially of the arrangements of "A. J. S." (described in the "E.M." a few years since), and of Dr. Kitchener, as formerly made by Dollond.

Through the courtesy of one of our correspondents I have had the opportunity of trying the latter (which are become very rare) in comparison with that of "A. J. S.," and with the ordinary Huyghenians. The instrument used was a 4in. Wray, of which the well-known reduction of the secondary spectrum to a minimum gave an excellent opportunity for observihg any chromatic defects in the eyepieces.

The "A. J. S." eyepiece gives powers from 120 to 250 on a 5ft. focus, while the Kitchener gives powers from 50 to 200 by the graduations; but there is nothing to indicate the focal length to which these numbers refer. In his own reference to them (p. 204, Vol. II., "Economy of the Eyes") the doctor describes *two* patterns, one giving 400 and the other 200 on an achromatic of 44in. focus; so I think we may take 44in. as the standard. As the "Wray" is 60in. focus, the powers are raised nearly 50 per cent., which, of course, tells against the eyepiece when pushed to the extreme, and this I found to become evident in the shape of a considerable amount of colouration. When, however, the magnification was not in excess of the 200, that is when the tubes were only drawn out to such an extent as to give this power on the 5ft. focus, the image was remarkably good—quite equal, I should say, to that given by an ordinary equivalent Hughenian. With tubes fully extended giving about 270 diameters, colour became very decided; but up to, say, 250 there was little to find fault with. This power of 250 is also the extreme of the "A. J. S." eyepiece, up to which it is practically free from obtrusive aberration. There is, however, this noteworthy difference: that whereas the fully extended "Kitchener" is some 13in. long, the "A. J. S." is less than half that length.

I should add that though I take (for the reasons stated) the standard focus at 44in., the owner of the eyepiece puts it at some inches less, which would correspondingly increase the powers on the "Wray." I tried to measure the eyepiece by Mr. Berthon's method, but could not satisfy myself that my results were sufficiently trustworthy to set against what I have already given.

It is to me a rather puzzling thing that the two pairs of lenses of which the Kitchener is composed should admit of such a great variation in distance apart without materially affecting the correction, and it is this point to which I would specially direct Mr. Penny's attention. Kitchener nowhere gives the optical details; but the following are my notes of the foci of the lenses, taken, if I remember right, from a book by Dr. Dick:—

"Full length 14·4in., shut up 5·5, and power is then 100 on a 3½ft. telescope, and each division is $\frac{1}{10}$in. [These dimensions probably refer to the pattern that gave 400 diameters as a maximum, as they are different to those of the one I refer to.]

"Focus of first lens next o.g. 1in., plane side next o.g.; focus of second lens 1·5in. double (equal) convex; distance apart, 1·7in.; focus of third lens, 1·1, with plane side next eye; focus of eye-lens, 0·6in., plane side next eye; distance apart, 1·1in."

In this the lenses, with one exception, are all plano-convex; but in the one I have been trying I found some of them were slightly concave on one side.

Some time ago I asked readers of the "E. M." to tell me how to *accurately* measure the foci of these small lenses, as I wished to test Dr. Dick's figures; but my request was unheeded by those who could have helped me. It would be of interest if some one with keener sight than I now have, and with more perfect means of measuring and testing, would make a systematic comparison of various e.p.'s, pancratic and ordinary, and give us the results. **A. S. L.**

SUFFERING WITCHES TO LIVE.

[29022.]—"A JANSENIST" (p. 437) accuses the Bible of causing immense numbers to be executed as witches, and if he could find evidence of any such execution in Israel, or any in Christendom, say, in Constantine's time or the next few centuries, when Christians had most power, he might have some ground for this. But how comes it that nobody discovered witches ought to be put to death till about Joan of Arc's time? No book can fairly be taxed with ordering what people only began to deduce from a translation of it after all those centuries.

The true sense of the command quoted was doubtless taken, in all early times, as modern Jews expound it: "Thou shalt cause none to live by sorcery," or "Let none make a living by spiritualism" (real or pretended). Wherever the Pentateuch ordered putting offenders to death—and it knew of but six capital crimes, immensely fewer than the English law of the Queen's grandfather's time, the bloodiest that probably ever existed on earth—it distinctly said Put them to death, and no such phrase as this, "Shalt not suffer to live." It is, rather, "Shalt not cause to earn a living." The prohibition, which was by no means political, but adopted by the New Testament, and as binding on us as on Hebrews, is against all trading in mediumship; and everyone who paid the late Daniel Home was guilty of transgressing it. Even Saul, we may observe, went to the woman of Endor with no intent of trading with her, for instead of paying, he was at last induced to accept her hospitality. And his previous banishing of all her trade was parallel to our Puritan Parliaments closing the country to Romish Sacrament-makers, who are, in the Biblical sense, a class of "wizards" or pretenders to magic, and it was rightly held that whoever desired their sacraments should have to go abroad for them. If this was not to 19th-century taste, I certainly hold it Biblical. But as for causing the witch-killings, "A Jansenist" might as well quote the command to "Preach the Gospel to every creature, baptising them," &c., and then say "Behold the consequence," that the population of Russia and all Greek orthodox countries is now kept down by the multitudes of weakly infants succumbing to cold-water immersion, and if we had been of that church it had cost us Sir Isaac Newton and many another life of value. **E. L. G.**

WORDS AND THEIR ORIGIN.

[29023.]—"ADAM," as we write it, and often name our children, is a word of the old Arabic language, spelled *Udm*, and pronounced so; its sole meaning, "Man," *Homo*, or "human being." Thence it found a place in the polite Persian (full of Arabic words), *Udm-Khor*, "man-eater" (or cannibal). A popular vulnerary weed of the *Salvia* species is called *Ján-i-Udm*, or the "Life of Man." In modern Hindoostanee (a compound language derived from the intercommunication of many nations), *Admee* means either man or woman, and as such is used in conversation. The scholarship of centuries ago must have been of a very poor order, judging from the remarkable blunders made in the translation of the Hebrew books into English, and of the Greek Testament also. I thought modern learning would have corrected the latter; but I and many others have been rather disappointed with the labours of the divines and professors—to me it seems they halted half-way from theological objections. I know enough of Greek to say so! **Eos.**

SOME LITTLE-KNOWN PLANTS OF THE "FLORA MEDICA."

[29024.]—MYRTACEÆ.—The prevailing principle in this important order consists of volatile oil, the most valuable being that extracted from Melaleuca Cajeputi (cajeput tree) of Banda, Java, and Amboyna, whence it is exported in small quantities to India, commanding a high price.

I have occasionally met with a fine healthy tree in the southern parts of Hindostan, and was surprised to learn that it was not largely propagated, for I found the leaves full of the fragrant oil. The oil of commerce is very fluid, light, transparent, of a very beautiful green colour, very volatile and inflammable; its odour resembles that of camphor, but is more pungent and penetrating. It is sometimes adulterated with camphor dissolved in other volatile oils; but the fraud is detected by mixing the suspected oil with sugar and water, on which the camphor immediately separates in the solid form. The green colour has been erroneously attributed to the presence of copper, proceeding from bottles in which it was asserted to be sent from Banda to Europe. These statements have, however, been entirely controverted. Though copper may be accidentally present in some specimens, it does not exist in others of equally green colour.

Cajeput oil, in doses of from one to three or five drops mixed with water and sugar, has been much used as a stomachic stimulant, especially during the prevalence of cholera epidemics. It is employed in spasmodic pains attributed to the stomach, and in flatulence not dependent on an inflammatory state. In malignant cholera it has been much given, but with very doubtful advantage. Externally it forms a very valuable stimulating liniment and embrocation, useful in rheumatism, paralysis, neuralgia, and similar affections. To my own personal knowledge it has given great relief to inflamed joints. **Eos.**

TWISTED TREES.—TO "H. A. G."

[29025.]—HAVING seen your letter (28522), I have examined the wood out here (we use a great deal for fires), and find that when twisted it has a right-hand twist, like an ordinary screw. I have not seen one here with a left-hand twist, but am shortly going up in the bush, and will examine.

Christchurch, N.Z. **H. P.**

Importation of Dirty Grain.—The acres of the British farmer have long ceased to yield a corn supply sufficient for the national requirements. Imports of foreign grain, therefore, however undesired by home growers, are advantageous to the population generally, provided of course that their quality can be guaranteed. The fulfilment of this all-important condition unfortunately cannot always be relied upon, and the cheap loaf, that valued memorial of free trade, is consequently a somewhat discounted benefit. By way of illustration we need only refer to a recent report by Miss Ormerod at a meeting of the Royal Agricultural Society. The observations contained in this paper go to show that the cleanliness of foreign grain occasionally leaves much to be desired, and that some cargoes of corn are almost alive with weevils. The effect of this potent though apparently insignificant pest is well known. The question of its eradication is as much one of profit as of taste, since the grain which it has inhabited and reduced to a mere husk is obviously of no market value. The presence of a few of the insects in a relatively large bulk of corn is doubtless of no great moment, and it is not easily avoidable; but a cargo populated by them is for the luckless buyer and the consumer a more serious consideration. We are no advocates for trade protection, but we must contend for a reasonable degree of official oversight on behalf of the public health and food supply of the country. In the case of goods so obviously faulty as the grain above mentioned the tax of confiscation is not unduly heavy, and it should, if occasionally exacted, act as an effectual check upon the culpable carelessness of exporters.—*Lancet.*

REPLIES TO QUERIES.

**** In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[65405.]—**Twist Drills.**—Querist can get bit stock drills with square shank from $\frac{1}{16}$ to $\frac{1}{2}$in., at Melhuish, Fetter-lane, London. They will fit your brace nicely. E. J. ALFORD.

[65473.]—**Survival.**—Not possessing Darwin's work, and not having time nor inclination to resort to a public library to examine it, I must decline acceding to "F.R.A.S.'s" request for quotations, for which, indeed, it is not very logical to ask, as my contention is that Darwin's theory involves a great deal more than he himself was aware of. "F.R.A.S." must admit that Darwin suggested (unlike most of his followers, who positively assert) that man was originally an improved specimen of an inferior animal, and that that specimen of animal was originally an improved species of an animal inferior to it, and so on almost *ad infinitum*; and that this improvement of breed was possible because "the fittest" of the several races survived. The inferior races, of course, may perish, or, if surviving, remain pretty much as they were, barring the part of it that has been "improved." If Darwin did not think that the evolution or creation of the higher races was, on the whole, a raising of the world in the scale of existence, I pity him. I may observe that there is no presumption in criticising Darwin's use of the superlative word "fittest" (a point my critic avoids), as he himself states that, as a student of languages, he was a very dolt. His constant employment of "might have been" always reminds me of the American story: "Might your name be John Thompkins?" "It might be John Thompkins, but it ain't by a very long chalk." B.

[65497.] — **Self-steering Perambulators.**— What is meant by the "numerous types" of the above? In what way are they self-steering? J. L. P.

[65498.]—**Rainfall.**—I do not think there is any useful formula for calculating the evaporation or absorption of rainfall. As far as absorption is concerned it obviously must depend on the character of the soil and subsoil, on the condition of the surface, and also on the contour of the land. For evaporation, Nystrom gives inches of rainfall multiplied by 3,630 = cubic feet per acre; but clearly it must depend on conditions. PLUVIAL.

[65533.]—**Incubator.**—There should be no difficulty about this matter. If the > shaped form is adopted, the tank may surround half of it; but of course the bottom board need not slant and might lie on top of tank. The upper board, lined with sheepskin with the wool on, will keep the chicks as warm as they need be. GALLUS.

[65538.]—**Heating Surface.**—How can the relative values be found mathematically without experiment has first been made to obtain the requisite data. If the horizontal surface above flame is taken as unity vertical surfaces may be reckoned as half. See Molesworth. S. M. P.

[65539.]—**String Telephones.**—I think the descriptions required might be found in the *Transactions* of the Royal Society, and probably also in back volumes of the *Mechanics' Magazine.* All sorts of diaphragms were used—e.g., cardboard pill-boxes and chip boxes. J. T.

[65545.] — **Japanning Zinc.** — Japanning is understood to include stoving. For directions see an article in No. 860, and look in the indices. A suitable oven was illustrated in p. 174 this volume. NUN. DOR.

[65549.]—**Regilding.**—Full description of the method of regilding picture-frames in No. 870; but if querist has never done any work of the kind, it is better to give it to those in the trade, especially if the gilding is to be done with real gold, and the frames have much moulding and undercut work in them. J. T. M.

[65552.]—**Antimony.**—I don't think there is any easy way of separating antimony from type or stereo metal. M. A.

[65597.]—**Bolts.**—A 3in. bolt is 3in. long from underside of head to point. In ordering bolts from either maker or vendor, always make a rough sketch, with figured dimensions showing size and description of head, nut, and shoulder. In ordering washers, give thickness, and say what size bolt you require them for. Draw a line between each item, and take a copy of your orders. These are generally delegated to the juniors of the warehouse to execute, so always give particulars fully, but concisely and clearly. When shall we be able to buy bolts with the corners left on the heads and nuts? Why is great utility continually being sacrificed to doubtful ornament? TOMSON.

[65600.]—**Saw-Mill Machinery.**—I was in a similar dilemma to "Saw-Mill Owner" some time back. Could not keep the main belt on—would come off occasionally, though taut enough for Blondin. So I stretched a stout wire by the aid of a small pair of blocks, level and parallel with centre line of engine. Made a mark on side of flywheel and gauged to wire; moved wheel round and gauged from mark to wire again. Found main shaft all right; found also the driven spindle was level and square with wire. At last I found all the trouble was caused by a thick-headed stoker putting his very oily hand on the bright main driving pulley when oiling the wall bearing of main shaft. STEAM USER.

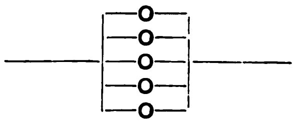
[65697-98-99.]—**To Chemists.—Breathing of Plants.—Animal Heat.**—If "Zero" can have access to P. Béron's complete works, he will find in them all the information he requires, and even much more than he can expect. (1) The indication of the physico-chemical constituent elements of chlorophyl; the mode of its formation out of water, decomposed under the influence of solar electricity, heat, and light. (2) The mode of transformation of chlorophyl into vegetable substances of every kind. (3) The mode of production and changes of colours in the chlorophyl of flowers' petals, their respective proportions in physico-chemical constituent elements by equations. (4) The cause of the production of chlorophyl in spring, of its transformation in summer, and of its disposition in autumn. (5) The explanation of the so-called breathing of plants, their exhalation, the mode of their constitution, both physical and chemical. (6) The origin of animal and human heat; why the same quantity of aliments near the North Pole or on the Equator produce in the human body the same temperature—37° C., in spite of the local temperature, varying above 80° C., and all the laws thereof. These works are, chiefly: 1. "Origine des Sciences Physiques et Naturelles, et des Sciences Métaphysiques et Morales." 2. "Le Déluge." 3. "Origine et Vie des Plantes, avant et après le Déluge." Three 4to. prints. 4. "Cosmobiographie Grand Atlas Cosmobiographique," with 403 pages 4to. text. 5. "Panépistême, Physique Simplifiée," in four big volumes 8vo. 6. "La Terre et l'Homme avant et après le Déluge," extract from "Physique Céleste," three big volumes 8vo. These works, which have not been translated into English, are now out of print, and no longer in trade; but if "Zero" wishes to procure them, I may perhaps help him in finding a second-hand copy.

Morchain, Somme, France. CH. RABACHE.

[65703.]—**Hot-Water Pipes.**—"K. D. Y." can most easily heat his room with a current of pure air at any desired temperature up to 300° C., by means of either oil-lamps or gas, without hot-water pipes and boiler, with a very simple system worth knowing. If he will write to me, I shall be very pleased to let him know the process.

Morchain, Somme, France. CH. RABACHE.

[65721.]—**Dynamo.**—TO MR. BOTTONE.—If the machine gives current when run right-handed, and you intend to run it in that direction, do not reverse the connection of the F.M. wires; but if you desire to run it left-handed, then, of course, you must reverse the connections. You must not drive a dynamo with an armature nearly 8in. in diameter at the same rate that you drive one of $1\frac{1}{4}$in. diameter, though the angular velocity must be about the same in both cases if the intensity of the field is the same. In your case I should not exceed 1,000 revs. per minute. Your machine as it stands would probably light well five or six of your 48 volt. lamps if arranged in parallel, thus—



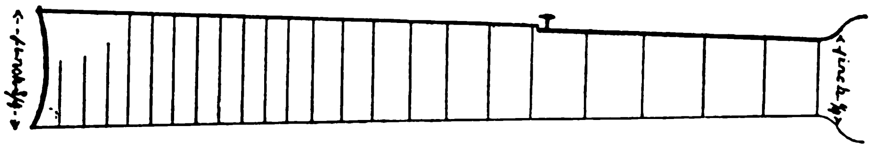
You could not get sufficient 18 or 20 gauge wire on your fields to convert it into a good shunt machine; but 25lb. No. 22 would do it well. See also reply No. 65857. S. BOTTONE.

[65722.]—**Ants.**—I have read—should not wonder if 'twere in "ours," ten or twelve years ago—that "dilute carbolic acid," syringed over trees or plants, does not injure them, and effectually drives away all kinds of insect pests. H. O'B.

[65745.]—**Coralines.**—In my juvenile years I picked up all sorts of seaside objects, and always used repeated washings in fresh-water, so as to remove all traces of the salt-water. The pretty Tectularia cupressina, an especial favourite, was thus washed and suspended to dry on a string if not attached to a shell or stone, to be sent to friends at a distance, and I have known it last for years. H. O'B.

[65747.]—**Banjo.**—Length of fingerboard from hoop to nutt should be 13in. for 6in. hoop, head $4\frac{1}{2}$in. The best proportions for piccolo banjo, however, are 7in. hoop and 14in. fingerboard. To find proper positions for frets, halve the distance from natt to bridge, and one-ninth of this gives first fret. Halve the distance from first fret to bridge, and one-ninth of this gives second fret. Continue in same manner for all frets required. Inlay small star or other mark above 7th, 10th, and 14th frets. These are indispensable in playing, as they enable you to hit the positions at once. The little peg the thumb string passes over before passing round its straining peg should be immediately above the 5th fret. The bridge for 6in. hoop should be about 2in. from edge, not less. For so small a banjo you must use raised frets; make these of thin brass or German silver, raised slightly above fingerboard. Round the edges of them, or they will cut the strings. Make hoop of ¼in. maple for choice, or beech; both are better than oak. Use a good sound skin for head, and strain it up till it is as tight as a board; don't use vellum. The straining-screws should be not more than 1½in. apart. If "Jo" requires any further information I shall be happy to give it, and if he cares to advertise his address, and tells me the exact diameter of hoop he intends to make, I will send him a full-size working sketch for his banjo. BANJOKER.

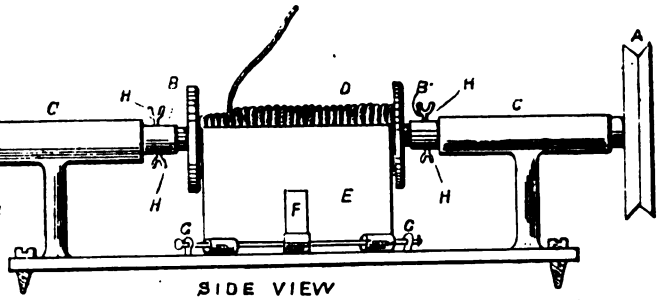
[65747.]—**Banjo.**—I don't understand what "Jo" wants with a finger-stick. I send drawing of finger-board with frets; if this will not suit, buy a good tutor. SILVER STRING.



[65756.]—**Electric Bobbin Winding.**—Fig. 1, A, pulley to carry belt to a suitable driving wheel; B, movable spindle, working in the holder C; C, holder; D, bobbin partly wound; E, flat piece of metal pressing against bobbin by means of spring; F, spring, and hinged at G; H screws to hold poles of magnets firm, ends of B are hollow. Fig. 2, details of B and C. Section shows a spring K. Fig. 3, L, reel of wire on standard, to which is attached arm holding two rubber rollers that touch each other, between which the wire passes.

E. WARD BUSSELL, A.E.E.

FIG 1



SIDE VIEW

FIG. 2

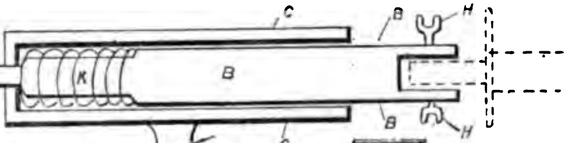
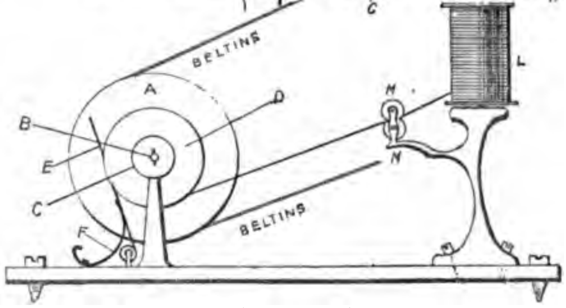


FIG 3



END VIEW

[65758.]—**Railway Gauge.**—I note that "J. H. B." and Mr. Stretton, in their replies, seem to imply that Mr. Stephenson adopted the 4ft. 8½in. gauge, and did not invent it. Would these gentlemen give some proof for their theory, because it is so different to a very recent statement on the question. Was the odd half-inch a mistake or not? "J. H. B." and "C. E. S." say it was not; but a writer to an engineering paper has said it was a mistake, and that Stephenson built an engine for a 4ft. 9in. gauge; but, "lo! and behold," it proved to be only 4ft. 8½in. Will some of our able readers throw more light on the difficulty. DRIVER.

[65759.]—**Scotch Express Trains.**—"W. R.," in your issue of the 13th inst., appears to be somewhat in error with respect to the above. As a matter of fact, the 10 a.m. ex King's Cross, according to Bradshaw, gains five minutes in the run to Grantham, five minutes Grantham to York, ten minutes off stop at York—not a stop of ten minutes as "W. R." states. Another five minutes is gained to Newcastle, and a like gain to Berwick; beyond this the timing is as before. Total gain, thirty minutes on the time taken before 1st July last. As this averages about 49·6 miles per hour, the speed does not appear excessive, and a further acceleration, which is talked of, not improbable. One hears some rumours of a seven hours' run to Edinburgh with dining cars, and alterations to the central station at Newcastle; some time farther may be saved, but should doubt the above seven hours' trip. Be this as it may, the Forth Bridge will be a great gain in the distance to Perth and the North, and certainly the G.N. and N.E. railways are worthy of all praise for their admirable express trains. R. H. G.

[65759.]—**Scotch Express Trains.**—"W. R." has very naturally been led into error by "Bradshaw" when he says in his reply that the down tourist express runs from Newcastle to Edinburgh —124½ miles—without a stop. True, it does not stop to pick up passengers, but it does stop for the engine to take water. The longest run on the North-Eastern is 80½ miles—from York to Newcastle. The East Coast performance to Edinburgh in 8½ hours is fine work; but it is generally understood that on the 1st of next month the West Coast time and the Midland will both be again reduced. For some years the King's Cross and Grantham run of 105½ miles has been the longest in the world; but it is now placed in the shade by the Midland wonderful runs between London and Nottingham of 123 miles 61 chains. These runs are made possible by the new large tenders lately built. Another quick run of the Midland is worthy of note, from St. Pancras to Leicester in 1h. 55m. (99 miles 9 chains)—that is, a reduction of 13 minutes in the running time. The great part of the increase of speed seems to have been made in the south by the English lines; we shall have to look to the Scotch companies to do their share—that is, the Glasgow and South-Western, Caledonian, and North British. How the trains are worked forward—say from Carlisle—will greatly influence the respective routes. Can any reader say the result the new line will have at Ashburys, near Manchester, by which a through route is formed from Scotland, via Hellifield, to Manchester Victoria Station, and thence round to Marple on the Midland, Manchester, and London line. Will it be as short as the present route from St. Pancras, via Normanton. LOCO.

[65764.]—**Eight-Day Clock with Moon Dial.**—This is evidently one of those arrangements in which a flat disc or moon with pointer upon it is made to revolve once in 59 days. This is generally accomplished by 118 teeth being formed on the edge of the disc, and one tooth being moved at each revolution of the 12-hour wheel. The connection between the two (which appears to have been removed in the querist's clock) usually consists of a kind of sliding bolt, one end of which comes in contact with a pin driven into the 12-hour wheel, while the other is made to engage the teeth in the moon disc. The upper part of the bolt is, of course, hinged so as to drive the wheel on its ascent, but spring clear as it descends. A light spring pawl keeps the moon disc in position while the bolt is descending and not acting. The whole thing, however, is an execrable arrangement, and forms one of the most efficient clock stoppers ever devised. This is why it is always taken off sooner or later, and the man who took it away from the querist's clock was probably wiser in his generation than the maker of it. No doubt these things might be made to work better than they do if more mechanical skill were used in their design; but, speaking generally, the fewer things a clock has to move the better. In an old clock with well-worn pinions, if you can get it to let off the striking train it is as much as you can fairly expect of it. Anything else is very likely to prove the last straw, especially when the clock has got a little dirty. W. J. R.

[65766.]—**Harmonium.**—The gentleman who examined your harmonium is probably correct. I consider that it would be far better if bellows makers would secure the leather valves to a separate board, which could be removed when required. If the querist will send his address, I will send him full instructions for removing the defect, free of charge. The leather valves inside feeders have curled, which allows the air to escape, thus causing the noise complained of.

Swansea. G. FRYER.

[65766.]—**Harmonium.**—This querist should take a piece of ¾in. board, and drill holes in it the same size and distance apart as present valve-board, screw and glue a ledge around of about an inch square stuff, then inside of the shallow tray so made fit the valves, which are usually a double thickness of sheepskin, except where each valve is glued to the board, where a single thickness is left to form hinge. When all complete, put a joint of soft sheepskin around ledge, which must be planed truly, and screw the new valve-board over the present one. This will be a permanent cure, if the board is well seasoned. DON.

[65766.]—**Harmonium.**—The buzzing noise is caused by the leather inside, which forms the pallet not lying flat. To get over this, he must cut out a piece at the bottom board, leaving, say, 2in. at sides and 3in. or 4in. end grain, then prepare a piece of thin hard wood large enough to cover the orifice. Remake the pallet holes and get a new piece of soft white sheepskin for the pallet, the joint between the false bottom and the original bottom to be leathered and then screwed on. This will get over the difficulty.

Gillingham, Kent. C. W. B.

[65767.]—**Mechanics.**—ERROR.—E D will represent W, not half W, as written.

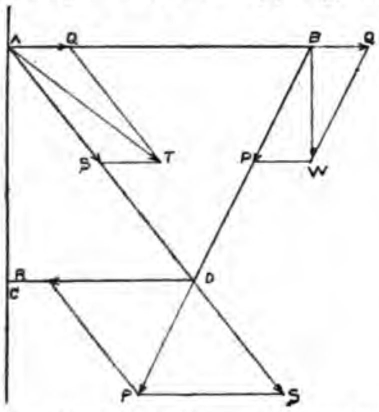
Bristol. T. C.

[65770.]—**Pitch of Screw.**—Is the distance between the successive threads the shortest distance, or that measured in a direction parallel to the axis of the screw? THORNFIELD.

[65770.]—**Screw.**—The pitch of a screw is the measure of the inclination of, or the advance which, a thread makes in one convolution. In a right-angled triangle, if the base represents the outer circumference of the screw and the perpendicular the "pitch," the hypothenuse will show the angle of inclination of, and the length of, the thread. Another line might be drawn to show the angle, length, and diameter of the screw at the bottom of the thread. In workshop phraseology, the "pitch of a screw" is the width of a thread and a space, just as the pitch of the tooth of a wheel or rack is the width of a tooth and space measured parallel with, or on the "pitch line."

HELIX.

[65767.]—**Mechanics.**—Replace W by its components P and Q, as in figure. Transfer P so as to act at D, and resolve into the components R and S. Thus, we see that Q and S are the tensions in A B and A D respectively, and P and R the compr stresses in B D and C D. The angles $\theta, \theta_1, \theta_2$, are supposed known; in any case they are readily determined by trigonometry, when the lengths of the bars are known. Since W B P = $\frac{\pi}{2} - \theta$, we have $P = \frac{W}{\sin. \theta}$, $Q = W \cot. \theta$. B P and D P represent the same forces applied at different points. To find R and S, the components of P acting at D, we use the angles D R P = θ_2, D P R = θ_1, and R D P = $\pi - (\theta_1 + \theta_2)$. Then,



since the sides of a triangle are proportional to the sines of the opposite angles, we obtain—

$$R = \frac{P \sin. \theta_1}{\sin. \theta_2} = \frac{W \sin \theta_1}{\sin. \theta \sin. \theta_2}$$

$$S = \frac{P \sin. (\theta_1 + \theta_2)}{\sin \theta_2} = \frac{W \sin. (\theta_1 + \theta_2)}{\sin. \theta \sin. \theta_2}$$

The stresses on all the rods are now known in terms of W. The forces Q and S may be transferred along their lines of action to act upon A at an angle B A D = $\pi - (\theta + \theta_1)$ with each other. Their resultant is, therefore—

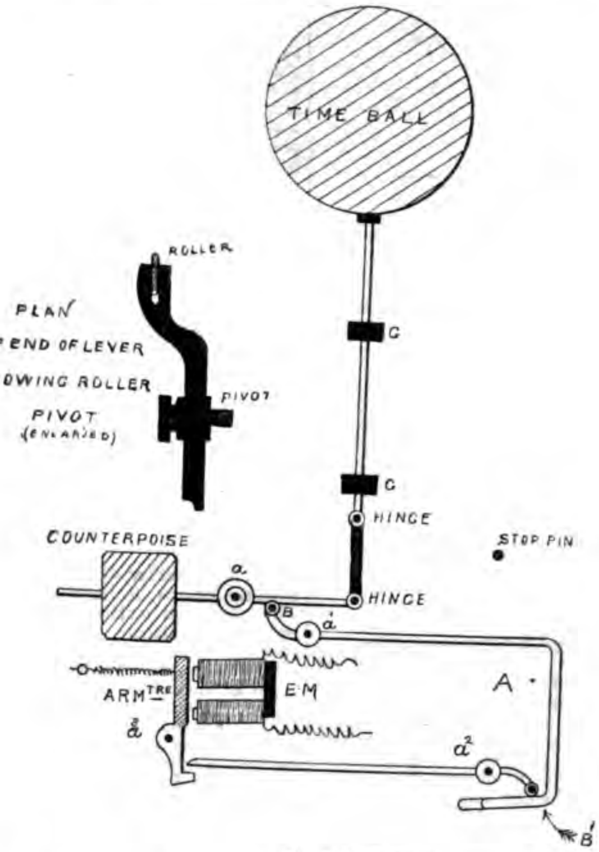
$$[Q^2 + S^2 - 2 \, Q S \cos. (\theta + \theta_1)]^{\frac{1}{2}}$$

in the direction A T. "Statics" can easily find the value of this resultant, if he requires it, by substituting the values of Q and S given above.

Portsmouth. A. M.

[65779.]—**Time-Balls.**—To Mr. W. Perren-Maycock.—It is some time since I had an opportunity of examining time-ball mechanism; but I recollect that there were a series of levers which, on being released by an electro-magnet, allowed *the ball to fall. The accompanying sketch illustrates my own idea of* an efficient apparatus. The time-ball is guided by two bearings G G. It is hinged at bottom to end of counterpoise-lever, which is pivoted at a. The counterpoise is capable of adjustment at any required point. There are two levers, A and B, pivoted at a^1 and a^2. B B^1 are anti-friction rollers. The roller ends of the levers are bent as shown, to enable the hinged end of counterpoise-lever, when it falls, to clear the pivot a^1; as also the end d of lever A to clear pivot a^2. The end of A being bent, as shown, the instrument takes up less room than would otherwise be the case. The end c of B is held by catch piece of armature pivoted at a^3 through the tension of the spring. The whole apparatus is firmly mounted in a strong cast-iron frame.

W. Perren-Maycock, A.S.T.E.



[65771.]—**Wood-Lice**—Will settle on slices of potato, turnip, &c., fresh cut daily, and placed in the frames or about the rockery, thence to be removed by careful watching and picking.

H. O'B.

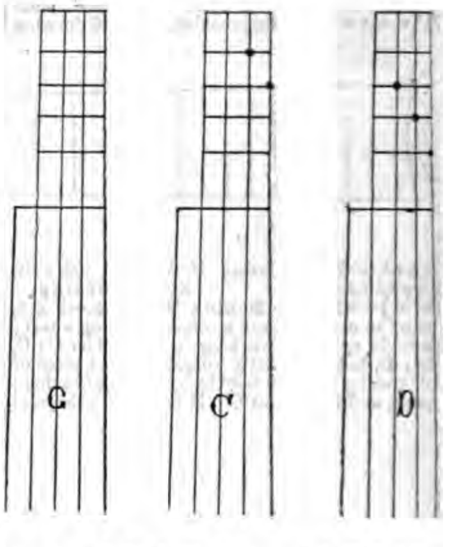
[65780.]—**Tubular Organ Action.**—Without professing to say "which is the best and most reliable," I can strongly recommend Roosevelt's system as absolutely satisfactory when carefully made. I think sketches have already appeared in "E.M." J. E. M.

[65794.]—**Spermaceti.**—Spermaceti is obtained from the great-headed cachalot or sperm whale. Anterior to the cranium, the upper jaw has a large cavity containing an oily liquid, which is removed with buckets soon after the animal has been killed, and then congeals into a yellow mass. This is drained in suitable bags, and then pressed to remove oil; the pressed cake is purified by melting it in water, straining off impurities, and boiling with weak solution of potash, washing with water, and finally allowed to congeal. It is then in white crystalline masses, somewhat unctuous to the touch of a slight fatty odour and taste. Specific gravity 0·943, and fusing at about 43° C. (113° F.) It is soluble in chloroform, ether, fixed and volatile oils, and is readily saponified when boiled with alcoholic solution of potash, yielding palmitate of potassium and cetylic alcohol or ethol. When boiled with nitric acid, spermaceti is slowly oxidised, œnanthylic, succinic, and other acids being found among the products. Vooght.

[65794.]—**Spermaceti.**—Cetaceum is a concrete, fatty substance, found in several parts of the body of Physeter macrocephalus, a species of whale known as the "great-headed cachalot." The head is the chief repository of this secretion, especially a cavity in the upper jaw, in which it exists, mixed with oil. The spermaceti whale occurs in the Pacific, Indian, and China seas. The liquid first drawn from the head of the animal is a mixture of spermaceti and sperm oil; from this the solid matter is separated by filtration through bags, and subsequent compression. After this it is melted in water, skimmed, and remelted with a little potash water, to remove the last traces of the oil; lastly, it is permitted to concrete slowly, during which it crystallises in brilliant white masses. Pure spermaceti is white, tasteless, inodorous, crystalline, insoluble in water, slightly soluble in boiling alcohol; it forms a soap with potash. It is composed of carbon 81·66, hydrogen 12·86, oxygen 5·47. It is at present solely employed in ointments and cosmetics. Ambergris (that costly perfume) is occasionally found in the entrails of this whale, and is supposed to be its hardened fœces; the same substance is also found floating on the shores of the seas frequented by the "cachalot." It is a greyish, peculiar, opaque solid, containing a fat (ambreine), benzoic acid, and extractive matter.

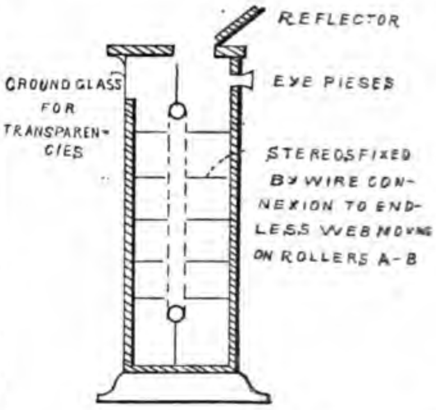
Eos.

[65786.]—**Banjo Accompaniment.**—"Beginner" must understand that there are three chords in every key. Say that we take the chord of G, the



open key of the banjo, there we shall find G, C, and D. I should advise "Beginner" to have a few lessons on the American ear-system. I send drawings in the key of G. Silver String.

[65792.]—**Revolving Stereoscope.**—To construct. The annexed sketch will, I think, enable



T. Casson to make one for himself. The principle is very simple: two rollers and an endless strap or web, to which the stereoscopic views are fixed by means of wire clamps. The cost of the lenses should be about 1s. each. The slides are to be got at all prices from 6d. to 10s. each. Transparencies are far more effective in this form than the ordinary stereo slides.

Plymouth. B. Sc.

[65796.] — **Preserving Lemons.** — Keeping them in cold water is said to be a good plan; but I have not tried it. Fal.

[65797.]—**Preserving Lemons.**—Carefully dry each lemon; place them in an earthenware vessel, and pour melted fat over them. By thus excluding the air they cannot become mouldy. At the time of pouring the fat over them it must be at its melting point, not a higher temperature.

Frederick Davis.

[65798.]—**Statics.**—The man pulling does not affect the direction of the strain on the pulley, as the tension on the rope or chain is equal [illegible] of wheel. The direction of strain, therefore, bisects the angle formed by the rope. The strain on the rope is the weight W, plus the small amount caused by the partly downward pull of the man, and which is easily graphically solved by the "parallelogram of forces," for which see any elementary textbook.

Bristol. T. C.

[65800.]—**Dynamo 50c.p.**—TO MR. BOTTONE.—Supposing you intend to use five lamps of 10c.p. each, with a cold resistance of about 25 ohms, you may wind your armature with about 1lb. No. 20 (if a Siemens H), or about 2lb. of the same gauge if of a ring form. In either case you may use 10lb. No. 24 on the fields, which should be connected up in shunt with the brushes. Speed about 2,500 revs. per minute; power required to drive, about ¼H.P.

S. BOTTONE.

[65802.]—**American Gallon.**—The United States gallon liquid measure equals 231c.in. or 8⅓lb. avoirdupois; ditto dry, 268c.in. The Imperial (English) gallon liquid measure equals 277·274c.in., or 1·2 U.S. gallon; ditto the same. See C. F. Howard's "Arithmetic," 1s. 449, Strand, and Simpkin, Marshall, and J. Heywood. J. H.

[65803.]—**Electric Shock in Bath.**—TO MR. BOTTONE.—This will indeed be shocking, to use a coil for this purpose. Pray let the shocks be very mild, as when the body is surrounded with water, the effect is very much intensified. All you have to do is to place a wooden trellis at the bottom of the bath, if it is a metal one, so that the body does not come into direct contact with the metal. Connect one terminal of the coil, by means of a wire, to the bath; or if that is not of metal, insert a rather large metal plate (clean copper) in the water at the foot of the bath, and connect this plate to one terminal of the coil. Let a bracket project from the wall a little above the patient's arm, and to this bracket let there be suspended a metallic stirrup which he can grasp easily. Place this stirrup in metallic connection with the other terminal of the coil. Do not give it him too strong.

S. BOTTONE.

[65804.]—**Recordon's Electro-Magnet.**—TO MR. BOTTONE.—If the magnet is to be used for months together, nothing can beat the Leclanché cell, of which three in series should be ample. But if this is required only for short experiments, a bottle bichromate of about one-quart capacity would be more convenient and more effectual.

S. BOTTONE.

[65807.]—**Lathe Wheel.**—If you want to make the pattern for the sake of doing so, go ahead and make it, but without the grooves in these will be turned out of the solid. But unless your friend will turn it for nothing, I would advise you to write to Taylor, of Manchester, for prices, as you will find it cheaper.

Bristol. T. C.

[65808.]—**Boots.**—Try system of Nicholls, at shop on north side of Strand, opposite Norfolk-street. J. H.

[65808.]—**Boots.**—I think that "W. R. C." will be able to have lasts and boots made to fit him by Mr. Simpson, 88, Dean-street, Soho, W., who has made several pairs for my wife, whose feet are very much out of the usual shape. ARDENT.

[65808.]—**Boots.**—I can deeply sympathise with "W. R. C." If he will try a pair of boots made of buckskin, he will be enabled to go about in comfort until the much-to-be desired bootmaker arrives. Buckskin does not differ in appearance from ordinary leather, lasts longer, and conforms to the foot. R. A.

[65808.]—**Boots.**—I am sorry to tell "W. R. C.' that I have been seeking in vain for forty years a boot-maker and a last-maker who would make boots or lasts like my foot. As Mr. Ouless, by courageously painting people in their real ugliness, at once rose to fame and fortune, so would a boot-maker who had similar courage and made ugly boots for ugly feet. M.

[65808.]—**Boots.**—I think if querist got a plaster cast of his feet he would find no difficulty in getting a fit. I should get the lasts cast from the plaster-cast in iron. Mobbs's foundry, Guildhall-road, Northampton, would do that for him cheap, and if he cannot get the boots made at home I will undertake the job and fit him at the same time. I will not cut his corns with the price.

A. SMITH.

Staff, 4th Batt. Royal Warwick Regt., Warwick.

[65808.]—**Boots.**—The only way to insure comfort in boots is to have a pair of lasts made of the exact form of the feet, and a pair or more of trees corresponding to them, on which the boots and shoes should be kept and cleaned. This is the plan I have adopted for many years; consequently my new shoes fit me as easily as my old. If "W. R. C." will adopt this device—an old one—he will experience no more trouble or discomfort. He should read "Motions of the Human Foot," and the "Foot and its Covering," 1s. each, published by Mr. Dowie, 455, Strand, London, W.C., if he wants further information on the subject.

G. G. B.

[65808.]—**Boots.**—"W. R. C." should go to a respectable bootmaker who does cut and close his own uppers and fit his own lasts—there are plenty in and near London. Even here in Cornwall, so far removed from the large centres, we do it. "W. R. C." should stand with all his weight on a sheet of paper, and have his foot traced round with a pencil by the bootmaker, and then the lasts should be made *that* shape. All the measurements in the world are of no use unless this is done. "W. R. C." wants what is called the "hygienic" style; all children's feet are this shape—straight on the inside, which is the natural shape.

Truro. CHARLES BARRETT.

[65808.]—**Boots.**—"W. R. C." is not obliged to accept boots that do not fit him, especially if the bootmaker does not comply with his directions. I have no experience of London makers; but I have no difficulty in the country in getting boots made to any pattern I desire. "W. R. C." is wrong in his idea that the lacing should extend to the place shown in the sketch, because it is at that place where the uppers are joined together and the tongue inserted. This extra thickness and rigidity would cause much inconvenience if placed where the foot bends. Its present locality is chosen because the foot is motionless at that place, and the extra thickness is less felt there. Further, there would be less protection against ingress of wet, as the opening would no longer be covered by the trousers. SM.

[65809.]—**Cleaning Silver Plate.**—Use soft brush and soft leather along with precipitated chalk mixed with methylated spirit, when the discolouration is cleaned off. Rub and brush dry along with a touch now and again of dry chalk, using a stiff brush. DENS.

[65809.]—**Cleaning Plate.**—The "best way" —hum, ha! If you have arrived at years of discretion, you may use cyanide of potassium; but, as then you must keep it somewhere safe, you had better rely on jeweller's rouge, a brush, and elbow grease —the last named most important. NUN. DOR.

[65809.]—**Cleaning Plate.**—If "Thornfield" will advertise his address, I will let him know where he can get the best plate-powder that is made. It is merely mixed with a little water, rubbed on the silver with a brush, and then polished off with a dry leather. It is warranted to contain no mercury. FAL.

[65809.]—**Cleaning Plate.**—For cleaning plated articles such as teapots, coffee-pots, &c., make a thin paste of whiting, mix with water, and apply with brush; when dry, brush off with clean one. Finish with rouge on hard wool buff. For chased things, after rouging wash in hot soap-and-water and a little soda; dry in box-dust, or soft cloth. If badly tarnished, mix whiting with spirit of wine. W. S.

[65810.]—**Silas Lapham.**—"The Rise of Silas Lapham," by W. D. Howells. BANKER.

[65810.]—**Silas Lapham.**—"The Rise of Silas Lapham" is a serial story commenced, in November, 1884, in the *Century Illustrated Monthly Magazine*, published by The Century Co., New York, and F. Warne and Co., London. FAL.

[65811.]—**Cleaning Skulls.**—Boil them in a solution of chloride of lime and rinse well in clean water. FAL.

[65811.]—**Cleaning Skulls.**—Your query is rather vague, because you do not state in what condition the skulls are at present. As you are a lady, I shall presume that it is only a secondary cleaning that you wish to know about. First brush over carefully with soap-and-water to remove the dirt; then put them out on a roof (or other place inaccessible to cats) to bleach; let them lie there for months, occasionally changing their position so that the sun and air permeates all parts freely.

Plymouth. B.Sc.

[65812.]—**Iron v. Wood Planes.**—For bringing wood both hard and soft to a thickness nothing will beat a good close-grained beech plane well oiled (as above). It rides well without the disagreeable slip of a metal plane when taking off heavy shavings. For fine joints in small work the reversed iron plane is far away the best, on account of the small width of mouth that is required to clear shavings; but for very long joints, or joints above 2ft. or 3ft. in length, the ordinary 30in. joint plane cannot in my opinion be bettered if kept in good order. Iron planes answer better as a rule on woods of the character of box, rosewood, partridge, ebony, &c., by reason of their keeping face better than wood planes, and for the facility with which they cut endwise the grain without splitting off the corners. CHAS. S. BEAL.

[65813.]—**Variation of Compass.**—If "O.G." takes the variation at 19° W. he will be quite near enough. "J. C. L." seems not to be aware that the variation varies with the place, and is not the same at Greenwich and at 100 miles off. M.

[65815.]—**Gum-Arabic.**—This may be accomplished by adding a small quantity of nitric or acetic acid; or, if the smell is not objected to, a few drops of oil of cloves. PRINCIPIA.

[65815.]—**Gum-Arabic.**—Boiling water should not be used, as it decomposes the gum, and spoils its sticking properties. Employ cold water, and add a little glycerine, to prevent the development of an acid. True gum-acacia can scarcely be obtained now. FREDERICK DAVIS.

[65815.]—**Gum-Arabic Preservative.**—You will find the following excellent preservatives. I have placed them in their order of efficacy:—Naphthaline, 1 grain to each pint; creasote, 2 drops to each pint; carbolic acid, 2 or 3 drops to each pint; oil of cloves, 4 or 6 drops to the pint.

S. BOTTONE.

[65817.]—**Lathe Centres.**—By using a proper tool lathe centres can easily be trued up without removing them from their places. Messrs. Churchill and Co. and Mr. Hines, Norwich, both supply lathe-centre grinding tools; indeed, I fancy that you would be able to get one at almost any machinist's.

FAL.

[65817.]—**Lathe Centres.**—There is no "best way" unless these are turned up in the chuck. The line centre may be ground in position by means of an emery wheel after hardening. Both centres should be coned to a slight taper, and mandrel and barrel rimered to same taper (as well as chuck), so that either centre will fit anywhere, and be turned up easily. This is a far better plan than having them screwed in, as is sometimes foolishly done.

Bristol. T. C.

[65818.]—**Check Valve.**—The check valve should be as close to the boiler as possible. It is a good plan to have a cock next boiler and the check valve next to that, so that by closing the cock the check valve can be examined when steam is up.

Bristol. T. C.

[65820.]—**Greasing Planes.**—A drop or two of oil is what I always use. If you do not like this, try French chalk in powder. FAL.

[65820.]—**Greasing Planes.**—I see that "Z." is in a difficulty that troubles a good many woodworkers who like to work in comfort without the nuisance of a dragging plane. It is easily remedied —plug the mouth of plane with a piece of hard close-grained wood covered with thin leather, taking care not to injure the face of plane by forcing it in too tightly (of course, you remove the wedge and iron first); now fill the opening of plane with linseed oil, good "cold drawn," and leave it over-night; it will soak all into the plane by the morning. You can repeat this several times, according to the nature of the wood your plane is made of. I have known a long "jointer" take up as much as 1½ pints of oil through the opening and by spreading on the face. Always take care to let the oil thoroughly soak in before applying fresh. Nobody would believe the difference to be so great as it is between a plane so prepared and one used as it leaves the makers. CHAS. S. BEAL.

[65822.]—**Carlsbad** is in Bohemia, and is easiest got at viâ Leipzig. There are between 30 and 40 physicians practising, and many of them speak English. Hotels: Windsor, Schloss, Stadt, Hanover, and Drei Fasanen are good; lodgings at about 20s. per week in the season are very much patronised by those who can speak German. Baedeker's "Germany" gives a little information about the place, and as you should not hurry to get there, it gives information about all the interesting places you pass on the road.

Plymouth. B.Sc.

[65824.]—**Photo-Enlarging.**—Use the Britannia Bromide Paper made by the Ilford Company: they will send a packet for 7s. 6d., with full instructions for development. SM.

[65824.]—**Photo. Enlarging.**—You should use gelatine bromide paper for enlarging. Instructions are sent with it. If you will advertise your address I will help you as to the best way of working, &c. ENLARGER.

[65824.]—**Photo. Enlarging.**—The cheapest paper, and I should say equal to the best, is that made by the Britannia Company, Ilford, E., and called "Britannia bromide paper." Full instructions are given with it, so that there is no need to give them here. But I should enlarge more than from quarter to half plate if I were "Photo." It seems hardly worth while to enlarge so little.

R. A. R. BENNETT.

[65824.]—**Photo. Enlarging.**—The favourite papers are those of the Platinotype (newest printing-out process) and Autotype Companies'. All particulars of how they are worked may be obtained at 29, Southampton-row, High Holborn, and 74, New Oxford-street, respectively. A small volume on "Enlarging" is contained in the *British Journal Photographic Almanac* for 1888. You should get this; price only 1s.

Plymouth. B.Sc.

[65827.]—**Magnetic Variation.**—The variation for 1888 is very nearly 17° 40′ W.; it travels towards Zero at nearly 7′ a-year. I. A.

[65833.]—**Electric Bells.**—It would be better to remove the porous pots from the cells, so as to avoid any possible corrosion of the terminal on the carbon; no other deleterious action can take place. SM.

[65833.]—**Electric Bells.**—Provided the zinc is kept out of the NH_4Cl solution, it will not hurt the porous cell; the difficulty will be that the pores of the cells will become choked up by the crystals of the salt deposited by evaporation. I should advise you to bottle up the solution, wash and dry the cells, and store away until wanted.

PRINCIPIA.

[65835.]—**Archimedean Screw Pump.**—600 revs. a minute! Phew! You must mean a centrifugal pump, surely. If so, you will find a formula in Molesworth.

Bristol. T. C.

[65836.]—**Ancient Village.**—You should first make an accurate drawing on a small scale of the village or market-place as you intend it to appear; then from this make light frames of wood having the same outlines as the original sketch, but of course full size; cover these with unbleached calico stretched tight, which must be well wetted before it is stretched. As soon as this is dry give it a coat of whiting and size, and then draw and paint upon it. "Duffer" would get a great deal of information from some articles on "Practical Scene-Painting for Amateurs," now being published in "Amateur Work" (Ward, Lock, and Co., Salisbury-square, London). Some of the street scenes there described and illustrated would just suit him. FAL.

[65837.]—**Tricycle.**—If the tricycle is at any time driven by the steam-engine, the speed must be reduced to the limit fixed by the law. "Duffer" can no more drive a coach-and-six through that Act, than he can profitably fit a tricycle with accumulators and dynamo—that idea is absurd. The tricycle is a machine for exercise, and any motive power except that of the muscles is out of place.

ESSAR.

[65837.]—**Tricycle.**—Whatever you might be able to do with the proverbial "coach-and-six" you certainly could not drive a steam tricycle through the Act of Parliament regulating the use of steam-power on ordinary roads, even though it was worked in conjunction with pedals. The modern tricycle runs so easily that I really do not see what necessity there is for any auxiliary power at all, particularly if the tricycle is fitted with a good two-speed gearing; besides this, the weight of the engine and fuel would add so greatly to the difficulty of driving the machine that steam would have to be used on the flat as well as uphill, making the tricycle in reality a steam-engine and nothing else. I should be very glad to see the restrictions on motive power other than animal being used to propel carriages on the highway removed, particularly as small engines are now made for launches which burn petroleum, and which could easily be adapted to carriages; but until the law is altered there is no use attempting anything in this direction. The words "other than animal" would shut out electricity as well as steam. FAL.

[65838.]—**Traction Engine.**—I think you must have left your door open too long, or exposed the stays to sudden cooling, to cause them leaking. I should take out the leaky stays, and replace larger ones, and in the case of those that are cracked, if only ⅛in. crack, put in stays ⅜in. larger, only in boring out the old one use drill ⅜in. larger, same size as stay to be substituted, and centre your drill on one side of old stay, so as to cover the crack; but should the crack be longer, plug by all means. You will find a long drift-punch, and a long tap with a drift on the end of it long enough to reach both plates a great boon in tapping the holes. Let the stays fit tight, and rivet the heads. W. D. V.

[65839.]—**Engine.**—Area of 32in. piston is 804¼in., and h.p. 201sq.in. The steam being cut off at four-tenths stroke in high-pressure cylinder, has to fill the low-pressure cylinder four times as large, so that it is expanded 10 times. Allow for losses, and call it nine times. Steam pressure 90lb. expanded nine times, and allowing 2lb. back pressure, gives a mean pressure of about 33lb. The I.H.P. will therefore be $\frac{33 \times 804 \times 6 \times 2 \times 36}{33{,}000}$ = 347. Mean back-pressure in high-pressure cylinder about 16lb.

Bristol. T. C.

[65840.]—***Worm-Eaten Furniture.***—It is said that dosing the articles with benzole or paraffin oil will cure this; I have not tried, but should be inclined to say that it would.

PRINCIPIA.

[65840.]—**Worm-Eaten Furniture.**—The only thing that can be done in your case is to saturate the wood thoroughly with petroleum or benzine. The beech top of my bench was attacked a few months ago. Using a fine-nose syringe, I squirted the holes full of petroleum. It was rather a long job; but I have not seen any fresh holes since. It would probably be a good plan to stop the holes with putty so as to give the worms the full benefit of the petroleum before it evaporated. FAL.

[65840.]—**Worm-Eaten Furniture.**—Wash the affected parts with solution of perchloride of mercury and infusion of quassia. This is really produced by a species of Ptinus; the eggs are deposited in some crack in a piece of furniture, and as the larvæ hatch they eat their way into the furniture, and when a sufficient depth they undergo transformation, and return by other passages as very small black beetles; the noise made by the insect striking its head against the wood has given it the name of "Death-watch."

FREDERICK DAVIS.

[65841.]—**Polariscope.**—I advise "J. H. B." to get from the Science and Art Department the syllabus of instruction at the Normal School of Science, South Kensington, price 3d. It contains directions for making a cheap polariscope. If the querist lives in this locality I shall be glad to show him an instrument made by one of my students at the Elswick Science Schools.

WM. JOHN GREY, F.C.S.
Analytical Chemist, Newcastle-on-Tyne.

[65843.]—**Gun Locks.**—The tools used for engraving gun-lock plates are the usual gravers; they are the same shape as a turning graver, but on a much smaller scale, and are sharpened in the same manner; no hammer is used. The tools used for chequering are, firstly, the chequering tool, which is made in the form of a very fine double saw, riveted on either side of a piece of thin steel, such as clock spring. Secondly, the chequering is cut up with a small oval smooth until it acquires the diamond form. To strengthen mainsprings, heat a piece of round iron or steel to a bright red, and with a hand-vice at the turn and a pair of pliers at the hooks, hold the spring over the hot metal until the part in contact becomes a bright blue. Now, without removing the spring, bend it at both ends to give it more set. So soon as you think it has gone enough, dip it in cold water; repeat this on different parts of the play side of the spring until you get the required strength. The safer way, if the locks are good, would be to send it to a reliable gunmaker, as you may spoil the shape.

FABRICANT.

[65844.]—**Polish.**—Tool handles are always polished in the lathe, ordinary French polish being used. A piece of cotton wool is made into a ball and enveloped in linen rag; this is held to the mouth of the bottle containing the polish, and a little polish allowed to run on to it; it is then covered with another piece of rag, and held gently to the work while it revolves in the lathe. It is essential to success that both the work and the hand be kept moving; a drop or two of linseed-oil on the outer piece of rag facilitates matters very much. To do this work well requires a good deal of practice. To colour your ash-sticks, dissolve vandyke brown in a strong solution of soda, and pay it over the stick with a brush until the colour is deep enough to please you; then varnish with best copal varnish. FAL.

[65844.]—**Polish.**—Mix together a little whiting, French polish, and a very little linseed oil, enough of each to make a cream; then fill the pores of the wood if it be ash. When the pore-filling material is hard, clean off the surface with a coarse rag. After this smooth with fine glass-paper, then polish with French polish. Get a little wadding to make the rubber with, covering it with linen that has been washed several times; wet your rubber by holding the bottle upside-down, then cover with the linen rag, and commence polishing as lightly as possible, gradually increasing the pressure until the polish be nearly worked out. If you use no oil, or very little, you will find it will not take so much polish, and do the handles much better, as you will have no oily smears to remove with spirits. To polish a walking-stick, if you want a dark brown, stain it with walnut stain after it is cleaned up with glass-paper; then add to the pore-filling material a little brown umber to darken it, to match colour of the stick after being stained; clean off the filling and commence polishing, rubbing from end to end in a semi-circular motion till the polishing tool becomes dry. J. RIDDLE.

[65845.]—**Heat.**—There is a good deal of the kind of information required by "Bertran" given in Watts's "Dictionary of Chemistry." If the querist will be more explicit I will try to help him if he has not access to the work. Many data on the subject are scattered through the various scientific journals.

WM. JOHN GREY, F.C.S.
Analytical Chemist, Newcastle-on-Tyne.

[65846.]—**Indiarubber Collars.**—Prevention is better than cure. You should use a collar-stud, hinged as to the button, that will not break the holes. They are sold at 1d. and 6d. SM.

[65846.]—**Indiarubber Collars.**—When once these begin to go, I think it is impossible either to save or repair them. Like all things made of indiarubber, they fail after a time, whether they are used or not. Some that I have had lasted for months; others, again, though of the same make, went very quickly. The latter, I believe were "old shop-keepers." The best thing to do is to get fresh-made ones, if you can. FAL.

[65848.]—**Celluloid.**—The so-called "giant cement" will fix this perfectly. PRINCIPIA.

[65848.]—**Celluloid.**—To stand tear and wear the ball would require a pin, either screw or rivet, besides any cement that would be used, such as diamond or giant, either one or other being as suitable as any for the purpose. DENS.

[65849.]—**Specific Gravity.**—A solution of soda whose specific gravity is 1·047, would contain 18·8 grains to the fluid ounce. A solution of potash whose specific gravity is 1·058, would contain [illegible] grains to the fluid ounce. One gramme is equal to 15·432 grains, and from this "Principia" may calculate any solution. FREDERICK DAVIS.

[65850.]—**Block-Tin Castings.**—Oil the mould. SM.

[65850.]—**Block-Tin Castings.**—Rub face of mould with French chalk. DENS.

[65850.]—**Block-Tin Castings.**—Black-lead the mould.

Bristol. T. C.

[65850.]—**Block-Tin Castings.**—Must make the moulds of cast iron; brass will not do.

METALLURGIC.

[65850.]—**Block Tin Castings.**—Your brass mould requires to be stained black, so as not to leave a clean bright surface. Corrosive sublimate and vinegar made warm will do it. Other recipes in back volumes. E. T.

[65850.]—**Block-Tin Castings.**—The moulds for this work are, I believe, usually made of iron. They must be hot, and the casting performed rapidly. To prevent the casting sticking the mould should be coated with a mixture of water and whiting, or red ochre applied while the mould is hot, but not too much laid on, or else it will end the mould. PRINCIPIA.

[65850.]—**Block-Tin Castings.**—I should advise you to coat your moulds over (when warm) with a thin wash of ordinary yellow clay—i.e., clay mixed up with water and applied with a brush, and, if necessary, a second coat, repeating this occasionally as you advance with the work; you will find them come out easy and clean from the moulds. BRAZIER.

[65850.]—**Block-Tin Castings.**—The trouble "S. B. P." has with his moulds tinning possibly arises from his not having lined them properly. Let him first clean off every trace of tin, scraping or burning it away if necessary. Then, with the mould at about the same temperature as when casting, touch lightly with a brush dipped in a mixture of red ochre and water. Do this several times in succession, until a thin adherent film of ochre has been formed on every part of the mould that the metal can come in contact with. Cast as usual; but look carefully to the mould every time it is opened, and touch it occasionally with the ochre brush. This is especially necessary with a brass mould, which is always liable to tin if the brass gets bare at any point. Not only will this plan prevent the adhesion of the molten tin, but much better castings generally will be obtained from a mould so coated. W. J. B.

[65851.]—**Cutting Stencil Plates.**—Very good stencil plates may be cut out of zinc with a fret-saw. I have several sets of letters that I cut that way—it may be done very rapidly, and at the same time correctly, with a little practice. If a word has to be repeated often, it saves a great deal of trouble to stencil the word with your set of letters on cartridge paper; cut this out with a sharp knife while the paper rests on a piece of glass, and use this as a stencil. Sets of letters cut out of the oiled paper used with copying-machines are also very useful. FAL.

[65857.]—**Dynamo.**—TO MR. BOTTONE.—The armature must be made 6in. deep, 7½in. diameter, and wound with 6lb. No. 16. The pole pieces must be made as wide as the armature is deep—viz., 6in. The cores of the F.M.'s being 8in. in height, and 3in. or 3in.. in diameter, should be wound with 2lb. No. 22, in shunt with the brushes.

S. BOTTONE.

NSWERED QUERIES.

◆

ibers and titles of queries which remain unan- five weeks are inserted in this list, and if still l are repeated four weeks afterwards. We trust will look over the list, and send what information r the benefit of their fellow contributors.

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idel, 244.
e-walk Clock, 245.
imping Metal, 245.
eat Lick Refractor, 245.
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lid Drawn Tubing, 337.
orm Wheel-Cutting in Lathe, 337.
ne-Preparing Machinery, 337.

QUERIES.

◆

—Converting Stops.—I have a lens at the ich are marked the various foci, thus :—

10 ... ... 1 times.
... ... 2 „
20 ... ... 4 „
30 ... ... 8 „
— 40 ... 16 „
—— 50

of "ours" convert this into the U.S. numbers of graphic Society of Great Britain ?—HYPO.

—A Fallacious Equation.—Will some one l me why the following processes lead to an conclusion? The final equation comes out , which is absurd.

$$x = a$$
$$\therefore\ x^2 = ax$$

² to each side, we get

$$2a^2 + x^2 = 2a^2 + ax$$

; $3x^2$ from each side, we get

$$2a^2 + x^2 - 3x^2 = 2a^2 + ax - 3x^2$$
$$2a^2 - 2x^2 = 2a^2 + ax - 3x^2$$
$$+ 2x)(a - x) = (2a + 3x)(a - x)$$

each side by the common factor, we get

$$2a + 2x = 2a + 3x$$

x ; substituting x for a, we get

$$2x + 2x = 2x + 3$$
$$\therefore\ 2x + 2x = 5x$$
$$\therefore\ 2 + 2 = 5.$$

]—**Shellac.**—In Munro and Jamieson's pocket- 174, the best insulating shellac is recommended, Dr. Muirhead uses for his standard condensers. of your readers inform me what particular kind is meant, and how prepared ?—A. F. TOOVEY.

]—**High Reducing Temperature.**—How ain a very high reducing temperature in a shaft aving an air supply pump of 4in. diam.—G. H. G.

]—**Antimony Poisoning.**—Can any of your correspondents tell me what are the symptoms of poisoning, say by inhalation of the vapour, and the usual antidotes in such cases ?—A TECHNICAL

]—**Joy's Motion.**—I should be much obliged orrespondent could tell me how the lead is ob- the above motion, and if it is the same both in backwards and forwards. Also if there is any n the subject.—F. S. R.

]—**Blacking Inside of Brass Tubes.**—I black the inside of the brass lens tubes for a ntern. Will some reader kindly give me a recipe at dull black, as in telescopes and most optical nts to prevent reflection ?—BLACK.

]—**Rendering Glue less Brittle**—I shall ged for information of any liquid or powder other cerine that could be used for the purpose of glue less brittle.—G. WOODWARD.

]—**Soldering.**—Can any of "ours" tell me of a itable for aluminium ? I have seen a recipe re, but cannot find it in back numbers of the -SM.

]—**Plaster Statuettes.**—I am very anxious the method of painting statues. Up to the pre- ve failed with common oil paints to get the effect nd notwithstanding the mixture of wax with the cannot get rid of the shiny appearance, nor do properly. Would some one kindly give me full ons ?—E. F.

]—**Impressions of Old Pottery.**—I wish sts or impressions of the incised and stamped orna- n on ancient pottery, and being quite a novice at will some kind reader give me the best substance to use, and the best way to apply it to get the most delicate impressions of from 2in. to 3in. square at one time ?—J. R. M.

[65869.]—**The Argentine Republic.**—Having read papers, &c., setting forth the want of labour and advantages of "Argentine Republic" South America, I have thought of going there as general fitter, &c.; but should be glad to know whether all the things are genuine. Also any information as to climate, &c —C. R. S. O.

[65870.]—**Cement Tank and Fishes.**—I made a tank in my greenhouse and coated it with Portland cement. I put minnows into it at various times (as an experiment, but I intend it for gold-fish), but they all die in the course of two or three days. I have tried rain, well, and river water, but it makes no difference. Will any of your readers inform me if it be that the cement imparts to the water some poisonous substance? Also how am I to remedy this ?—RUSTIC.

[65871.]—**Chemical.**—Can any correspondent suggest a satisfactory way of demonstrating the supposed fact that Euglena, and some green Planarians give off oxygen, derived presumably from chlorophyl ? Oxidation of ferrous sulphate has been tried, but although only two or three drops were added to 6in. test tube of water containing the above animals, they are dead. Could potassium iodide be employed ?—R. A. C.

[65872]—**Engine.**—Will some practical reader kindly inform me as to the following? I am about to make patterns for castings of a small triple expansion engine for a steam launch. The cylinders to be gun-metal 1in., 1⅝in., 3in. by 3in. stroke. What thickness should the cylinders and flanges be to stand the high pressure? I want the engine to be as light as possible. Also what should be the proper lap, lead, and cut-off in the different cylinders, so that each may do an equal amount of work and economise steam. There is only one crank, so the three pistons move forward at the same time.—F. E. A.

[65873.]—**Boiler Composition.**—I have been informed that a composition for preventing the formation of scale in boilers in our Government dockyards is made of soda ash, whiting, and silica. Can anyone tell me if such a mixture is really in use, and I would be glad if anyone can tell me what action the two last substances have on the scale? I suppose practical men will say that the stuff is worse than useless, but probably the wisdom of the government engineers has discovered properties in these substances which are not known by—A TECHNICAL CHEMIST.

[65874.]—**The Common House-Fly.**—Will some naturalist kindly answer this? Directly warm weather sets in we are surrounded by swarms of flies. Where do they come from? Are they newly hatched or rather metamorphosed creatures, or are they older ones that have been dormant during the cold, and reawakened into life by the heat? And lastly, where are the eggs, or chrysalides, or dormant flies (as the case may be) hidden ?—A. B. C.

[65875]—**Herreshoff Boiler.**—Could any of your correspondents favour me with details of construction of the Herreshoff coil boiler, the type of boiler which is employed mainly in American launches with so great success? I contemplate fitting a 25ft. launch with one. I should be much obliged if I were referred to any engineering periodical where it is described in detail. On p. 407, No. 1,059 of "E. M.," it is described, but only incidentally and in barest outline.—TUBAL CAIN.

[65876.]—**Screws.**—Let there be a properly made ordinary screw of commerce with a slot in it measuring ⅛in.—in other words, the diameter of whose head measures ⅝in. Now let there be three screw-drivers of precisely the same size, weight, dimensions, proportions, &c., and differing only in the sharp part which drives the screw. One has a width of ⅛in., another ⅝in., another 1in. Supposing the driving power to be the same, which screw-driver out of the three will work the best and why, supposing there to be no obstacles to impede the proper manipulation of each particular tool.—A. J. B., Brooklyn, U.S.A.

[65877.]—**Motive Power for Punkahs in India.**—I want to get a small night punkah pulled by electricity. The punkah would be about 7ft. long and swing inside a mosquito net, and it would be constructed in the lightest manner possible. I think an engine capable of driving a sewing machine easily would, with suitable gearing, develop sufficient power. Would some of your correspondents give me their opinion as to the most suitable engine and batteries for the purpose, and where such can be obtained; what such an engine and batteries would cost to buy and what to maintain? It would have to do nine hours work daily for eight months of the year. The engine would need to be strongly constructed about bearings and other wearing parts. The estimate of maintaining cost I would like to include such expenses as renewing zincs, &c. Particulars also as to where battery ingredients and parts can be obtained would also oblige, and particulars as to what they are and how mixed, for possibly I might get some of them here. Could the recharging of battery be left to the care of native servants? If so, such a sized battery as would last for nine hours' work only would suit best, for then the recharging would be a daily operation and not be overlooked. Many of your correspondents have doubtless been in India, and any suggestions they can make as to punkah pulling by electricity or other means would be very acceptable.—A. M. MONTEATH, Calcutta.

[65878.]—**Medical Coil.**—I am greatly obliged to "Porthos" for his clear sketch and information. Will he or any reader kindly satisfy me by answering the following? Should every layer of wire in primary be a separate length, joining into one current at each end, or should it be all one piece, and secondary likewise? Please state thickness of paper cylinder, and if I can make one.—F. W. W.

[65879]—**Pump Valves.**—Can any reader give me information on the following point? I have read that with indiarubber disc valves, or with conical mitre valves, the bars or ribs of the seating should be at an angle in order that the valve shall rotate and thus prevent any grooving of the seating. I have also heard on good authority that this sounds all very well on paper, but that in practice they will not rotate, and the inclination of the ribs obstructs the water to a certain extent. Which of these two is right ?—R.

[65880.]—**Is Total Darkness Beyond our Atmosphere?**—Writers on light tell us that if the earth had no atmosphere we should be involved in total darkness from the instant of sunset till the instant of sunrise. If, therefore, our atmosphere extends to only about 45 miles from the earth is all the intervening space reaching to the sun and stars total darkness? If any of "ours" would kindly tell me the best way to prove this to other people, they would confer a great favour on—W. M.

[65881.]—**Dry and Wet Meters.**—May I ask any of our readers why gas companies will only let wet meters? Are they more favourable registers for the company? The dry meters are infinitely superior in every respect as far as my experience can testify, having had one in constant use for over 20 years without the slightest trouble. On the other hand, we had a wet meter fixed about three years back, with annoyance caused by necessity of watering and drawing off tar water and exchanging meter several times during the period.—F. E. SPILLER.

[65882.]—**A Trick with Figures.**—Referring to the extract from *La Nature* on p. 410 of "E. M.," "Trick with Figures," there surely must be some error here, as I fail to make the figures 426727 work correctly. The difficulty appears to be when the first figures past the centre of the number adds up to more than 9; but still I make out that this spoils the whole trick. Shall be pleased to have this explained.—J. WILSON, JUN.

[65883.]—**Aluminium.**—Will some of your readers kindly inform me as to whether it is possible to estimate correctly the amount of aluminium in an alloy of aluminium with iron in excess? I have been told that it cannot be done, for the reason that other constituents are often mistaken for it. Is there any other way of detecting aluminium accurately besides separating the iron with pure caustic soda ?—NEMO.

[65884.]—**Automatic Electric Instrument.**—On the 2nd inst. I was at East Croydon, and seeing one of the above-named instruments I thought I would try the strength of my nerves, for being struck by lightning on Dec. 18, 1884, as can be seen in the "E. M." Vol. XLI. p. 268, ever since then, when storms are coming on, I am always full of pains. Sometimes they are a prickling sensation, and sometimes more like the cramp—the cramp-like pains are at the back of my legs under the hams, and the prickling feeling flies all over. It seems as soon as the air blows upon me the prickling commences. I was in bed a few nights since, and was awoke by the numbing pains in my legs. I could not get them warm; although I lay upon blankets, yet it felt as though a north-east wind was blowing upon me. The next day the weather was rough, thunder and lightning. I tried the above-named instrument; but it would not act either with me or anyone else. I took train at West Croydon for London, and when I arrived at the station (London Bridge I think it was) there was one of the instruments upon the platform. My friend tried: he could hold no longer than the hand pointed to 46. I then tried myself. As soon as I took hold of the handle the hand went to the far side. I think the highest number was 80, if I have made no mistake. I could hold it with ease; in fact, I only felt it give me one grip. I could hold it as long as I thought well. As the weather is very stormy and the pains are very bad—very bad indeed—I thought I would ask our friendly readers whether they could explain the cause of the hand of the instrument flying across the dial, and having so little effect upon me. Some of the bystanders said, after my friend told them of me being struck by lightning some time ago, it was a cross action, the electricity that was in me and that of the instrument. I do hope that some of our readers will consider the matter and that I may be eased of the pain. I might say that as soon as the storms are over the pains are easy, and sometimes I am left without a pain at all; I can run about as well as ever I could, and not ten minutes before I could hardly walk. I can almost always tell when the pains are coming, for I feel as though I should be choked with wind, and my bowels turn costive very suddenly. I am thankful that I get relief after the storms are passed. If any of our readers can give any advice, so that I can get relief in those hours of suffering, I shall be greatly obliged. I might just say, when the pains are on and for a time after, it leaves my knees very weak.—A BRAND PLUCKED FROM THE BURNING.

[65885.]—**Sewage Pumps.**—Would any of "ours" assist me? I am in charge of three sewage pumps and engines, direct acting, condensing; each engine and pump work independently of the other, but all delivering into the same rising main. The suction pipes are 8in. bore, and the rising main grows larger till it goes past the last pump, and then stops at 13in. bore all the rest of the height. First the sewage has to be forced 5ft., then runs on a level 72ft. and forced another 35ft. almost perpendicular. What I want to know is, would I burn less coal if I were giving each pump a separate discharge pipe, 7in. bore, and leading the pipes direct to the top of the hill, that would be 40ft., with about 45° of a slope on pipe ?—ENGINEMAN.

[65886.]—**Haydon's Cutter Bar.**—How can shoulders be turned with this tool? My slide-rest is one of Holtzapffel's for ornamental turning, and I cannot set the tool otherwise than at right angles to the work, and in that position it will not make a square shoulder. There is a form of cutter bar made with a joint, so that the tool can be turned to a limited extent, either to the right or left. Anyone who has tried this will oblige me very much by giving me his experience with reference to it. I should also be glad to know what form of cutter is best for shoulders, and if they can be cut with the same tool used for the cylinder ?—PAL.

[65887.]—**Indiarubber Ball.**—If a strip of indiarubber is of such a thickness that, when 1in. wide, it can be stretched to twice its length with a pull of 1lb., what will be the internal pressure per square inch in an indiarubber ball of the same thickness of material when blown to twice its original diameter, and again to three times the original diameter, the original diameter before any pressure is used being 1ft.? Also required a general expression for n diameters, and for p pounds instead of 1lb., original diam. being d inches.—M I.C.E., Bath.

[65888.]—**Ideas.**—Can any reader inform me how it is and in what way ideas are contained in the mind? We are told that the brain is the centre of thought, therefore, when we think of, and have ideas, is it actually the brain that is thinking? In other words, are our thoughts and ideas part of the brain, or do they exist in some other form, and if so, what form? Also how is it that our consciousness is deadened and then revived, as when we sleep and when we wake?—PSYCHOLOGICAL.

[65889.] — **Vegetarians and Evolution.** — Vegetarians argue that men should eat the kind of food which their teeth are best adapted to consume, which, say they, is not flesh. Does not this mode of arguing take it for granted that man's constitution is just as it was at the first, and has suffered no degradation or weakening, and must not every person who argues thus and is consistent be an advanced evolutionist? And, reversely, must not those who believe that man has sunk far below his original condition regard the teeth argument as worthless?—K.

[65890.]—**Broken Tooth.**—About twelve months ago I broke a small piece off one of my teeth, and since then a piece of the gum has grown over the bottom of the place; but for the last six or eight months every time I accidentally touch the place with my tongue or food there is a sharp and terrible pain which gradually dies out in about a quarter of an hour. I have tried stopping, but to no purpose. Should feel greatly obliged to anyone who would tell me how to cure it. I may mention that it is on the right side of the mouth and in the bottom jaw.—WALTER J. PARKER.

[65891.]—**Plate Influence Machine.** — I have access to tubes of, I believe, the largest size for showing the effect of the electrical discharge in vacua. Some are spiral coiled tubes, and in that condition are about 2ft. 6in. in length, therefore their total length must be far in excess of that. Would Mr. S. Bottone or some other electrician be kind enough to tell me the diameter of the plates of a Wimshurst machine that would be strong enough to show such tubes? I am aware that the best means of showing such tubes is by the Rhumkorff coil.—J. D. H.

[65892.]—**Turbine.**—Will anyone be kind enough to tell me what size turbine I should want to drive a 1in. double-acting force pump with 5in. stroke, but can alter it to any length of stroke? I wish it to play a small fountain jet. I have plenty of water in the stream, and I shall be able to have a 2ft. body of water on top of it and then a free discharge from the bottom. And will you kindly give me instructions? A drawing also will assist me, as I want to make it myself.—F. W. B.

[65893.]—**Boring Lathe Heads.**—Will some reader give a few hints as to the best way of doing the above, so as to have both heads true with each other and true with the bed? 1. Is it necessary to have the bar through both at once? 2. How is it best to apply the feed? 3. Is it necessary to have the heads in their own bed? How is the bar to be set dead true, supposing the job to be a 5in. pair of heads and the bed 3ft. 6in., and too big to be bolted on a lathe carriage?—YOUNG SUBSCRIBER.

[65894.]—**Green Peas.**—I shall be glad to know the best way of cooking green peas? At certain hotels where I occasionally dine they are at all times delicious, but my cook, who can boil a potato with anyone, has not yet got the knack of cooking peas. There is, no doubt, a certain amount of art required, but that it is very simple when known.—VERDANT.

[65895.]—**Stress on Water Tank.**—A circular water tank is 20ft. diam. and 25ft. deep. It is constructed of six rings of cast-iron plates. Find the total stress on any vertical section of the bottom row of plates made by a plane passing though the axis of the cylinder, neglecting any assistance afforded by the flanges or connection with the bottom plate.—APPLIED MECHANICS.

[65896.]—**Pulley.** — Describe Weston's differential pulley. If the weight is to be raised at the rate of 5ft. per minute, and the diam. of the pulleys of the compound sheave are 7in. and 8in. respectively, at what rate must the chain be hauled?—APPLIED MECHANICS.

[65897.]—**Belt.**—A belt having a linear velocity of 350ft. per minute transmits 5H.P. to a pulley round which it passes. Find the tension of the belt on the driving side, supposing it to be double that on the slack side.—APPLIED MECHANICS.

[65898.]—**Shellac-Oil of Turpentine.**—Can any of our chemical friends suggest anything that will, with the aid of heat, thin shellac, of a less smoky nature than oil of turpentine? I wish to melt 30lb. or 40lb. of pure shellac and so thin it that it will easily pour into moulds to form sticks of sealing wax. Gurgun oil, mentioned by our respected friend "Eos," is of too greasy a nature and spoils subsequent polishing, and wood spirit softens. I wish it to stand the climate of India and Africa after manufacture.—X. L.

[65899.]—**Heating by Steam.**—I am asked to heat a large shop with about 150ft. 1½in. pipes and 14 bends. The pipe will be dead level except where it passes four 5ft. gangways. In these four places it will dip about 2½in. Will this work so? Having no experience in this work I shall be glad of any information. The boiler is 30ft. distant. The pipe from same will pass through another person's place, so will have to be small. Will ½in. do?—GASFITTER.

[65900.]—**Positive Collodion Pictures.**—I am working the old positive collodion process and frequently have to photograph from copies that have a red background with black letters printed thereon, consequently the whole picture comes out one solid black mass. Can any of "ours" kindly tell me how to get over this difficulty? The same thing occurs with a blue background and white letters. The difference being that the picture is one white mass.—COLLODION.

[65901.]—**Preserving Greenhouse Pipes.**—Can any of our readers tell me if, by putting oil into the expansion box of warming apparatus and drawing the water all out, whether the oil will stick on the inside of the pipes, to preserve them from rust? I should like to know if any one has tried it, and with what results. Also if they can propose any other plan for preservation during summer months for which I should feel obliged.—HEATER.

[65902.]—**Cyclometer.**—I have a 30in. cyclometer, which I wish to attach to my safety bicycle. It previously hung to the shaft of a tricycle I had, and was worked by a pair of cams on a boss. The cams worked a short lever attached to a ratchet wheel (from right to left, just ½in.) What I want now is to fix it at the bottom of front fork in a horizontal position, so as to see the face when riding. Can anyone tell me how to work the lever backwards and forwards in a simple, quick, and effective manner?—CYCLIST.

[65903.]—**Metal Engraving.**—I have been trying to do a little in metal engraving, chiefly on brass. The forming of the letters with lead pencil I do fairly well; but when I come to the cutting part I am beaten, chiefly because I cannot get a good point on my graver. I should, therefore, feel obliged if some one would answer the following questions:—1. Are the under sides of the graver sharpened? 2. What angle should top part of same be, and what kind of motion is given to the graver to produce it, and how held in the hand? 3. What kind of oilstone is necessary for the purpose?—VERY PERPLEXED.

[65904.]—**A Mermaid—A Problem.**—There has been on view for the last three or four months, at a stuffed-animal dealer's in Kingston, an animal which may well be taken for a mermaid. It is about 18in. in length over all. The face is strikingly human, the nose, lips, and chin being very distinct. There is long hair on the head, but none on the face or body. The creature has a pair of arms, but below the shoulders the body is that of a fish, including the tail. The colour is the same all over—a dark green. The animal is said to have been found stranded on a rock near the Cape of Good Hope. Some of "ours" may have something to say on this remarkable natural curiosity. Is this the "missing link" between fish and man?—V. J. B.

[65905.]—**Absorption of Oxygen by Baryta.**—Can any of your readers tell me the precise temperatures within which baryta absorbs oxygen? Roscoe merely says:—"If gently heated."—DABBLER IN SCIENCE.

[65906.]—**Condensing Gases.**—Can anyone give me an idea for constructing some simple apparatus for condensing gases? I want to keep them absolutely pure. Would a stout glass tube, closed at one end and with a piston at the other, do? The space above the piston might be filled with mercury, perhaps; and if such an apparatus would work, how am I to judge the pressure, and what ought to be the thickness of the glass for each atmosphere?—DABBLER IN SCIENCE.

[65907.]—**Magnetism.**—To "SIGMA."—Is there any reasonable explanation of the fact that in a magnet the force is strongest not at the poles, but at some distance from (that is within) them? I should be very glad of "Sigma's" opinion, because, judging from his book, he seems to seek explanations for facts, instead of forcing facts into accordance with theory. If he can spare the time and trouble, I should feel much obliged if he would be kind enough to amplify a little a statement in his book. He mentions—"Forces at present unknown (for there are such)." Could he give just an idea which would suffice as a ground-work for others?—DABBLER IN SCIENCE.

[65908.]—**Electricity and Crystals.**—Are any experiments known to have been made on the influence of the electric current on crystallography? Would it be an impossible thing to force a substance to crystallise abnormally by a continuous current polarising the molecules?—DABBLER IN SCIENCE.

[65909.]—**Perspiring Watchmakers' Hands.**—I am apprenticed to a watchmaker, and my hands always perspire freely, even in cold weather. Would any reader kindly tell me of the best remedy, as it spoils the appearance of the watches and clocks I clean?—JAMES R. ELWELL.

[65910.]—**Preece's Arm Repeaters.**—How are these instruments constructed? Could any reader give me instructions for making one? Also probable cost and battery power. Working drawings would greatly oblige.—METEOR.

[65911.] — **Dry-Plate Negatives.** — In several negatives that I have taken I find that when held in a slanting position the image is shown distinctly in the positive colours. If this owing to over-exposure?—NEGATIVE.

[65912.]—**Wheels.**—To "W. W. C."—I find your answer to "Young Mechanic," p. 400 of June 29, 1888, query 65616 of June 15, p. 361, but cannot apply it to my case. Will you please tell me when these two wheels come together again—driving wheel 144, driven wheel 55? How many revs. will each wheel make, with example in plain figures please?—ANOTHER MECHANIC.

[65913.]—**Saccharin.**—I should be very pleased if any reader would kindly give me a few hints on the manufacture of saccharine? I have a rough method, but it is not at all definite in the quantity of the ingredients, and I cannot produce it as I should like.—TOLUOL.

[65914.]—**Lancaster's Instantograph.**—Having recently purchased one of the above, should be very glad if some of our readers would give their experience with same for ordinary and seaside work. Any information will oblige, especially regarding shutter work. What is the length of exposure for different positions of arm of shutter?—INSTANTO.

[65915.]—**Telescope.**—Will any reader kindly inform me what should be the diameter of the lenses of a telescope with which it is required to get a field of 7ft. at 100yds.? The size of the eyepiece is ½in., and the length of telescope 16in. Any practical hints will oblige.—ARQUEBUSIER.

[65916.]—**Locomotive Domes.**—Which lines use, and which do not use, domes on the boilers? In engines without domes is it a fact that the boiler has to be run with only about half a boiler of water? What is the cause that upon engines without domes trouble is found by the vacuum ejectors receiving water? Are the vacuum steam pipes continued into the dome?—FITTER.

[65917.]—**Angle Rings.**—To "T. C., BRISTOL."—Many thanks for reply to query, but it is not what I wanted exactly. What I want is a ring about ½in. in the flanges and about 1-16in. thick (flanges turned outwards). I thought of making patterns and getting them cast. Would that do as well? If so, what is the best way to make patterns?—W. S.

[65918.]—**Leclanche Cell.**—I have 12 smallest size Leclanché cells, which have been in use for about five months, and I wish to recharge the porous pots. I should be glad to know—1. How I can open and reseal them? 2. What is proportion of manganese and crushed carbon, and what quantity is required to fill 12 pots? 3. Will the carbon plates have become deteriorated through use, and is it, all things considered, advisable to purchase charged pots?—JAWKINS.

[65919.]—**Pattern Making and Lead Modelling.**—Could any reader give us an interesting account of how patterns are made, such as fire grates or gas-stoves? I believe they are done by people called lead modellers. Is it anything after the style of repoussé work? I have been a reader for a great number of years, but have never seen this subject treated on.—R. T.

[65920.]—**Watchmaker's Lathe.** — I bought a watchmaker's lathe (commonly called turns) the other day. Two of the centres I cannot understand. They have got a piece of steel fitted in one end, like the drill in a watchmaker's drill stock. It is made a little larger at the end and turned off into nearly a point, at the end of which is a chamfer. Between the largest part of the piece mentioned and the centre itself two rollers, about ½in. diam., run freely, and on the outside roller is a piece of steel wire, about ½in. long, which sticks out beyond the centre.—JAMES R. ELWELL.

[65921.]—**Archery.**—What kind of bows and arrows were used by the ancient warriors? Are such to be obtained at the present day? What kind are now supposed to be best for power, accuracy, and durability? What would be the price of such sets? In ancient history (William Tell, for instance) we read of performances with bows and arrows that would stagger the modern rifleman. Is it possible that such records are exaggerated? Does it require very much practice to become a skilful archer?—IGNORANT.

[65922.]—**Door Contact.**—I want to connect an electric bell just to call attention when anybody passes through a pair of swing half-glass doors. They are fixed with springs in the floor, so always keep closed. You can open them by pulling or pushing, so want the contact to be made if opened either way on both doors. Particulars of the simplest method will oblige.—A. W. A.

[65923.]—**Electric Light.**—I have a new 15 or [illegible] lamp. I want to light it occasionally for reading. Will any reader tell me how to make a rough powerful battery suitable for the purpose, or where I can buy one? I have all metals to my hand, lathe, drilling machines, tools, &c., so should think with information I could make a good one at medium cost.—A. W. A.

[65924.]—**Repairing Vulcanite in Artificial Teeth.**—Having cracked the vulcanite plate in the above, can I repair it with any home-made or purchased cement that will stand the pressure of mastication or the action of gastric juice?—ALEXANDER.

[65925.]—**Economical Paint or Colour-wash for Rooms, Kitchens.**—I beg to ask if "Sheffield" or some other good friend will please tell me how to prepare the above—a nice salmon or other colour suitable for the above.—THOS. CASSON.

[65926.]—**Acetic Acid and Tumours.**—If your correspondent, "G. T. B., Manchester," would kindly give particulars of the acetic-acid cure for tumours, he would confer a great boon on thousands of sufferers and greatly oblige—M. G. M.

[65927.]—**Speed of Steam-Engine.**—What would be the best speed for a small engine? Diam. of piston 6½in., length of stroke 12in., pressure 60lb., flywheel 4ft. 6in.—ANGLO-DANE.

[65928.]—**Mangold** is a vegetable well known and much cultivated in England, the name of which is not to be found in dictionaries. Would any kind reader oblige with the scientific name of that plant?—FOREIGNER.

[65929.]—**Lighting Oils.**—A great variety of such oils are sold in England under names which are unknown abroad. Such as kerosine, benzoline, gasoline, paraffin oil, camphine, &c. Would any fellow-reader let me know what they are?—FOREIGNER.

[65930.]—**Photo Negatives.**—I have read somewhere that negatives plates can be transformed into positive portraits on glass by immersing them in a solution of alabaster. Can anyone tell me how this solution is made?—FOREIGNER.

[65931.]—**Foreign Meat and Borax.**—Would Arthur Robottom say what he takes borax for, whether it aids digestion or what, and in what doses does he take it as it appears to keep him in good health?—IRON TURNER.

[65932.]—**Electric Bell.**—TO MR. ALLSOP OR MR. S. BOTTONE.—Will you please inform me what quantity of wire is required for magnet to ring 6in. bell?—F. S.

[65933.]—**Power for Flannel Machinery.**—Can any of your readers inform me what power gas-engine would be sufficient to drive twelve 7ft. plain flannel looms and one pair of hand mules of 360 spindles each?—R. W.

[65934.]—**MacFarlane Gray's Steering Gear.**—Will any of "ours" kindly send a description, with sketch, if possible, of the above steering gear?—V. J. B.

[65935.]—**Steam Cranes at Newhaven Harbour.**—Can anyone give a few particulars of the steam cranes on the East Quay, Newhaven, constructed by J. Wilson and Co., Sandhills, Liverpool?—V. J. B.

[65936.]—**North British Compounds.**—Have any particulars of Mr. Nisbet's Compound locomotives on the North British Railway been published? Has their performance hitherto been satisfactory?—V. J. B.

[65937.]—**Aniline Dye for Basel.**—I want an aniline dye (orange) for Basel skins. Can you or any of your correspondents inform me how to prepare it?—BOX AND SON.

[65938.]—**Speed of Wheels.**—Will any reader please give a simple rule to find out the speed of wheel driven and the speed of wheels to be driven?—DUSTY MILLER.

[65939.]—**Soldering Platinum.**—What is the best way of soldering or fastening platinum electrodes in an electrolysis apparatus to copper wires?—S.

[65940.]—**Height of Violin Bridge.**—What is the proper height for the bridge of a full-sized violin?—B. R.

[65941.]—**Wind in the Gas-Pipes.**—How can I ascertain the quantity of air in the gas?—METALLURGIC.

[65942.]—**Terre Verte.**—Will any of "ours" give me the analysis, physical properties, and uses of this substance?—PRINCIPIA.

"**Lord Macaulay's Writings and Speeches,**" "Jevon's Logic," Italian (new) Testament, "Hygiene for Schools," "Mrs Gatty's Natural History," &c. Offers wanted.—ROBERT SMITH, East Wall, Londonderry.

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Wanted, good 50in. ball bearing **Bicycle.** Exchange splendid GRANDFATHER'S, nearly equal new.—S. VINEY, Martock.

Lathe wanted, second-hand, in good repair, 3 to 4in. centre, screwcutting (hollow mandrel preferred), with chucks, &c., in exchange for this I will make PHOTOGRAPHIC CAMERAS or other apparatus, or Electrical Instruments to value, or part cash.—H. HERBERT, 119, Hartfield-road, Wimbledon.

Bench Lathe, new, 4in., planed bed, short standards, tees, drill chucks, face-plate, no flywheel. Exchange offers to £3 10s. value.—17, Newland-street, Kettering.

Three-cell Silvertown No. 3 agglomerate **Leclanche** BATTERY, in polished mahogany wall box, 5in. Electric Bell fitted on same, 4in. Barrel Push, 30 yards Wire, six 4in. continuous ringing bells. What offers?—M., 11, Victor-road, Holloway, London.

Alternate-Current Machine. Exchange for 1-1 plate Camera and Lens.—Below.

Arc Lamp. Exchange for half-plate Camera and Lens.—BEAUMONT, 101, Nunnery-lane, York.

Lens, ½-plate, wide angle, Rectilinear, by Morrison, New York, first-class for landscapes, architecture, interiors, portraits, &c., cost about £5. Want two 10 by 8 Double Slides as part, or offers.—H. RUTHERFORD, Jardington, Dumfries.

Howe **Sewing Machine,** treadle, lockstitch, cost £6 10s. What offers in exchange? Anything taken to value of 20s. —3, Victoria-street, Spalding.

Lady's **Silver Watch,** cost £2. Good Microscope, in case, cost 15s., both in new condition. Exchange for anything useful.—3, Victoria-street, Spalding.

Model **Portable Engine,** riveted tubular loco. Boiler, 16in. long, on wheels, engine on top, 1¼in. by 2¼in. stroke, parallel guide bars, connecting rod and pedestals, fitted with brasses, flywheel, funnel, water space, round firebox, fittings. Exchange 40s.—EDWIN, Roebuck Hotel, Stoke, Staffordshire.

Will exchange horizontal **Engine,** 1½ by 2½, and Boiler, 14 by 6, to burn charcoal, for larger set of Castings, Drawing Instruments, Tools, or Scientific Apparatus.—S., 14, Linton-grove, West Norwood.

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"**English Mechanic,**" 1873 to 1888; also 423 numbers "Photographic News," from 1868 to 1878. Wanted, small back-geared Lathe, with Chuck or offers.—H. ROBINSON, 4, North-road, Clayton, Manchester.

Tandem Tricycle, balls to all wheels and cranks, bearings, lantern, pinion gear, silver-plated parts, splendid saddle seats, with rails and back-rest, Bayliss and Thomas, Coventry make, cost £18. What offers? Safety part payment.—T. ELLINGWORTH, Church-street, Leighton Buzzard.

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Horizontal **Iron Boiler,** loco. type, 5 tubes, water space round fire box, strongly made, tested to 100lb. Exchange Jewellery.—20, Windmill-road, Croydon.

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Turning.—To be sold, the property of a gentleman giving up turning, Lathe, by Holtzapffell and Co., eccentric, oval, and other chucks, quantity of turning tools, also assortment of carpenter's tools. Full particulars and interview arranged to likely purchaser.—E. W. MILTON, 8, Eldon-road, Hampstead, N.W.

Cheap **Gas.**—Send sixpence for my system of regulation; it will save one half of your gas account without affecting its luminating power.—R. LAWRENCE, 22, James-street, Calton, Glasgow.

Make your own and wear **Medical Belts,** and ensure health, strength, and energy. Post free 14 stamps.—R. LAWRENCE, 22, James-street, Calton, Glasgow.

Plating Dynamos, from 30s. to £20. Cauterising Hand-power Dynamos, 45s. each.—H. JONES.

Dynamos, 8 light, massive balance wheel, specially for Otto 5-man Gas Engine, £8.—H. JONES.

Gramme Dynamos, laminated, high efficiency, 6 lights of 20c.p., £6; 8 lights, £8; 10 lights, £10.—H. JONES.

Dynamos.—Lighting, Plating, Blasting, Refining, Storing, &c. List, one stamp.—H. JONES, 48, High-street, Lambeth, S.E.

Success to All—No plant, capital, or experience. Gratis list post free.—TAYLOR, Woodbine-street, Dewsbury.

Harmonium, 2 sets reeds, not quite finished, thirty shillings; bargain—C. TRUMAN, 47, Brook-street, Teignmouth.

Testing Galvanometer, new, 800 ohms, with extra quantity coil and ¼ shunt, jewelled pivot, levelling screws, 30s Approval.—VINCENT, 57, Roden-street, Holloway, London.

Astronomical Telescopes.—Apparatus and parts made to order.—A. CLARKSON, 28, Bartlett's Buildings, Holborn Circus, London.

Astronomical Eyepieces, any power, fitted to any telescope, 15s. each.—CLARKSON.

Astronomical Telescope, by Sir Howard Grubb, 3in. aperture, on equatorial and divided circles, 15 guineas.—CLARKSON.

Equatorial Mounting only, to carry 3in. telescope, by Sir Howard Grubb, separately, £5 10s.—CLARKSON.

Astronomical Telescope, 3¼in., mounted on equatorial, and driving clock, and iron column, £40.—CLARKSON.

Astronomical Driving Clock for above telescope, or the equatorial can be had separately.—CLARKSON.

Astronomical silver-on-glass **Telescopes.** Mountings made for these; also flats, finders, rack, eye pieces, mounts.—CLARKSON.

Astronomical Telescope, by Troughton and Simms, 3½in. aperture, on equatorial, £30.—CLARKSON.

Astronomical Telescope, silver-on-glass, 8½ speculum, by With, and mounting by Browning, £25.—CLARKSON.

Astronomical Refracting Telescopes, several second-hand by best makers.—CLARKSON, 28, Bartlett's-buildings, Holborn Circus, London.

A large quantity of **Telegraphic Apparatus,** a little over old metal price.—KING, 13, St. John's-square, Clerkenwell, London, E.C.

Microscopic Objects.—Large stock, well mounted, 5s. dozen. List. Approval.—HENRY EBBAGE, 344, Caledonian-road, London.

phenomenon the aëronaut ascribed to the resistance to expansion, occasioned by the tenacious adhesion of the silk to the folds, which the comparatively collapsed state of the balloon had previously allowed it to assume, which, when overcome, caused a noise like an explosion. Subsequently another Scottish party, in November, ran a risk utterly unexpected. Far greater and more tenacious adhesions were caused by frost. Sudden expansion of the gas might then easily rip open the frozen plaits.

One of the most precious properties of General Hutchinson's patent presser is to keep the skin smooth and free from wrinkles, as well as cause the balloon to rise and fall within certain limits.

(*To be concluded.*)

ASTRONOMICAL NOTES FOR AUGUST, 1888.

The Sun.

Day of Month.	Souths.	At Greenwich Mean Noon.		
		Right Ascension.	Declination North.	Sidereal Time.
	h. m. s.	h. m. s.	° ′ ″	h. m. s.
1	0 6 2·03 P.M.	8 48 8	17 51 37	8 42 5·73
6	0 5 35·24 ,,	9 7 24	16 31 33	9 1 48·51
11	0 4 53·81 ,,	9 26 25	15 4 48	9 21 31·28
16	0 3 58·08 ,,	9 45 12	13 32 2	9 41 14·05
21	0 2 49·17 ,,	10 3 46	11 53 55	10 0 56·82
26	0 1 28·91 ,,	10 22 9	10 11 6	10 20 39·59
31	11 59 59·51 A.M.	10 40 22	8 24 12	10 40 22·36

The method of finding the Sidereal Time at Mean Noon at any other station is described on page 403 of Vol. XLVI.

Spots are now so very small and rare upon the sun's disc as to be scarcely worth looking for by the student.

There will be

a Partial Eclipse of the Sun

on the 7th; but at Greenwich the magnitude of the greatest phase is only 0·013 (Sun's diameter = 1). It

			Greenwich Mean Time.	
Begins	August	7	6h. 48·8m.	p.m.
Greatest phase......	,,	,,	6 57·7	,,
Ends	,,	,,	7 6·5	,,

As viewed with the naked eye, the angle from the North Pole of the Sun of First Contact, 6° towards the East; of Last Contact, 24°. As viewed with the naked eye, the angle from the Vertex of the Sun of First Contact 32° towards the West; Last Contact 13°.

The Sun sets at 7h. 36m.

The Moon

Is New at 6h. 21·0m. p.m. on August 7th, and enters her First Quarter at 4h. 44·1m. p.m. on the 14th. She will be Full at 4h. 20·3m. p.m. on the 21st, and enter her Last Quarter at 2h. 18·3m. in the afternoon of the 29th.

Day of Month.	Moon's Age at Noon.	Souths.
	Days.	h. m.
1	23·2	6 54·3 a.m.
6	28·2	11 0·8 ,,
11	3·7	3 18·0 p.m.
16	8·7	7 45·0 ,,
21	13·7	12 22·5 ,,
26	18·7	3 22·4 a.m.
31	23·7	7 7·6 ,,

The Moon will be in conjunction with Mercury at 9h. a.m. on the 6th, with Saturn at 10h. a.m. on the 7th, with Venus at 9h. a.m. on *the 8th, with Mars* at 9h. p.m. on the 13th, and *with Jupiter at midnight* on the 14th.

Occultations of (and Near Approaches to) Fixed Stars by the Moon.

Day of Month.	Name of Star.	Magnitude.	Disappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.	Reappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.
			h. m.		°	°	h. m.		°	°
2	B.A.C. 1351	6½	2 20 a.m.	Bright	153	112	3 6 a.m.	Dark	245	205
2	63 Tauri	6	†2 44 ,,	N.N.W.	199	158				
4	χ^3 Orionis	6	1 52 ,,	Bright	22	346	2 4 ,,	Dark	357	319
4	χ^4 Orionis	5	1 58 ,,	Bright	146	109	2 36 ,,	Dark	234	195
20	γ Capricorni	3½	12 58 p.m.	Dark	112	126	2 10 ,,	Bright	290	314
21	50 Aquarii	6	†8 17 ,,	N. by W.	195	162				
22	ψ^3 Aquarii	5	9 46 ,,	Bright	59	29	10 30 p.m.	Dark	345	320
22	ψ^2 Aquarii	4½	†9 55 ,,	N.N.W.	201	172				
26	ξ^2 Ceti	4	11 20 ,,	Bright	136	98	12 22 p.m.	Dark	273	238

† Near approaches. A description of the construction and use of the above table, illustrated by a diagram, will be found on p. 403 of Vol. XLVI.

Jupiter's Satellites.

Day of Month.	Satellite.	Phenomenon.	H.	M.	S.	Day of Month.	Satellite.	Phenomenon.	H.	M.	S.	Day of Month.	Satellite.	Phenomenon.	H.	M.	S.
3	I	Sh E	9	15	P.M.	18	II	Sh I	8	10	P.M.	26	I	Tr E	8	14	P.M.
10	I	Sh I	8	58	,,	18	III	Sh I	8	50	,,	27	II	Ec R	7	58	27,,
11	I	Ec R	8	23	13,,	25	II	Tr I	8	6	,,						

Ec Eclipse; Tr Transit of Satellite; Sh Transit of Shadow; R Reappearance; I Ingress; E Egress.

Mercury

Is a Morning Star during the first two-thirds of the month, but comes into superior conjunction with the Sun at 1h. a.m. on the 24th, subsequently to which he, of course, Souths after the Sun. At the beginning of August he may be caught with the naked eye in the E.N.E. before sunrise. His diameter dwindles from 6·8″ on the 1st, to 4·8″ by the 31st.

Day of Month.	Right Ascension.	Declination. North.	Souths.
	h. m.	° ′	h. m.
1	7 27·5	20 45·1	10 45·6 a.m.
6	7 58·1	20 42·2	10 56·4 ,,
11	8 35·5	19 38·6	11 14·1 ,,
16	9 16·1	17 29·5	11 34·9 ,,
21	9 56·1	14 27·4	11 55·2 ,,
26	10 33·8	10 52·3	0 13·1 p.m.
31	11 8·5	7 1·6	0 28·0 ,,

Commencing in Gemini, the path thus indicated extends right across Cancer and over a considerable part of Leo. Mercury will be pretty close to Regulus on the morning of the 21st; but being then behind the Sun, will be invisible. He will be in conjunction with Saturn at 4h. a.m. on the 14th.

Venus

Is an evening star, in the sense of southing aft[illegible]t she is a comparatively insig[illegible] (her diameter never exceeding 10″ [illegible] the month), is nearly circular, and is too close to the horizon at sunset to be fairly visible.

Day of Month.	Right Ascension.	Declination North.	[illegible]ths.
	h. m.	° ′	h. m.
1	9 12·9	17 29·7	0 30·7 p.m.
6	9 37·5	15 38·6	0 35·6 ,,
11	10 1·6	13 36·8	0 40·0 ,,
16	10 25·3	11 25·8	0 43·9 ,,
21	10 48·6	9 7·2	0 47·5 ,,
26	11 11·5	6 42·5	0 50·8 ,,
31	11 34·3	4 13·1	0 53·8 ,,

Starting from the confines of Cancer and Leo, Venus traverses nearly the whole of the last named constellation during August. She will be a little more than 1° north of Regulus on the 11th.

Mars

Rises and souths in bright sunshine, so that, to be seen at all, he must be caught in the southwest as soon as ever it is sufficiently dusk. His angular diameter, which is only 9·7″ on the 1st, diminishes to 8·4″ by the end of the month, so that he simply presents the aspect of a very large red star. The telescope will reveal that he is gibbous—and that is about all.

Day of Month.	Right Ascension.	Declination South.	Souths.
	h. m.	° ′	h. m.
1	14 11·4	14 30·3	5 28·4 p.m.
6	14 22·1	15 28·5	5 19·4 ,,
11	14 33·3	16 26·3	5 11·0 ,,
16	14 45·0	17 23·1	5 2·9 ,,
21	14 57·1	18 18·7	4 55·3 ,,
26	15 9·6	19 12·4	4 48·1 ,,
31	15 22·5	20 3·9	4 41·4 ,,

It will be seen from the above ephemeris that Mars travels from that part of the sky where Virgo and Libra are conterminous, the greater part of the way across Libra.

Jupiter

for the purpose of the observer is as badly placed as (and during the earlier part of the month even worse than) Mars, and should be looked for, as in the case of that planet, immediately the twilight enables him to be seen. His angular equatorial diameter shrinks from 37·3″ on August to 34·1″ on the 31st. He is in quadrature with the Sun at 7h a.m. on the 20th, and although he is much too far off the earth for actual gibbosity to be visible, a little attention will reveal a distinct shading in the limb furthest from the Sun.

Day of Month.	Right Ascension.	Declination South.	Souths.
	h. m.	° ′	h. m.
1	15 38·0	18 40·9	6 54·3 p.m.
6	15 38·7	18 44·4	6 35·8 ,,
11	15 39·7	18 48·9	6 17·2 ,,
16	15 41·0	18 54·4	5 58·8 ,,
21	15 42·6	19 0·7	5 40·7 ,,
26	15 44·5	19 7·8	5 22·9 ,,
31	15 46·6	19 15·6	5 5·4 ,,

The short arc indicated above is described

Fig 2

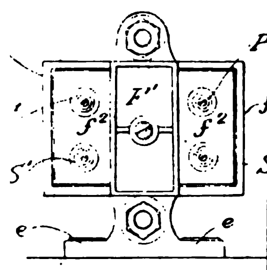


Fig 3B

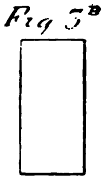
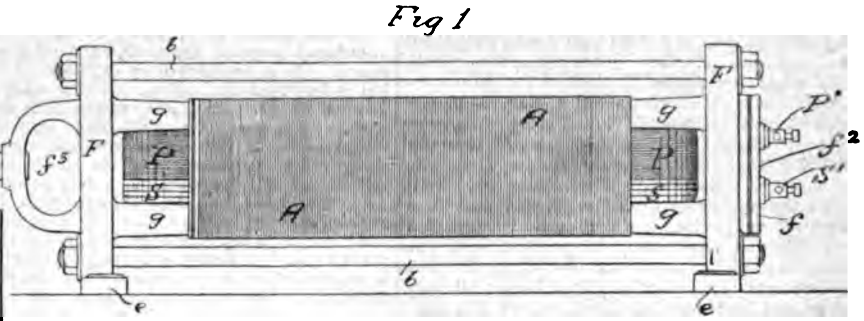


Fig 1



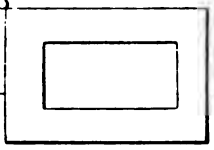


Fig 3A

Fig 3

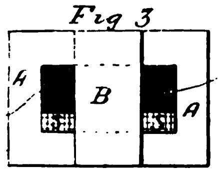


Fig 4

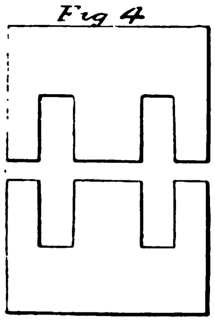


Fig 5

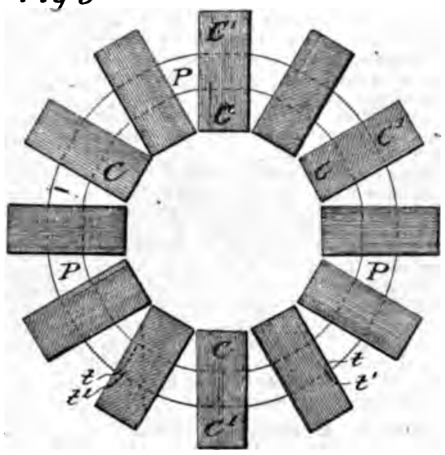
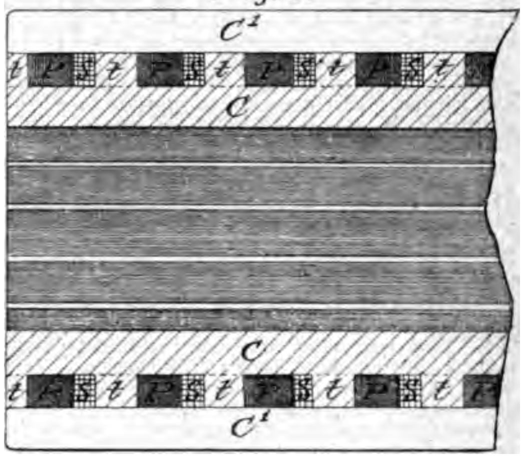


Fig. 6.



y in Libra, to the west of β Scorpii, ds which star Jupiter is travelling.

owing to the twilight and Jupiter's lerable south declination, the phenomena satellites will be difficult or impossible to re, we only give those that (should the e clear) will certainly be visible.

Saturn

into conjunction with the Sun at 1h. a.m. igust 2nd; while

Uranus and Neptune

th for the observer's purpose invisible; tter coming into quadrature with the Sun m. on the 25th.

Shooting Stars,

lmost universally known, appear between st 9th and 11th, the Irish Catholics re- g them as the tears of St. Lawrence, who roiled on August 10th. They are more iar to the modern astronomer under the of the Perseids, from the constellation ce they appear to radiate, and their orbit wn to be identical with that of Comet III.

Watch may be also be kept between the nd 25th.

wich Mean Time of Southing of of the Principal Fixed Stars on Night of August 1st, 1888.

Star.	Souths.			
	h.	m.	s.	
culis	8	26	5·20	p.m.
iuchi	8	46	13·67	"
onis	9	10	26·19	"
...	9	49	28·30	"
læ	10	16	30·75	"
...	11	1	26·95	"
ricorni	11	27	53·98	"
i...	11	53	36·49	"
ei	12	31	48·72	"
arii	12	41	31·12	"

method of finding the Greenwich Mean f Southing of either of the stars in the list for any other night in August, as also f determining the local instant of its t at any other station, will be found on of Vol. XLVI.

DEY AND WEBBER'S TRANSFORMERS.

object of the invention, which has een patented by Mr. Mordey and Major- l Webber, of Belvedere-road, S.E., is to so construct transformers, induction coils, &c., that they may be simple and inexpensive, may give a high degree of efficiency without heating, and may be easily separated for examination or repair without unwinding. In the drawings, Fig. 1 is a side view, Fig. 2 an end view, and Fig. 3 a transverse section of one form of a transformer or coil constructed according to this invention. The patentees do not limit themselves to the exact details illustrated, as certain of them can, it will be evident, be varied without departing from the nature of the invention. P P is the primary wire or conductor, and S S the secondary wire or conductor, the relative sections of which are in the inverse ratio of the tension of the inducing and induced currents. Thus, for example, for the induction of a very large current of low electro-motive force, such as would be required for electric jointing or welding, the secondary conductor may consist of a simple bar of copper bent into the form of a long U. The primary and secondary coils or conductors are respectively connected to the terminals $P^1 P^1$ and $S^1 S^1$, and may be wound either in two simple portions, as illustrated, or in smaller portions alternating in position or otherwise placed with reference to each other. A A are pieces of thin sheet iron each having an opening *a* therethrough. One of these pieces is shown separately in Fig. 3A. B B are pieces of thin sheet iron without an opening through them. One of these pieces is shown separately in Fig. 3B. The pieces A A or the pieces B B have an insulating substance on one side, such as a coating of varnish or a layer of paper. For the sake of ease of manufacture and economy of material the pieces A and B may be so proportioned that the pieces which are stamped out in making the pieces A are the right size for and may be used as the pieces B. The pieces A are placed around or over the conductors P and S, and the pieces B are inserted between the pieces A, so that the pieces A and B alternate with each other as shown. The pieces B pass through the coils of the conductors, as shown in Fig. 3, and are in contact with the pieces A. As there is an insulating material on one side only of the pieces A or B, electrical contact only exists between adjacent pieces on one side of each piece. Instead of the order described and shown, two pieces, A, may be placed together, then two pieces, B, and so on, the adjoining pieces of the same kind being electrically separated, so that there is only electrical contact between two adjacent pieces of the different kinds, so that whichever arrangement may be used eddy currents are prevented, whilst magnetic continuity is secured. The pieces are firmly secured, for example, by clamping bolts and nuts *b* passing through the cast end plates F F^1. The end plate at F^1 carries the frame *f*, in which an insulating board or slab f^3 is supported, on which the terminals $S^1 S^1$ and $P^1 P^1$ are mounted. The opposite end plate F is shaped to form a loop or ring f^3, which serves for carrying or suspending the apparatus. Both the end plates F and F^1 are extended at *e e* to form feet. *g g* are light extensions of the castings. For the purpose of avoiding eddy currents therein they may be blocks of hard wood or other non-metallic material. These extensions or blocks are for the purpose of pressing the iron strips together on the bolts *b* being screwed up. The spaces between the pieces A A and B B may be occupied by U-shaped pieces or slips of sheet iron; but it is preferred to leave them open in order to increase the ventilating and cooling surface. The end portions of the coils may be occupied by slips of sheet iron varnished (or the like) on one side, and placed in the end portions of the coils at right angles to the pieces B B, the outer portions of the ends of the coils being covered by U-shaped pieces of sheet iron placed at right angles to the pieces A, and meeting the slips of iron which occupy the inner portions of the ends of the coils; but generally the patentees prefer to dispense with them, and therefore they are not shown in the drawing. Instead of the pieces being formed as at A and B, they may be otherwise formed to give an equivalent effect; for example, they may be all E-shaped as shown in Fig. 4, and be placed alternately with each other, or two by two alternately, so that the mid-tongues or projections of the E-shaped pieces pass through the coils alternately from the two openings or ends of the coils, the projections or tongues overlapping each of the adjacent ones. The pieces when so shaped are electrically separated on one side.

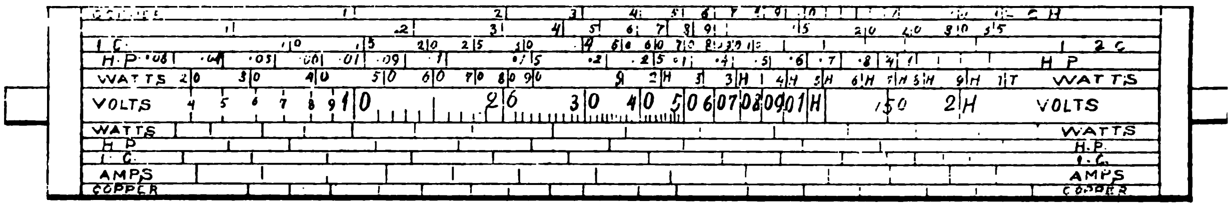
In constructing large transformers or such as have a number of separate pairs of coils, the plates A may be made with a corresponding number of rectangular openings, each occupied by a primary and secondary coil and cross pieces B. Similarly in such cases the E pieces (Fig. 4) may have a number of projections to be applied to the required number of pairs of coils.

Such a construction is shown in end view in

Fig. 5 and in longitudinal section in Fig. 6. There are several pairs of primary and secondary coils (P and S) each pair being embraced by portions of the E-shaped iron pieces $C\ C^1$ which are placed in position as follows:—Inside the coils or rings P S a number of the iron strips C are placed having as many tongues or projections, *t t*, as may be necessary, they extending radially outwards between the pairs of coils. Similar strips C^1 are then placed on the outer surface of the cylinder so formed, the tongues or projections $t\,t^1$ thereof extending inwards and alternating in position with the tongues or projections *t t* of the strips C. The double sets of strips ($C\ C^1$) thus form a number of closed magnetic circuits around the conductors P S, which may be wound in circular coils as shown, or in elongated coils such as are shown in Figs. 1 to 4. When the circular form is adopted, as shown in Figs. 5 and 6, the strips $C\ C^1$ are conveniently arranged in clusters placed in radial positions, as shown in the end view Fig. 5, they being supported in any suitable manner. This construction presents the advantage of very short magnetic circuits. The several coils may be connected in series or in parallel as may be desired. In constructing resistance coils for use with alternating or varying currents, in which it is desired to have a considerable inductive effect, this form of apparatus is used with but one coil or winding.

A SLIDE-RULE FOR ELECTRICIANS.

ALL electricians, whether amateurs or practical men, must have felt the need of some ready means of ascertaining the electrical capabilities of any dynamo, battery, steam-engine, &c., either as regards incandescent lighting, electro-plating, or as a transformer of energy. Mr. John Innes, F.C.S., has designed a slide-rule, of which we annex a cut, which gives at a glance an answer to any one or all of these queries without any calculation whatsoever, and without requiring any profound knowledge of electricity or of mechanical engineering. It consists in a rule divided into five lines—viz., ampères, incandescent candle power, copper deposited per hour, horse-power, and watts. These lines are subdivided so as to give the weight of copper deposited in an hour from ½ drachm up to 20lb., from $\frac{7}{10}$ths of an ampère up to 8,000, &c., and so on. In the middle of the rule is the slider, marked in volts from 4 to 200. This slider carries an index, which, in the figure, is standing between 4 and 5 ampères (the rule is furnished with four such pointers, not shown in the cut, to avoid confusion, two in front and two behind). One example will suffice to show how the rule is used. Suppose we desire to know what light (incandescent) a dynamo giving 4·25 ampères at 50 volts pressure? We place the pointer as in the figure at the 4·25 on the ampère line; then, running the eye along to 50 volts, we note the number of incandescent candle-power in its line. We find this to be 65. We also see, by looking in the horse-power line, that to do this will require a force of $\frac{3}{10}$H.P., which is also seen to correspond to 217 watts. This same current in ampères is also seen (by looking over the pointer on the copper hour-line) to be capable of depositing $2\frac{3}{10}$ths of a drachm avoirdupois per hour. The agent for the sale of these rules is Mr. S. Bottone, Carshalton, Surrey.



ELECTRICIANS SLIDE RULE

RICIN, THE TOXIC FERMENT CONTAINED IN CASTOR-OIL SEEDS.

IT has long been known that the seeds of the castor-oil plant are poisonous, but the nature and properties of the toxic principle were not understood. Dr. H. Stillmark finds that the only toxic principle contained in ricinus seeds is an albuminoid body, which he names "ricin," and classes amongst the so-called "unformed ferments." It is unaffected by dry heat of 100° C., but is destroyed by boiling. It acts, when administered by the mouth or by hypodermic or intravenous injection, by producing hæmorrhagic inflammation of the gastro-intestinal tract, especially, and primarily affecting the small intestine, and secondarily the stomach and large intestine. As to the lethal dose, Dr. Stillmark finds that for animals it is 0·1 milligramme per kilogramme of body weight when the drug is injected into the veins, so that for a man weighing 60 kilogrammes it would be 6·0 milligrammes. As drugs administered in this way are perhaps ten times as active as when taken into the stomach, the ordinary lethal dose of ricin may probably be set down as about 60 milligrammes, a quantity contained in ten ordinary seeds. Christison, however, once had a fatal case where only "two or three" seeds had been swallowed. This seems to have been a very exceptional instance, as there are many cases on record where a much larger quantity has been taken without a fatal issue—e.g., Rapp reported a case where an Italian non-commissioned officer took seventeen ricinus seeds, and recovered; Bouchardat, on the other hand, had one where a girl of eighteen ate twenty seeds, and died in five days. Experiments on the physiological action of ricin showed that it possesses a peculiar effect upon blood. When this is defibrinated, ricin produces a conglomeration of the red corpuscles, together with the formation of a fibrin-like substance. When blood is freshly drawn from a vein ricin causes it rapidly to coagulate. Again, defibrinated blood is rendered capable of passing through a filter by ricin—that is to say, the serum passes through, leaving the red corpuscles behind; an extremely dilute solution is sufficient—1 of ricin to 60,000.

HYDROGEN PEROXIDE FOR DOMESTIC USE.

THE various qualities of hydrogen peroxide are available in the most differing directions for domestic purposes. As a means of bleaching and cleansing, it can be used in the place of chloride of lime and oxalic acid for removing stains of every description, while it enjoys a preference over the above-named chemicals from its not being either poisonous or irritating. Claret, coffee, and other stains should be strongly moistened with hydrogen peroxide, and then dipped in spirits of ammonia. The stains will disappear in a very short space of time. Ink stains should be treated in exactly the same manner. In most cases they will disappear entirely; but, on the other hand, in the cases of certain kinds of ink, it is necessary to subject the spots to an after-treatment with diluted acid in order to bring into solution the deposited oxide of iron. Prior to this second treatment rinsing with water must take place. By this means ink spots can be removed from paper without disturbing or destroying the fibre.

Discoloured laces, cuffs, knitted articles, &c., at once become white when treated with hydrogen peroxide with addition of spirits of ammonia, while the same remark applies to discoloured white-handled knives and forks, whether ivory or bone.

It is specially suited for domestic use, inasmuch as it is absolutely inodorous and non-poisonous. Hydrogen peroxide is the best application for cleansing and binding wounds and sores; it must often be renewed. Bleeding is at once stopped by its use. For rinsing the mouth a solution of one spoonful of hydrogen peroxide in a tumbler of water forms an excellent wash; it at once removes all disagreeable tastes and smells. As a purifier of the atmosphere in sick rooms it is unrivalled; a solution of eight parts hydrogen peroxide is blown through a spray-jet in the usual manner into the air. Pots, pans, and wooden vessels at once lose any disagreeable smells they may have when treated with hydrogen peroxide. In diphtheria, croup, whooping-cough, &c., hydrogen peroxide is the first remedy that should be used, and will be found to have a most beneficial effect. Fresh meat treated with hydrogen peroxide will keep for a
long time, inasmuch as all the blood
become closed. Game is preserved for a
when treated with hydrogen peroxide. B
other fatty matter, when kneaded thro
hydrogen peroxide, not only lose any dis
smell they may have, but also keep v
longer.—*Königswarter und Ebell.*

PRACTICAL DETAILS OF SMITHING*.

Welding Gun Barrels—Dropping drel—Hand Bruises—Solid Bar Pressure—Flow of Metal—Fluid a Comparative Terms—Broaching.

THE bands which were used on gu
the barrel firmly to the stock wer
made, for the military service, of fla
welded in a ring; but as there were two
parts of circles, which they were to
which was of the size of the barrel, an
larger, to fit the stock, these bands,
welded, were driven upon a mandrel,
shaped exactly like a cross-section of th
stock and barrel at the place where th
to fit. To this mandrel it was made to
staking it in at the corners, and by the
of a little expert hammering. During
of getting out guns in 1861 this meth
proved upon by parties who desired t
outsides on the automatic profiling
designed at the Springfield Armoury
Buckland. The improvement consiste
dies made in which the bands were dr
mandrel, which was inserted in them t
distance to make them uniform, and
correct size. Another advantage of this
was that it could be performed much
peditiously than the old way.

There was this disagreeable feature:
handles of the mandrel were stiff, the
blow made it very hard on the han
operator, for it was not easy to get the
into the dies always just level, and as
always brought them level in an instant,
the effect of the blow was transferred to t
of the mandrel, and discharged itself in t
of the workmen. To avoid this, the hand
reduced from 1¼in. round to ⅜in. round, w
gave all the strength needed, and also yiel
sufficient flexibility to remedy the trouble.

These jars, producing bruises, are the
many well-known complaints among bla
who are not, as a general thing, of com
disposition; for, being more dependent
themselves than any other tradesmen f
&c., they have nobody else to complain of.
a lucky smith who has not at some time b
up from one to three months with w
physicians, I think, now call a catarrh in t
but which, in my younger days, the old
smiths called a "frog felon." Excessive u
hammer, or a too stiff handle in the ham
cause it. It is not uncommon for blacksmi
take up the hammer to use again, after hav
it aside and gone into other business for
to have six or eight blisters in the hand
and they are fortunate if they do not devel
felons. Even when using the hammer ev
a change of work may produce the same re
can remember how my hand used to be
and blistered inside so that I could not op
weeks when I have forged small gun screw
short-handled, heavy steel hammer, pou
steel jumpers, for from five to ten cents a
Men who are unused to the business, or w
stopped working at it until their han
become tender, are liable to have a catarrh
hand when they commence to strike w
sledge-hammer. As there is no pain more e
than comes from these malignant inflamm
and as there is no sure refuge or relief
command of the sufferer, every reasona
caution is, and of right ought to be, ex
guarding against them. They are somet
duced, however, like blisters in bliste

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* By B. F. SPALDING, in American M

ratchet-wheel. The axle W_2 likewise carries a winch, M. The pulleys r R and r_1 R_1 are provided with belts that permit of revolving the pulleys r_1 R_1, the axle, W_1, and the external drum, T, in the direction of the winch, and the pulleys, r R, the axle, W_2, and the inner drum in the opposite direction. The wooden base carries likewise two supports, half of glass and half of metal, which terminate in metallic balls, *m* and *n*. In the centre are metallic balls, S S, each of which carries a comb that surrounds the edges of the external drum, T. The fixed steel axle, *ef*, carries within the drum a vertical metallic rod, at each end of which there are combs arranged at right angles with the external ones. The exciters at the lower part are movable in the interior of the balls *m* and *n*. In order to excite the machine the two exciters, A_1 A_2, are moved towards each other until their balls touch. The winch is turned to the right or left, and a piece of hard rubber is rubbed lightly against a piece of cloth that is held near the centre of the surface of the drum T. A slight crackling then shows that the machine is excited.—*La Lumière Electrique.*

SCIENTIFIC SOCIETIES.

ASTRONOMICAL SOCIETY OF FRANCE.

THE June meeting took place on the 6th in the rooms of the society, 28, Rue Serpente, M. Flammarion, president, in the chair.

M. Vallet sent drawings of various lunar features made with a small instrument; M. Petit drawings of Mars and Jupiter, with remarks on the colours of these planets; M. Rengel configuration of Jupiter, β Scorpii, and a star of 8th mag.; M. Gaudibert sent a drawing of the lunar crater Flammarion. One of the most remarkable details of this mountain is a fine straight rill with serrated edge, situated on the northern border of the crater. This rill, interrupted by a mass of hills, reappears in Réaumur; it extends eastwards beyond the terminator.

MM. Cornillon and Bruguière sent a note on a large sunspot observed from May 11th to 23rd. M. Schmoll said that this spot was just on the limits of visibility to the naked eye from May 16th to 18th. M. Schmoll related observations of Saturn and Jupiter. On May 12th he observed the lunar crescent 42½ hours after the new moon, its breadth being only about 30″ or 35″.

MM. Flammarion and Trouvelot said they had observed the new star described in Circular 20 of the Wolsingham Observatory.

M. Flammarion read a paper on the "Solar Eclipses of the 19th Century." On comparing M. Oppolzer's charts with the results of observation, M. Flammarion has found considerable differences between the two. M. J. Oppert asked if the lines of centrality in Oppolzer's charts were reliable, especially as regards the ancient historical eclipses. M. Flammarion said that he would not advise historians to adopt these charts, on account of their want of precision.

M. Trouvelot presented the society with a set of celestial photographs forwarded by Mr. Pickering, and made at Harvard College. The photograph of the Pleiades is very interesting, and shows the curious rectilinear trails of the nebulous matter which appear so strikingly in the last photograph taken by MM. Henry.

M. Trouvelot proposed a vote of thanks to Mr. Pickering, and that he should be named honorary member. This motion, seconded by Colonel Laussedat, was adopted unanimously.

Colonel Laussedat explained a graphical method of calculating solar eclipses based upon stereographical projection, which is two or three times more rapid than the usual numerical calculation.

THE returns for 1886 show that 22,134 human beings perished from snake bites in India. The number of cattle killed by snakes is returned at 2,514. It is stated that 417,596 snakes were destroyed, and that 25,360 rupees were paid by Government as rewards for their destruction. The mortality from snake-bite in Bengal is much larger among women than among men. They are usually bitten in the early morning, when they go out unseen before daylight, either to fetch wood from the faggot stack, or for some other domestic purpose. During the rainy season, when nearly all the rice fields are under water, the snakes take refuge on the higher plots of ground on which the villages are built, and they hide themselves in the little wood stacks and granaries in the courtyards of the houses; whilst, not unfrequently, they take up their abode in the house itself, where they are allowed to dwell with impunity, and are sometimes fed with milk; until, on some unlucky day, the wife treads accidentally on the snake in the dark, and it turns upon her and bites her. From the bite of a full-grown cobra death ensues in a very few minutes

SCIENTIFIC NEWS.

THE death is announced of Prof. L. J. Budge, the famous German physiologist, and author of the well-known "Handbuch der Physiologie" and the equally well-known "Compendium der Physiologie," which is to be found in the library of nearly every German medical student. For more than thirty years Dr. Budge was director of the Anatomical Institute at Griefswald.

The deaths are also announced of Dr. Johann Odstreil, an eminent mathematician and physicist, of Vienna; and of Dr. Rühle, of Bonn.

The International Geological Congress is to meet in the rooms of the University of London, Burlington-gardens, from the 17th to the 22nd of September next. The opening meeting will take place on Monday evening, September 17th, at 8 p.m. The ordinary business of the Congress will include the discussion of questions not considered at Berlin, or adjourned thence for fuller discussion at the London meeting. Amongst these are the Geological Map of Europe; the Classification of the Cambrian and Silurian Rocks, and of the Tertiary Strata; and Some Points of Nomenclature, &c., referred to the Congress by the International Commission. A special sitting will be devoted to a discussion on the "Crystalline Schists." Excursions will take place in the week after the meeting. Meanwhile the Geologists' Association is going to make an excursion to the Forest of Dean, Wye Valley, and South Wales, from August 6th to 11th, under the superintendence of Mr. William Galloway, of Cardiff; Mr. W. F. Gwinnell, Mr. J. Storrie, curator of the Cardiff Museum; Mr. T. H. Thomas, president of the Cardiff Naturalists' Society; Dr. C. T. Vachell, of Cardiff; and Mr. E. Wethered, hon. sec. of the Cotteswold Naturalists' Field Club and Cheltenham Natural History Society. Those who would like to join should communicate with Mr. T. V. Holmes, 28, Croom's-hill, Greenwich, S.E., before August 1st, as a reduction in railway fare can be obtained. Those who would like to take part in the International Geological Congress, should communicate with Mr. W. Topley, 28, Jermyn-street, S.W.

The general meeting of the German Geological Society will be held at Halle from Agust 13 to 15.

At the recent meeting of the Association of Municipal and Sanitary Engineers, Mr. W. Webster, F.C.S., read a paper describing his process of purifying sewage by means of a strong current of electricity. He said the chemical changes which take place in sewage when it is electrolysed depend chiefly on the well-known fact that water and sodium, magnesium, and other chlorides—which are always present in sewage—are split up into their constituent parts. Thus, at the positive pole, chlorine and oxygen are set free in a nascent state—in a condition in which they are intensely active—so that the organic matter in the sewage is rapidly oxidised and burnt up to innocuous compounds. He experimented on a sample of Crossness sewage, and the solid matter was speedily oxidised and rose to the surface, leaving the effluent water apparently clear—chemically so pure that he should not mind drinking a portion of it—a statement which produced some incredulous laughter. He exhibited a sample of effluent water eight months old, which was still bright and free from any smell, and also a sample of a disinfecting fluid obtained from sewage twelve months ago. As to cost, he said he had no actual data, but the chief item was engine-power. So far he had not treated more than 100 gallons of sewage at any one time, and he found that about ⅓H.P. was sufficient for that purpose. The system could be applied to any existing tanks, and three of the analyses submitted showed the amount of suspended matter to be *nil*. The thanks of the Association were voted to Mr. Webster for having brought so important and interesting a matter under the notice of the Association, before he had disclosed his process or made known the results in any other way. Several speakers considered the process likely to prove an important discovery, provided it could be economically applied to the treatment of large volumes of sewage.

The London Sea-water Supply Bill has passed both Houses of Parliament. An extension of time is granted for completing before July, 1890, the works which were authorised in [illegible] for bringing a sea-water supply to London through the county of Sussex. The reservoirs in the metropolis will be near Clapham Junction and Hammersmith. Sea-water will supply many useful purposes; it will doubtless be largely employed for baths in private houses, and will, no doubt, be utilised in public bathing establishments. In time it may probably replace fresh water which is now used for street watering, and probably may be found in some of the swimming lakes in the public parks.

The authorities of the Sorbonne have sanctioned the proposed professorship for the exposition of the Darwinian theory. Some of the members of the committee were, however, still opposed to it, but they abstained from voting.

The report of the judges appointed to determine the award for the prize of fifty guineas offered by the tobacco section of the London Chamber of Commerce for the best specimen of British-grown tobacco has been issued. The judges were Dr. J. Bell, F.R.S., Somerset House; Prof. W. Fream, LL.D., College of Agriculture, Downton, Wilts; Dr. J. Augustus Voelcker, Mr. Henry F. Moore, Frome, Somerset; Mr. W. H. Wills, Mr. James Biggs, Mr. Louis Morris (tobacco manufacturers), Mr. Algernon Gilliat (merchant), Mr. James Chambers, Mr. G. H. Ball (tobacco brokers), and Mr. C. A. Müller (tobacco importer). Only four exhibitors complied with the conditions of the competition so far as quantity was concerned; but, in view of the interest which is being manifested in regard to tobacco-growing in the United Kingdom, the judges considered it desirable to present a supplementary report on the remainder of the specimens, though not properly coming within the scope of their adjudication. They placed the four exhibits submitted to them in the following order of merit:—First, Messrs. James Carter and Co.; second, Mr. W. L Wigan; third, Sir Edward Birkbeck, M.P.; fourth, Mr. John Graves; and they recommended that the prize of fifty guineas should be awarded to Messrs. James Carter and Co. Closing their report with certain "general observations," the judges state that, speaking generally, not one of the four samples eligible for the prize was in any respect valuable for trade purposes or even merchantable, presuming that no duty was chargeable upon the article. As to the prospects of tobacco-growing on a remunerative basis in England, the judges say that, even under the most favourable conditions possible, such a crop cannot be made to pay, and that in most seasons it must be an absolute failure and heavy loss. The climate of this country, to begin with, is less favourable than that of Kentucky or Virginia, and the cost of production will be found far greater here than in the United States. Until the curing of tobacco is perfectly well understood in the United Kingdom, the finest leaf that can be grown will be absolutely wasted and useless.

A branch of the Selborne Society, operating on both sides of the Thames from Hampton to Putney, has been established with headquarters at Richmond. The objects of the Lower Thames Valley branch are to secure from unnecessary destruction such wild birds, animals, and plants as are harmless, beautiful, or rare, to promote the study of natural history, and to discourage the wearing (by way of ornament) of birds or their plumage. It is proposed that part of the funds of the branch should be devoted to the purchase of works on natural history for the free library of Richmond.

Mrs. Roper, the owner of Okehampton which she throws open to public use, comp that the Osmunda regalis and other fern which the valley of the Ockment as neighbourhood are famous, are being wholesale, although the park, which has fenced and walled round since 1080, i known to be private property. Several la of ferns consigned to London dealers hav seized, and it is to be hoped that some may be found of stopping the depredati those who would spoil any scenery to a little money. Public opinion ought to ie operations of these thieves. Osmunda nce plentiful in many parts of Corn- iow almost extinct ; and near London, imroses have become scarce. The is for lovers of nature to refuse to the stolen property.

Meymott Tidy, lecturing recently at l Institution, mentioned the difficulty ced in endeavouring to accurately vhat is a poison, and offered the g solution: "Any substance which e than by the agency of heat or y is capable of destroying life either ical action on the tissues of the living by physiological action after absorp- the living system." The fact would be that "poison" is a question of , not quality. Very small quantities of ıydrocyanic acid, &c., suffice to destroy ; used in limited quantities they are drugs. Neat sulphuric acid, like alcohol, is a poison, but both are , and even useful, when diluted. One wn definition of poisons is "substances range the vital functions and produce an action not mechanical."

olverhampton papers report a curious of eyesight apparently by the action ing. A collier, named Bates, who had ight through an accident, was being , when a flash of lightning was re- n the spectacles he was wearing to is disfigurement. After the peal of which followed he complained of pain d. The next moment to his surprise that he had regained possession of ht.

ecent meeting of the Scientific Com- the Royal Horticultural Society the f caterpillars, &c., was one of the liscussed, Mr. Wilson drawing atten- e local distribution of the caterpillars. rden in his neighbourhood none of were found, while in others there was a leaf left on the trees. At Wisley on had found that exposure to east associated with the presence of the Thus the trees in one line of plums, osed, were stripped of their foliage, another line of the same variety close e same description of soil, but where were sheltered by a furze fence, not a injured.

scussion on saccharin in the Paris of Medicine was continued by Dr. n Paul, who regards the new product ble antiseptic, as it is not toxic and r an agreeable odour and savour. If does not exceed 20 centigrammes Troy), nutrition is not interfered l urea, phosphoric acid, &c., are not a quantity. Dr. Paul has had diabetic who have taken saccharin for five nd more without inconvenience. He in the proportion of 2 per cent. sac- npedes the action of pepsin on the he pig and on white of egg, as well tion of diastase on starch, without, altogether stopping the action. , though, saccharin seems to assist ntation of milk.

ar, M. Dupont, director of the Museum al History of Brussels, went to the the purpose of studying the geology ley from the Atlantic to the conflu- e Kassai river, over 400 miles from After eight months devoted to this has returned to Europe, bringing prising reports with regard to the sources of the region. He says that t the entire extent of the country he he plateaux skirting the river, under alluvium, a stratum of iron ore from t. in thickness. In numerous places cks of iron ore, sometimes many cubic nensions, upon the slopes of ravines, y had been exposed by denudation. that there is scarcely a country in so rich in iron ore as the Congo basin, ineral is not only abundant, but can sily reduced. In his opinion, if the inents ever exhaust their resources e Congo basin can easily supply the world for a long period.

of electric traction, as calculated by m data furnished by one of the New tric tram-lines, is thus compared, taking the items of cost of cars, motive power, construction of roadway, depreciation and repairs, and operating expenses (including wages): for electricity 5, for horse-traction 7·37, and for cable-haulage 7·71. The operating expenses with horse-traction are more than three times those incidental to electric traction; while the cost of constructing the roadway is double for electricity what it is for horse-traction. The cost of roadway for cable traction is necessarily the heaviest item, being double that of the electric lines. For many reasons it is to be hoped that electric traction will be taken up by speculators.

Messrs. Cooke and Richards, in the American *Chemical Journal*, describe their researches into the exact atomic weights of hydrogen and oxygen, which they find to be 1 : 15·869, which, however, they do not consider final, as there must have been a small constant error either in their process or in that of Dumas.

The vapour density of chloride of aluminium at a temperature of barely 835° C., has been found by Nilson and Petterson to agree with that required for the formula $AlCl_3$.

It is proposed to issue, under authority from the Government, a series of volumes to be entitled "The Fauna of British India," containing descriptions of the animals found in British India and its dependencies, including Ceylon and Burmah. For the present the work will be restricted to vertebrate animals. The editorship of it has been entrusted by the Secretary of State for India in Council to Mr. W. T. Blanford, and the publication to Messrs. Taylor and Francis.

USEFUL AND SCIENTIFIC NOTES.

◆

Drilling in the Olden Time.—In an article entitled "The Chalk Age of Mechanical Engineering" the American *Engineer* gives the following. Many of our readers will remember drilling with the old sway and beam, and experiences much like that amusingly described. "Those of you who have chosen mechanical engineering as a profession, and who are to devise and direct the vast engineering plants of the future, will never have among your experience anything akin to what all the older members of the profession have had, of the upright drill of the 'chalk age.' You will never enjoy the luxury of hanging on the outer end of a scantling, the other end of which was under a beam, or the vice bench, and where between you and the beam a journeyman machinist, sitting on the floor with an iron brace and a flat drill, calmly and leisurely bored holes in a fire front or mended a broken casting. When I said calmly, I meant calmly so long as the cub held the lever steadily, and the flat drill found no blow-hole in the casting into which to drop and stick fast; for when this happened the plate would slip out from under the scantling, the wimble, the lever, and the cub usually came down together in a pile on top of the prostrate journeyman, who, scrambling from out the wreck, and alternately nursing a jammed finger and rubbing a bruised leg, added brilliancy to the tableau with the blue light of his profanity."

THE American *Locomotive Engineer* tells the following:—A young fireman whose sole idea was to shovel on as much coal as possible at every possible opportunity, filled the firebox up solid so badly on one occasion that his train arrived several hours late for want of steam. The engineer had tried remonstrance in vain, and concluded that some other method than precept was necessary. "Mike," said he, "take that scoop into the blacksmith shop and tell the boss blacksmith to give her a good bit less lead." The engineer's face was as calm as a summer sea, and looked as if it might have been a masterpiece of Michael Angelo moulded in the best Spanish mahogany. Mike took the shovel into the blacksmith's shop and repeated his order. The boss Vulcan cut off about 4in. from the edge of the scoop. Mike carried it back and asked the engineer how it would suit. "All right," said the runner, "that was the trouble; she'll steam tonight." She did. Mike could not get more coal into the firebox than she would burn, work as hard as he would, and after a few trips he got weak enough to tumble to the fact that a little judgment mixed with the coal was a good thing for a fire, and that, when he knew how, it was easy work to keep an engine hot with a scoop having any amount of "lead," provided he did not work it in the corner all the time.

ACCORDING to the last report of the State Superintendent of Mines for the State of Colorado, coal is being mined in 15 counties, and the total area of coalfields for the State is estimated at 100,000 square miles.

LETTERS TO THE EDITOR.

◆

[We do not hold ourselves responsible for the opinions of our correspondents. The editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, *332, Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

⁂ *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

> "I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

◆

PHOTOGRAPHS OF LIGHTNING—VARIABLE STARS—A FEASIBLE DECIMAL SYSTEM—"GLIMPSES IN THE TWILIGHT"—ECLIPSES OF JUPITER'S SATELLITES—MAGNETIC VARIATION—THE MICROSPHAIRA—OBSERVING THE SUN—GEOLOGY—THE LIVERPOOL ASTRONOMICAL SOCIETY—THE LATE M. HOUZEAU—HUYGHENIAN EYEPIECE—IN APOGEE—THE COMMON HOUSE-FLY—DARKNESS BEYOND OUR ATMOSPHERE.

[29026.]—THE first report of the Thunderstorm Committee of the Royal Meteorological Society on the photographs of lightning flashes sent to the society, drawn up by the Hon. Ralph Abercromby, contains much that is curious and interesting. The first thing that will strike the reader to whom the subject is comparatively new, is the wide discrepancy between the conventional representation of a flash of lightning in a picture, and the autotypes of the actual flashes themselves which illustrate Mr. Abercromby's report. Here we have what he calls "stream" lightning—a perfectly regular, unbroken, and but slightly sinuous line. "Ramified," a term which explains itself; "Meandering," to me the most remarkable of all the types, resembling a filament of silk or thread looped and twisted in a way which apparently defies all theory, and "Sinuous," consisting of seven or eight vertical sinuous lines, which may either be issuing from the earth and striking up to a cloud or travelling from a cloud down to the earth. A woodcut of the discharge from a large Wimshurst influence machine is given for comparison. It is very noteworthy that thirty-two years ago Mr. James Nasmyth, F.R.S., read a paper at the British Association, in which he pointed out that the zig-zag lightning of the artist had no counterpart in Nature, and gave illustrations from drawings of a simple form of meandering lightning and also of the Ramified or branched variety. No better testimony to his accuracy at once as an observer and a draughtsman could well be imagined than that which is afforded by the photographs reproduced by Mr. Abercromby.

The June number of Gould's *Astronomical Journal* contains a valuable contribution by Mr. Edwin F. Sawyer, entitled "Some Observations of Variable Stars in 1887." It is only by such persistent watching of these mysterious objects as that which Mr. Sawyer here records that we can ever hope to frame any consistent theory of the remarkable phenomena they present. The fourteen stars he has had under observation during the past year are R Virginis, R Coronæ Borealis, S Coronæ Borealis, R Scuti, *g* Herculis, R Canis Majoris, *o* Ceti, 36 Ceti, W. Cygni, *ρ* Persei, Algol, R. Lyræ, *ε* Aurigæ, and T Monocerotis. The student should compare the actually observed times of minima of some of these stars with those predicted in *The Companion to the Observatory* for the current year.

No unprejudiced person can deny that while a decimal system might and would reduce the number of the subdivisions of our existing monetary unit, it would greatly simplify calculation; and hence any feasible method of decimalising our money, weights, and measures, would be welcomed by a very large proportion of those engaged in commerce or the arts. Now I have just come across a little pamphlet by Mr. R. T. Rohde, published by Effingham Wilson, and entitled "A Practicable Decimal System," which seems to me to contain as simple and practical plan for this purpose as I have, so far, ever met with. To begin with our coinage, Mr. Rohde suggests that, leaving the sovereign as the legal monetary unit, it shall be reckoned as = five British dollars sterling, each dollar to be = 100 cents, so that a cent would be practically identically of the value of our existing halfpenny. Then we should have, as at present, only two gold coins in this country, the five-dollar piece, or sovereign, and the 2·5 dollar piece or half sovereign, and our silver coinage would consist of the dollar = 100 cents; the half-crown of five-eighths of a dollar = 62·5 cents; the florin or half-dollar = 50 cents; the shilling or quarter dollar = 25 cents; the sixpence, or one-eighth of a dollar = 12·5 cents; and the threepenny piece, or one sixteenth of a dollar = 6·25 cents. As for the bronze coinage, the present penny, halfpenny, and farthing would become two cent, one cent, and half-cent pieces respectively. He further proposes to take our present foot as the unit of measure and divide it into 100 parts, and so on with measures of area and capacity. For details, the reader should study the pamphlet of which I am speaking, itself; it will repay perusal, and is cheap enough. One suggestion I would make to its author, should these lines in any way meet his eye. It is this: that the existing standard inch should (as advised by Sir John Herschel) be increased by precisely one-thousandth part of its length, and then a rod of fifty such inches would be exactly the 10,000,000th part of the Earth's polar axis, an infinitely more philosophical measure than the notably erroneous French mètre; and one lending itself admirably to decimal subdivision.

Perhaps "Sceptic" (letter 28978, p. 434) will pardon me if, to the expression of opinion which he invites from "Sigma," I add my own. I may, then, derive my form of expressing it from a conversation, in which, some years ago, two Englishmen (one of them a well-known astronomer) and an American were the interlocutors. They were travelling in a tram-car in one of the great American towns, and the Englishmen were discussing some question, when the American intruded suddenly into the conversation with the remark, "Wall, stranger, that's a pretty tall one, that is?" "What," angrily demanded the friend of the gentleman addressed, "do you mean by that, sir; do you insinuate that my friend is a liar?" "Wall, no, stranger," was the response, "I won't go jest so far as that; but if I was to meet him walking down Broadway in my naytyve City of New York, between Ananias and Sapphira, I should say that they was an uncommon nice family party!" Borrowing, then, from our Transatlantic cousin, I would repeat that I don't say that Dr. Lee is a liar; but that if I met him, &c.

"W. J. S." (query 65801, p. 441) must forgive me for telling him in limine that he is *not* 8' 53" west of Greenwich; but 2° 13' 15" west. His longitude is really 8m. 53s. But this has nothing to do with the *Greenwich* Mean Time of Eclipse of either of Jupiter's Satellites, which happens at the same absolute instant at every station whence the planet is then visible. Hence, if your correspondent got his Greenwich time from the Stroud Post-office by the daily electrical 10 o'clock signal, Jupiter's 1st Satellite should have reappeared from eclipse at 9h. 52m. 25s., as shown by a watch so regulated. If, on the other hand, he keeps Stroud mean time, then should the reappearance have happened at 9h. 43m. 32s. He must, however, bear in mind that the ephemerides of Jupiter's Satellites in the *Nautical Almanac* are still computed from Damoiseau's Tables, published 52 years ago, and that while they are approximately correct for Satellite I., they are sometimes wildly out for the outer Satellites.

In reply to "D. G." (query 65813, p. 444), the present variation of the compass twenty miles S.W. of London is, nearly as may be, 17½° West of North. This is much more than sufficiently accurate for setting any vane whatever.

And I may add, in answer to query 65827 (same page), that on a line running (roughly) through Winchelsea, the east end of Sheppey and Harwich, the variation this year is 17° West of North. On another running through Cowes, Southampton, Reading, Peterborough, and Spurn Head, 18° West of North. On a third, passing just to the east of Exeter to the west of Bristol, to the east of Stafford, touching the eastern part of Leeds, and going out into the North Sea, just to the east of Hartlepool, 19° West of North; and on a fourth, which passes slightly to the west of the Land's End, and to the east of Carlisle, 20° West of North, and so on. It diminishes at a varying rate, perhaps 7' or so annually just now.

I am afraid that "J. C. L." (query 65826, p. 444) quite misunderstands the purpose for which Mr. Penrose devised his microsphaira, which is in no sense a substitute for a celestial globe, and which would no more help him to find Jupiter and Saturn on the fifth of next month than a teetotum would! Its use is to solve spherical triangles by inspection. Thus, if the Right Ascension and Declination of two stars were given, the microsphaira would show the angular distance between them, and so on; but it is impossible to explain its action in the absence of the instrument itself. In fact, I could scarcely have understood it myself from the drawing and description on p. 282 of Vol. XXXVI. of the *Monthly Notices* of the R.A.S., had I not had it in my own hands, and heard the *vivâ voce* explanation of its inventor. The graduated free link has a straight edge.

I think that "Heliostat" (query 65842, p. 445), was exceedingly fortunate not to lose the sight of his eye as well as the dark glass of his eyepiece. He can cut down his 9in. aperture to 2in., or better, he can have what used to be called a "Hodgson" eyepiece, in which a transparent diagonal reflector permits the major part both of the light and heat of the sun to pass through it, and sends comparatively few rays through the eyepiece proper. The whole aperture may be used with this. Or, finally, he may darken his observatory, and, using his telescope magic-lantern-wise, may throw an image of the sun on to a tightly-stretched sheet of fine-grained white paper, one advantage of which method, among others is, that it enable half-a-dozen people to view the sun's image at the same time.

"F." (query 65854, p. 445), will certainly be unable to discriminate between glacial and ordinary aqueous gravel without a study of its surroundings, unless it should perchance contain scratched and polished boulders or stones. The London clay swarms with fossils. I have beautiful Nautili from it, with some of the nacre still intact, in my own collection. If "F." will pay a visit to the Isle of Sheppey, and work at the exposed London clay cliffs there, it will be odd if he does not come back laden with fossils. A large proportion, though, of the vegetable remains he will get are so impregnated with iron pyrites as to crumble on exposure to the air. These must be kept in water.

Surely no vote of thanks was ever better earned than that passed at the annual meeting of the Liverpool Astronomical Society to its late admirable honorary secretary, Mr. W. H. Davies; for it is a matter of public knowledge that it is to his unwearied and indefatigable exertions that the society owes its present unexampled prosperity. In days when we are nauseated with the cadging and self-seeking of people who regard science wholly and solely as a means of filling their own pockets, it is delightful to meet with such disinterested zeal as that which has prompted Mr. Davies to sacrifice his most valuable time (which, of course, in his case means money) to promote the advancement of scientific knowledge. Undoubtedly, though, in his case he finds his best thanks in the unparalleled success which has attended his exertions. Happily, the society will not lose the benefit of his counsel and services, as he is to continue in office as treasurer.

I think, too, that the Liverpool Astronomical Society may congratulate itself on the retention among its officers and council of that eminent astronomer Mr. W. F. Denning, who has worked so hard and so efficiently filled its chair during the term of his office as president. Here again we have a man actively occupied and famed all over the world as one of our first living authorities in a department of astronomy largely of his own creation, cheerfully sacrificing valuable time and money in the service of that science of which he is so distinguished a representative.

It was with the very greatest regret that I today read the first paragraph in your "Scientific News," on p. 455. In truth, in M. Houzeau, the astronomical world has lost a man whom it will be hard to replace. His profound knowledge of astronomy, both practical and theoretical, raised the Brussels Observatory to a high rank among similar national institutions; while his name will descend to distant generations, in conjunction with that of M. Lancaster, as an author of that invaluable "Bibliographie" which is of such enduring value to every astronomical student.

Mr. Booth (letter 29003, p. 457) is apparently unaware that to secure achromatism in the Huyghenian eyepiece it is imperative that the distance between its component lenses should be equal to half the sum of their focal lengths.

In reply to "A Cherub" (letter 29004, p. 457), the sun is only in apogee once a year. The earth's orbit is not a circle, but an ellipse, with the sun in one of its foci, and it travels round this orbit in 365·25636 days. Hence it arrives at the same point with reference to the sun very approximately in this period. The sun was in apogee on the 3rd inst. at 5h. p.m.; in 1889 he will be in apogee at 9 p.m. on July 1st; in 1890 at 6h. a.m. on July 3rd; in 1891 at midnight on the 3rd of July, and so on. The earth is at her minimum distance from the sun (or the sun is said to be in perigee) this year at 4h. p.m. on December 31st, at which hour they will be separated by an interval of 90,842,920 miles. "The exceedingly cold and cloudy weather experienced of late" has *not* "been occasioned, directly or indirectly, by the sun's position and that of the earth," or it ought to recur regularly at the beginning of every July, which it notoriously does not. The science of Meteorology is in much too inchoate a stage for the predication of any cause for the recent vile weather to be possible. It is absolutely false that we may look for such weather every ninth year. Nothing in the shape of a recognisable weather cycle is at present known to exist. Two or three advertising quacks some years ago made a strenuous effort to have a "Solar Physical Observatory" provided for one of ther number, that he might predict the weather from the observation of sunspots; but gullible as John Bull is, he was not quite such a fool as to be taken in by so transparently false a pretence as that.

If "A. B. C." (query 65874, p. 465) will turn over the first dead bird or animal he finds, or, in fact, search in any mass of organic matter in a state of decomposition, he will soon find out where all the swarms of flies come from. The female fly in the summer and autumn selects such localities to deposit her eggs in, laying approximately 80 at a time, and doing so four times during her life. These hatch out into maggots, at least a great many of them do, though happily large numbers are destroyed before attaining the imago form. As long as they continue in the larval stage, they eat the decaying matter in which they live; then, after a time, their outer skin hardens, becomes brown, and incloses the quondam maggot in a little case, whence, in a few days, it emerges as a fly.

In answer to query 65880 (p. 465), if we got beyond the limits of our own atmosphere we should see the sun, moon, and stars shining on a perfectly black background. Rays coming straight to the eye from a self-luminous body are perceived, but none that cross the line of vision; light, quâ light, being absolutely invisible (unless it be reflected from some body). Our atmosphere is filled with minute particles of all sorts which scatter and reflect the luminous rays. Space is void. If "W. M." can get a view of the moon through a sufficiently powerful telescope, he will see in the glare of sunlight and the inky blackness of shadows on her surface, an illustration of what would happen on our own earth, were it devoid of air.

A Fellow of the Royal Astronomical Society.

ON THE LONG LOW RIDGES AND BANKS OF THE LUNAR MARIA.

[29027.]—The existence of long ranges or ridges on, or rising from, what are usually considered to have been water surfaces on the moon, adds another to the many anomalies of lunar physiography.

There can be little doubt that the maria really represent to us—as is generally supposed—the former seas and oceans of our satellite, though now in some way solidified; not the sites of them only, or desiccated floors, as some think, but the actual seas themselves.

The more we learn about our own ocean beds the more clearly we see that they are the reverse of level, and are cut up all over by huge chasms, depressions, and cavities on an enormous scale; so much so that their unevenness may rival or even exceed that of the land surfaces.

When this is considered in relation with the fact that the maria so universally present to our view true liquid contours, it is almost enough to demonstrate that the surfaces we now see are not those of desiccated sea bottoms, but the actual surfaces of the former seas.

Most selenographers, when treating of ruined or at least apparently ruined and semi-submerged forms and bays, perhaps unwittingly use arguments that establish this view.

Proctor, in his "Moon," p. 170, refers to the maria in the same sentence as both sea surfaces and sea bottoms; but Neison, with more consistency, considers them the original seas, in some way now solidified, perhaps as "mud" (p. 49).

But the evidence derived from the surface contours is so greatly in favour of these being the actual old liquid surfaces solidified that the suggestion of enormous alluvial tracts even is untenable, more especially as there is an absence of all signs of fluviatile erosion and atmosphere.

Turning now to the long banks seen on the maria, and which on the north-eastern quadrant attain great size, it seems to be obvious that they cannot be the crests of mountain ranges that rise from the sea bottoms, and protrude above the sea surface. If we saw a string of islands, large and small, extending in line, this view might be possible; but it is incredible that these low banks, occasionally 500 miles long, and with a few hundred feet elevation, can be the continuous summit of any submarine ridge or mountain range, still less so when we see the maria all covered by similar ridges elsewhere.

Thus we seem in a peculiar dilemma; on the one hand we have good evidence that the surfaces we now see are truly the old water surfaces solidified, and on the other hand we see these surfaces covered by ridges and ranges having no foundation on the sea bottom, but whose datum is evidently the sea *surface*.

Taking Schröter's great bank on Serenitatis, or the one from Kirch to Lambert on Mare Imbrium, it seems obvious that they are surface formations, especially when we note that these banks so often mark the borders of the great marginal zones of the inclosed maria, where there is an obvious side the question of temperature and solar heat, which of course underlies all. I am beginning to feel very weary "waiting for the verdict," but I know only too well what a difficult problem it all is, and that it cannot be properly grasped at one or two readings, and is highly speculative. However, I have had some valued encouragement from savants with letters to their names, and must just have patience. I think it will be all right in time. I hope sincerely in my time.

I agree with "E. L. G." that silver-on-glass is better speculum than metal to test the lunar heat rays, or than lenses.

A singular feature *re* the moon is the absence of all trace of an atmosphere in the *past*. We know there is practically none now, but as far as surface modelling goes there is no trace of it in the past, though of course it must have existed at some period or other, and the evidence is of two kinds—negative and positive.

A, there is an utter absence of river valley forms of water erosion; hence, one might say, "no air no rain, no rain no rivers."

B, the modelling is essentially a *dry, piled* one, quite opposed to all ideas of drainage, in actual defiance of it.

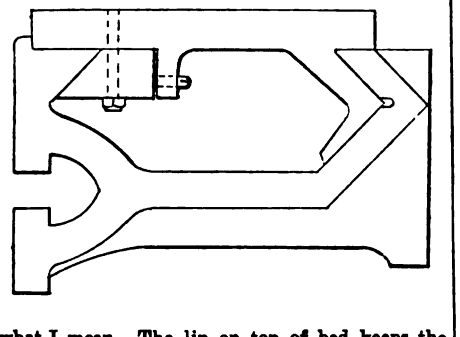
So that we may almost say we have fair evidence that the present surfacing was entirely carried out *after atmosphere had departed*. This, of course, is essential to my view, but I mention it as not really noticed.

I would awfully like to ask, and do ask, "F.R.A.S." if he can give me in a few lines the gist of Mr. T. E. Andrews' paper on "Ice and Snow and their Conductivity for Heat," "Viscoscity of Pure Ice," papers to Royal Soc., see *Nature*, page 11, May 3, first column. I am in the jungles, and can't get hold of all I should like.

Sibsagar, Asam, June 24. **S. E. Peal.**

FRONT-SLIDE LATHE.

[29031.]—As one of the chief objections to the front slide-lathe is the narrow bearing surface of saddle, consequently the too rapid wearing-out of truth of these parts, how would the double V, as used in planing machines, suit? Sketch will show



what I mean. The lip on top of bed keeps the op slide clear of turnings; it will also shed them clear of bottom slide. If there is anything in this plan, some of our friends might easily design a proper bed for it. **Tul.**

LATHE MATTERS.

[29032.]—I SEE in your paper of 20th inst. a letter from "O. J. L." in which he places the Haydon bar before Tangye's. I beg to say that there is no comparison; the Tangye bar being a far better tool for all-round work; besides which, the cutters are so simple to grind.

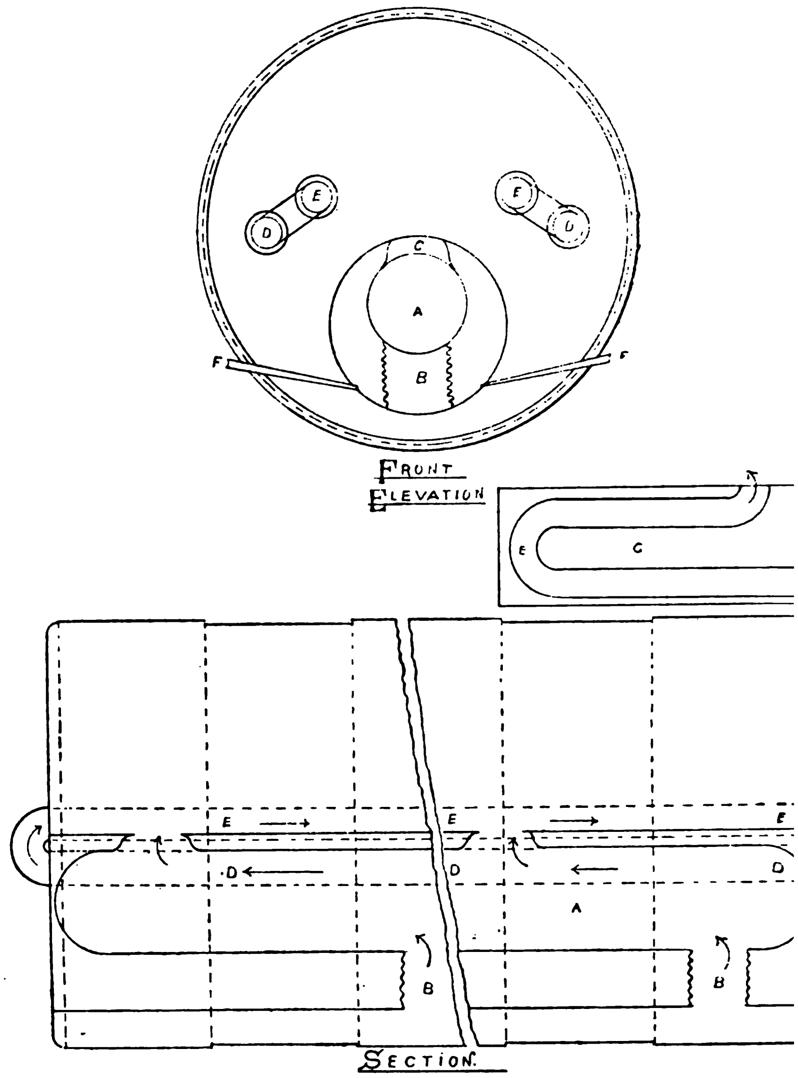
I have entirely discarded my Haydon bar on account of its small scope of work, and time expended in grinding the cutters.

There is another point in favour of the Tangye bar—viz., it holds the cutters so much firmer than the Haydon, and any amateur or professional that has used both bars will, I feel sure, be of my opinion. **Tara.**

[29033.]—MANY thanks to "J. K. P." for kindly noticing my query about testing lathe screws. I saw a differential motion by J. Rose, described in a back number, for very slightly drawing along the lead-screw of a lathe which was of a slightly too great or too small a pitch. Is not the Rogers-Bond comparator used for the comparison of scales and screws? Could the uncertainty in comparing screws such as "A and B" arise from a slight amount of drunkenness in either? But then that would not account for the same kind of uncertainty occurring in the measurement of bars. I presume the perfection of the fit of the nut would be of great importance, and perhaps it would have to be split and adjustable? Still, all this does not touch the question of drunkenness. I have never been able to screw a chuck in my slide-lathe and then find it run true when put on the mandrel—nearly *perhaps; but* a 4in. flange would be out by the thickness of a visiting card one side when touching the tool point at the other. I suppose this must be due to a slight amount of drunkenness somewhere in the threads of the mandrel or of the lead-screw. Can *anyone* screw a chuck, such as a face-plate, and have it run true when put on the nose? Watching the movements of a die-stock when fixed on a drunken screw revolved in the lathe, one sees a curious wriggling of the handles, and this suggested that by a similar arrangement of two dies embracing but a small part of the circle, on opposite sides, and having a pointer instead of the handles, which pointer would travel along a standard scale, one might detect a very small error in the direction of drunkenness. I have never tried this, because I thought that there was very likely some much better way. I have been told that cheap lathe screws are cut up in a tapping machine by the score, and not done in the slide lathe at all, and I suppose that method cannot be expected to give even approximately correct results. It occurred to me that if a lathe having a drunken screw were used to cut a screw of half its pitch, that the result would be a screw having the thread irregularly spaced, one larger and one smaller space coming alternately, which error would be obliterated by passing the dies over the new screw. Possibly, by continually cutting one screw by another, and using the new one as a parent for a third, &c., errors in the breed (if I may so express it) would be spread and gradually eliminated.

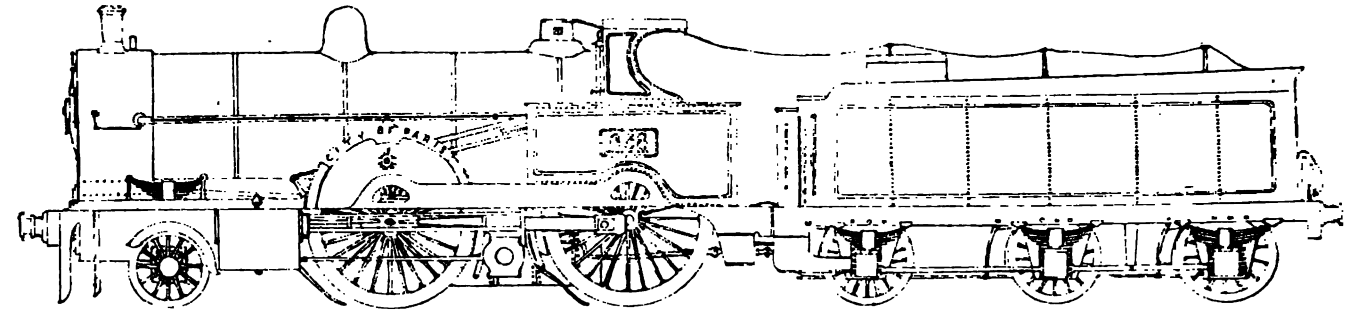
I hope someone will discuss the Barnes lathe in response to "O. J. L." It has some very good points. Is not the gearing below simply because the crank must be low down, too low for the centre of the flywheel, and so cogs are needed to connect?

F. A. M.



SCOTT'S BOILERS.

[29034.]—THIS system of generating steam has been invented by me. It is based upon the dynamic principle that heat is a mode of motion, and that the nearer the centres of energy or combining points of the atoms are to the furnace plates the greater is the amount of heat transmitted to the water. Frequently in the body of the burning fuel there is upwards of 8,000° of heat, while in proximity to the furnace plates less than 3,000° of
heat. If the heat does not reach the fur
it cannot be transmitted to the water.
therefore, the centres of energy are to
plates the greater will be the efficie
boiler. To secure the full benefits of
have entirely dispensed with fire-bar
fuel is placed upon the bottom of th
Combustion is supported and stimula
extent desired by the introduction of c
currents of air direct to the fuel under
The concentrated currents pass throug
constructed tuyeres, which are surr
water. While greater economy is secure
ing the fuel upon the furnace plates, yet t
of energy are then too far removed from
the furnace. To overcome this defect a
increase the efficiency of the system, a
is placed in the furnace. The size of this t
according to the size of the furnace. In
36in. diam., this tube would be 22in. in
placed 2in. from the top, leaving 12in. be
bottom of the tube and the bottom of the f
burning the fuel. It is claimed that
tube greatly adds to the efficiency of the s
flame and heated gases are forced betwe
and the furnace, the detention of t
retarded, and the practical effect is muc
by reason of the heat being concentrated
to impinge upon the plates. This int
has two connections at the top of the f
two connections at the bottom. This t
fore, promotes a large and constant cir
water in the boiler. This retards the
of incrustation, and causes the water to
equal temperature, and also produces a
pansion upon the furnace plates.
verting water into steam a film is fo
the plates; as this film is a non
it prevents the ready transmission o
to the water. The great circulation of
through this tube and through the boiler
this film, and brings the water into clo
with the plates, and further increases th
of the system. In Cornish and Lanca
this tube extends the whole length of th
marine boilers it extends from the fr
furnace to the rear of the combustion ch
the most essential part of the furnace t
surface is three times greater in this s
where firebars are used, and the inve



equal 4" for argument, then the mirror C must move 2". If the now corrected mirror is examined at centre of curve, what will be the result? Evidently the return ray will be separated from the incident ray B^1 exactly 2", and as $B^1 C$ equals twice $B^1 F$, the aberration at centre of curve will be twice that of a circular mirror at focus—that is, $B^1 B^2$ equals twice $F^1 F^2$. This is usually said to be four times the focal alteration; but I cannot reconcile this with the conditions. I am open to have error pointed out.

It appears also to me that the way in which this longitudinal aberration affects the definition is through the lateral aberration it causes. If we take an over-corrected mirror at focal point (Fig. 2) and let F be correct focus and F^1 the actual focus of outside zone, and A F a perpendicular from A, then the triangle $A F^1 F^2$ is similar to F C E, and $A F^1$ is nearly in proportion to $A F^2$ as C E is to $E F^2$—that is, as 12 to 1. The lateral aberration is then $^1/_{12}$th of the longitudinal, or, as it extends on both sides of the central line, it is ⅛th, or, in the case given, it equals ·01, nearly.

As the image of any point at the focus is not a point, but a spurious disc, it follows that if any telescope is so far corrected that these lateral aberrations do not extend beyond the necessary spurious disc, it is practically perfect. Over- or under-correction within these limits can in no way affect the final image, and must remain quite undiscoverable to every eye and under any power. This will not be found to give any very great latitude, however; but it serves to indicate the reason why mirrors, which testing shows to be slightly under or over-correct, give as perfect practical results as if they were absolutely perfect in figure.

Edwin Holmes.

FOUR DIMENSIONS.

[29038.]—AS a line that had length without breadth would belong to a world admitting of one dimension only, such a line may be kept out of court when the existence of a region where things have four dimensions is concerned. A line in this case must be regarded as having breadth as well as length. But, that being so, every perfect line has two parallel sides—i.e., is bounded on the two longer sides by two parallel lines, that, to shorten arguments, it may be allowable to regard as Euclidian. Parallel lines, say some, if extended infinitely will meet. If so, the two sides of our real line will do so under such circumstances, and when they meet the line will come to point and there end, and consequently be incapable of any further extension; and this with a line that is extended *ad infinitum*.

Again, let two of our lines be set parallel to each other—i.e., with their bases of the long triangles that are to be on the same line with each other, and then let both be extended till they both become triangles—i.e., both came to a point. The inner lines of the limiting four will then have receded from each other instead of meeting! Thus does the theory that lines can "go on for ever" parallel to each other, and yet after a certain stage is passed cease to be parallel, refute itself; though, indeed, no further proof of its absurdity can be needed than the mere attempt to shatter such an inconceivable idea.

K. L.

JADE IN THE BRITISH ISLES.

[29039.]—SOME months ago a correspondent stated in the pages of the *St. James's Gazette* that there is reason to believe that there formerly existed a vein of jade (since worn away by abrasion) in the neighbourhood of the island of Iona, and that pebbles of this stone are occasionally found there; but there seems to be some doubt if these pebbles are really jade. The fact that antiquities made of this stone have been found from time to time in Europe, as at Wangen, in considerable numbers, would seem to point to a nearer source of supply than China, which is, I believe, the nearest at present known.

Should any of your readers be able to throw light on this interesting subject, they would, by *doing so in the* pages of the "E. M.," greatly *oblige*.

July 18. **E. C. R.**

THE FLYING SCOTCHMEN: (1) L. AND N.W.R.

[29040.]—THIS train now consists of seven superb new bogie carriages and a Webb big Compound, as elevation sketch above, in place of the old 4-coupled "Precedent" engine, which has run this train for many years. It leaves Euston at 10 a.m. and Willesden Junction at 10.11 a.m., and arrives at Rugby at 11.42, leaving at 11.47 for Crewe, where it arrives at 1.15 p.m., and, after changing engines, starts 7min. later for Preston, where 25min. are allowed for passengers to dine, from 2.22 p.m. to 2.47. The next and last stoppage is at Carlisle at 4.40, whence a third engine runs the train into Glasgow by 7 o'clock, or 9 hours from Euston. The whole train is fitted with both vacuum and Westinghouse brakes. Sketches of the Midland and Great Northern in later numbers.

Richmond. **H. E. Bickerton.**

THE BOEHM FLUTE.—V.

[29041.]—I HAVE stated that flute heads of wood lined with metal are imperfect, heavy, and produce indifferent quality of tones. Silver or ebonite should produce the best head, as neither require lining with a tube; but although it is against makers' ideas, still I believe that a head of cocus wood, well saturated for some time before manufacture with linseed oil, and then thinly varnished internally, would be better than either, from some points of view. Still, somehow or other, experts object to varnish the inside of a wood instrument, and the only reasons I can surmise are that it may crack off, or that it causes the breath of the player to condense and the water to roll in globules while passing down the tube. In the oboe this of course would be a distinct defect, as these spherules might roll under the key-pads, and the sound-holes being small, would get choked; but in the flute the keys are all placed on the upper circumference of the tube, and being of large size this action could not do any harm. I have had a varnished wood flute for some years now, and find it is an improvement. The mouthpiece or head of every wind instrument being the tone-producer, a good head is the ambition of every player. If the head of a flute by one maker is changed for that of another, it is rare that the flute then will be in tune, even with itself; for besides the length, proportions, and parabola, other small differences are arranged to be adjusted between each flute-tube and its individual head. These differences may be much or little; still, they do exist, and make the change of head, unless adjusted by the maker, rarely an improvement. Instrumental performers seldom have time or inclination to investigate the basis on which musical instruments are constructed, and few players, I imagine, could give a clear, intelligent demonstration of the production of sound in a flute, by the action of air blown across the mouth-hole. The fact is now well known "that the issuing stream of air from the performer's lip acts the part of a reed," and is called by Hermann Smith an aëro-plastic reed. Schnæbeli considers its effect to be condensatory; Hermann Smith maintains that its action is exhaustive or rarefactive. Now it is curious that the simplest and most probable explanation of this action is, that it is alternatively condensatory and rarefactive. Air passing rapidly *over* the flute mouth-hole is certainly rarefactive, but when passing *into* the instrument it must be condensatory. Air when urged over the mouth-hole drags some air out of the flute, and this drag changes somewhat the direction of the air stream, lowering its path and causing it to flow into the mouth-hole; when it does so it compresses or condenses the air column within, and hinders the further entrance of air, reaction ensues, and the stream being then deflected slightly upward, flows over the mouth-hole again (this phenomenon taking place about the rate of from 250 to 1,000 times per second), thus throwing the internal column of air into vibration, and so producing sound. The hinge or pivot on which this vibratory movement turns being the sharp edge of the mouth-hole, the length of closed tube below acts as a regulator to the speed of vibration, and consequently the pitch of the note produced. When a flute sounds its lowest note C there is formed in the tube one node (or place of no vibration), which is located in the middle of the instrument, exactly at equal distances from the mouth-hole and the lower end of the tube. The middle of the ventrical segment (or place of greatest vibration) is at the mouth-hole, and another is at the lower end of the tube. The spaces from the mouth hole to this node and from this node to the lower end of the tube contain one-half of a ventral segment in each, and thus both the mouth-hole and the end of the tube are each the centre of a v.s., or place of greatest vibration. C_2 has two nodes, one complete v.s. in the centre, and a half at each end. C_3 has four nodes, three v.s. and the two halves. C_4 has eight nodes, seven v.s. and the two halves, &c. Each intermediate note shifts the positions of these nodes, according as the tube is shortened or lengthened by the opening or closing of the keys. The reason that cross-fingering is required for some notes is that some holes if too near a node, when the proper note is sounding, they (the holes) might alter the position of the v.s., and so alter its pitch, or cause the note to break down. So these dangerous holes are closed while those at the proper positions are left open to assist the formation of v.s. If, however, an open hole is slightly above the middle of a v.s., its tendency is to sharpen the pitch by drawing the v.s. up and so shortening all the v.s.; but if the position of an open hole is slightly below the centre of a v.s. its tendency is to flatten, by causing an extension of all the v.s. Now it is not required to have an open hole at each v.s. nor yet a closed tube at every node, but their nearness to such positions influences the pitch and intensity of the sounds produced, and although one correct open hole will start a note in a closed tube, still, if one or two open holes are near to nodes they will alter the pitch, enfeeble the tone, or prevent the required sound from being produced. It is instructive to draw all the v. s. and nodes of one octave of a flute on a sheet of paper, each on the top of the others, and if done with care, it will show much to the intelligent and thinking student.

Vulcanite.

FLUTE.

[29042.]—ACOUSTICAL experiments which I made with differently-shaped pieces of wood, the result of which I stated in "Ours," September 20th, 1878. "Vulcanite" may not have seen that statement, and wishing to have his opinion on it, I will state a part of it again.

I found that a flute made of wood cannot produce a tone of good quality unless made oval-shaped, for the reason following:—If we take a piece of wood of any kind about 3ft. long, 3in. wide, and 1in. thick, fasten a thin silk thread on one-eighth of its length from the end, and hang it up so that it is disconnected from other matter. If we then strike it with a small hammer on the broad or flat side, a musical note is produced. The same will take place when we strike the edge of the board; but this note is much higher than the first mentioned. Now we will suppose that these two notes are in harmony, and if that is so, the sound of the combined notes is of good quality. But I must say now that by striking either side we always hear both, only the tone of that side which is struck is more prominent. After this we take a few shavings off the edge; this will lower that note so much as to be inharmonious to the note emanating from the flat side. The tone of the board now is not so loud, and the quality is bad, comparatively speaking. If we take a little more from the edge, we again get a note in harmony with that of the flat side, and so on. Now when we come to 1in. square, the tone produced on either side would be equal if the grain of the wood did not differ, for that side which is in a line with the diameter of the tree is always higher. I have found it to be as much as a semi-tone. A flute made of such material cannot produce a tone as good as one made of homogeneous material.

In the letter, as stated above, I asked whether anything in nature grows inharmonic to its sides?—whether the sides of crystals are in harmony? But no answer has been given yet.

J. H. Schucht.

EYEPIECES.

[29043.]—MR. BOOTH (letter 29008) would find it much better to get an eyepiece of the A. J. S. form than the one he proposes. With the A. J. S. he could double his power without removing his eye, while within wide limits it is more perfectly corrected than the Huyghenian both for colour and spherical aberration. It admits, too, of graduating the power to any nicety, instead of proceeding by jumps, as the one he suggests necessitates. The A. J. S. would also be cheaper as well as better. I venture to predict if he gets one made he will seldom use any other within the limits of its power.

E. Holmes.

THE PATHOLOGY OF VEGETABLE LIFE.

[29044.]—YOUR correspondent "M. B.," in asking, "Do plants die of old age or from disease?" opens up a question in the pathology of vegetable life that very little is known about, and which has never been satisfactorily solved. We know that plants die from disease or decay, and other causes; but what gives rise to those primary causes, whose effect is to arrest the life of the plant, we cannot tell.

The health and life of a plant depend mainly upon light, heat, and moisture, and the withdrawal of any of these necessaries for a prolonged period, impedes nutrition and transpiration, endangers the proper elaboration of the sap, prevents the development of new tissue, and disarranges the whole organism.

It is a singular fact, and one that proves the extreme susceptibility of plant life to climatic effect, that certain poisonous plants grown in some districts are innocuous when grown in others. Such a difference can only be attributed to the varied conditions of soil and moisture under which plants are developed, to have so important an influence on their secretions. Plants often die from the effects of cold, especially those indigenous to warm and tropical climates, where the light is more intense, even if placed in our hot-houses, where they may be subjected to the same temperature. The heat being obtained by artificial means, and not naturally, their secretions are not formed at all, and death ensues.

We know that plants which have been kept in a warm room indoors, if, after some time, exposed to the ordinary temperature outside, or even placed in a position where they come in contact with a draught, will wither and die. It is seldom, if ever, a tree having attained full maturity, really dies of old age, without there being some primary cause for cessation of life, that is, if climatic and other influences are in harmony. Death may be caused in a plant (1) by the arresting or failure of any one of the following necessary functions to its life —viz., absorption, circulation, respiration, assimilation, development, and secretion. (2) By various climatic differences and excesses, as heat, cold, moisture, and light. How these several effects act we can only conjecture—most probably, through the deficiency of circulation and assimilation, the membrane constituting the walls of the cells gradually becomes hardened and encrusted by the deposit of earthy matters which have been left behind by the fluid substances that are transmitted through them, so that the tissues become choked up and no longer able to perform their proper functions, and become hard; the secretions are therefore not able to be developed, and death follows.

July 16. C. J. S. T.

RANGE-FINDER—NEW IDEA?

[29045.]—MR. RATHBONE (letter 29005, p. 457) can have no experience of range-finders or range-finding, or else he would never think that such a crude device as he mentions (and which, in another form—viz., Cavalli's micrometer, was invented many years ago) would be of any use to your military readers, or anyone else.

Supposing that the enemy were kind enough to put 6ft. targets in front of their advancing line of skirmishers, to enable Mr. Rathbone to take the range, he would find that with a base of 6ft. at 800 yards, the angle subtended would be about 10½ minutes, and at 900 yards about 7½ minutes, angles which he would find difficulty in taking accurately with a good instrument, and which the eye alone, and unaided, would not be able to distinguish between.

In all practical instruments the base is at the finder's end of the range, and any elementary treatise on geometry will give several examples of how to find the distance without the aid of instruments, providing you have the time.

In conclusion I would suggest that, before appearing in print, it would have been better if this genleman had studied the theory of some of the range finders, which have been so well illustrated at various times in the ENGLISH MECHANIC. Mr. Gr., B.A.

A PROBLEM IN DYNAMICS.

[29046.]—A DESCENDING body, P, draws another, Q, by means of a given system of pulleys along a horizontal plane; to determine their velocities, v and v', friction and the weight of pulleys being neglected.

If we proceed by the old method—that is, the one in use before the term "energy" was introduced—the way would be as follows:—A given *moving force* produces the same *quantity of motion*, whatever be the mass acted upon. If, then, both P and Q were being moved by it, the quantity of motion produced would be $v P + v' Q$. But if it acted on P only, producing a velocity, g, the quantity of motion would be $P g$, and these two expressions must be equal—that is, $v P + v' Q = P g$...(A). As there are two unknown quantities, v and v', we need a second equation between them furnished by the conditions of the problem, which is easily done by simple geometrical considerations when the system of pulleys is given. Thus, if we had only one pulley—to wit, that over which the string attached to P passes—the velocities of P and Q would be the same, v ε $v' = v$, and eqn. A gives $v = \frac{P g}{P + Q}$, as is well known. Suppose the system of pulleys were such that the velocity of Q is n times that of P, or $v' = n v$, we should have $v = \frac{P g}{P + n Q}$.

If we take two pulleys, as in the figure on p. 376, Q moves with twice the velocity of P. The value for v given by "M.I.C.E." is $\frac{P g}{P + n^2 Q}$, which, however, will not satisfy the condition as to quantities of motion mentioned above. I am unable to analyse his work, having been for some fifty years accustomed to employ the old method only. Nor is it easy to see what is the exact meaning of the term "energy"; if it were, we should hardly have two such men as "M.I.C.E." and Mr. Clodd differing about it as they seem to do. The latter, I believe, thinks that it must mean "repulsive force," such, I suppose, as would be exerted by compressed air, steam, &c.; in which case it would only amount to a new name for what used to be called their elasticity.

When old names are found to be ambiguous, they should be replaced by new ones; but it would seem not to be well to do so otherwise, or even to introduce a new name whose meaning is not clearer than the old one. As to introducing new *methods*, if they lead more simply to correct or more general results, we had better do so. Perhaps in the above problem it will be difficult to find a simpler or more trustworthy method than the old one.

I am sorry to find that I mistook the meaning of "M.I.C.E." as to the problem of the illumination of the road, and consequently sent the answer which belongs to a different problem. The fault lies entirely on my side, and not on his.

July 11. W. G. P.

SOME LITTLE-KNOWN PLANTS OF THE "FLORA MEDICA."

[29047.]—LEGUMINOSÆ — *Hedysarum alhagi* (or camel thorn) — producing "manna of the desert"; a native of the deserts of Egypt, Syria, Mesopotamia, Persia, and Northern India. From Delhi, through the great sandy wastes of the Punjaub to the western coast, this spinous shrub everywhere meets the eye; but I never found a specimen of this secretion. On the high authority of Royle, the plant does not produce it in India, Arabia, or Egypt. Persia and Bokhara seem its proper districts. Tournefort states that this manna is common on the "alhagis," in the environs of Tauris, in Persia. At Basoorah it is collected, and is also common in Khorasan on a small bush called "El hadsje." This manna occurs in small, round, unequal grains the size of coriander seeds, of yellowish-white colour, caking together and forming an opaque mass, in which are found portions of the thorns and fruits of the plant—inodorous, its flavour sweetly saccharine, followed by slight acridity. In every respect it seems identical with the manna of the Jews. Under the Oriental name of Turunjabin, it is imported into India; but it is rarely pure. The best used to fetch 10s. the pound avoirdupois. No analysis, to my knowledge, has been made. It is administered as a laxative in India. Eos.

RUSSIA is endeavouring to foster a new industry by extending the use of her stores of petroleum. Experiments are now being carried on for solidifying the petroleum used as fuel. These experiments have been mainly under the charge of Dr. Kauffmann, and he forms a compact mass out of the liquid by adding to it 1 to 8 per cent. of soap whilst the oil is in a heated state, the resulting product being of the hardness of compact tallow. It is stated that the product is difficult to light, burns slowly and without smoke, but develops much heat, and leaves about 2 per cent. of a hard black residuum.

REPLIES TO QUERIES.

◆

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[65284.]—**Ichneumon.**—The "fly" that "Dutch Paul" saw alight on the spider and sting it was an ichneumon. These latter, a large group of the Hymenoptera (bees, wasps, &c.), especially common and varied in the Tropics. They build clay nests, or have holes in the ground or dead trees, and some lay one egg in each hole, and then fill in six or eight live spiders for the young grub to feed on when hatched out. Each spider is so stung as to paralyse and yet not kill it. On the egg being hatched out, the minute yellow worm at once begins to devour spider No. 1, who, though alive, cannot offer any resistance, and he dies during some part of the process. No. 2 is then begun on and eaten through, and so on to the last, by which time the worm is mature, and emerges to "crystallise" himself, and pass into an ichneumon. The whole affair is most revolting to our notions of beneficent design in creation, and strikes a severe blow at it. It is suspected the ichneumonidæ can, in some way, count, as they put a certain number of spiders in holes containing eggs of male worms, and a greater number invariably in those containing eggs that will be female (and larger) worms.

S. E. PEAL.

[65294.]—**Great Lick Refractor (U.Q.)**—An illustrated description of this telescope, reprinted from the *Scientific American*, was given in the *Engineer* for July 6, 1888, from which the following is taken:—"The tube is made of hard steel plates riveted together. It was shipped in four sections, besides the cast-iron central sections, which were connected by bolts through flanges at their extremities. The plates near the middle of the tube are $\frac{3}{16}$in. thick, and the thickness of the sheets diminishes towards the ends, where it is $\frac{1}{8}$in. The tube is 52ft. long, 4ft. diameter in the middle, and tapers to a little over 3ft. at the ends."

A. J. H.

[65414.]—**Caledonian Railway Loco. (U.Q.)** —The long-boiler engines, erroneously supposed by "J. A." to be of recent date, have been out 11 to 14 years. They are known as the "special" class, and are 39 in number. They vary slightly in weight, the last ten being somewhat heavier than the two preceding lots; but the dimensions are mainly the same. The dimensions are:—Cylinders, 18in. by 24in.; wheels, six-coupled, 5ft. 2in. diam.; wheel base, 11ft.; boiler, 4ft. 2in. by 14ft. 5in.; firebox, 4ft. 3in. by 3ft. 4½in. by 5ft. 2½in.; 134 tubes, 2in. diam. Heating surface: Tubes 990sq.ft., firebox 92·5sq.ft.; total H.S., 1072·5sq.ft.; grate, 143sq.ft.; weight of engine, 37tons 3cwt. 2qrs. (in working order); tender, 1,840gal. water; weight, 28tons 5cwt. These engines are, on the whole, very well liked, though they are somewhat rough on the footplate. Some of the earlier lot were much too light at the leading end, and had a heavy cast-iron buffer beam added to equalise the weight.

J. F. MUNRO.

[65473.]—**Survival.**—"B.'s" difficulty appears to be of his own creating. Surely it is plain enough. Those animals "fit" to live in certain conditions were crowded out by those "fitter" to live in other environments; and those again by the animals "fittest" to survive in all conditions. He could say, of course, that these last were simply "fit" to survive, but it is really attempting to split a hair which does not exist to criticise Darwin's phrase, "fittest to survive," in the manner adopted by "B." VIDEO.

[65496.] — **Violoncello.** — The exact position must be obtained by experiment. Average about 1in. behind right foot of bridge. Let grain of soundpost cross to grain of belly. To take off the back, insert thin blade of knife, and go carefully round. Surely you do not intend moving the back to fix the soundpost. I have known this to be done. If not a little more than a cabinet-maker, leave the job for practical man. OMICRON.

[65569.]—**Preserving Milk.**—It is a matter for experiment how long carbonic acid under pressure will preserve milk; but I should think not a very long time—not more than a month, say. E. G.

[65573.] — **Gazogene.** — The querist should surely be able to see how to fit the new tube in when he has the apparatus before him; but if he means what luting to use, let him try fresh plaster of Paris mixed thin with alum water. P. M.

[65577.] — **Bunsen Gas Burner.** — A most interesting little exercise in experimental science to ascertain the amount of air mixed with coal-gas in a Bunsen burner. Ascertain the area of the inlets and the rate of inflow of air, and there you have it; but the simpler way would be to supply the air from a gasometer, and then knowing the capacity of the gasometer and taking note of the time, every inch fall of the reservoir would show almost exactly the quantity of air consumed.

NUN. DOR.

[65578.]—**Polishing Steel.**—The "beautiful black polish on steel" is what is known as burnishing, and is done, as a rule, by rubbing a piece of highly-polished steel rod over the work, using considerable pressure. The effect is to produce a surface almost perfectly free from marks of any kind, and consequently one that reflects all the light—hence it appears black. NUN. DOR.

[65581.]—**Trust Office.**—Why does not this querist apply to the Agent-General for New Zealand, Sir F. D. Bell, 7, Westminster Chambers, S.W., instead of occupying space with a query that can be of no interest to more than one out of a million readers? Let him address his letter to the Agent-General for New Zealand, and state the facts simply and plainly, and no doubt he will receive a satisfactory answer. NUN. DOR.

[65585.]—**Gas Bags.**—Better use the rubber cloth, if they must be made, as the pulses are sometimes rather strong; but why not purchase one of the usual bags or "pneumatic" balls (i.e., a ball with a neck at each end) to be had from the druggists' sundries men—say, Maw, Son, and Thompson, Aldersgate-street. Rubber cloth will do; but smear the joints well, and butt them—that is, lay a piece of smeared calico over; press with warm iron, and, if necessary, stitch, covering with solution afterwards. NUN. DOR.

[65590.]—**Electrical Clock.**—That must be a peculiar number of the "E. M." which "J. H. S." says (p. 361) is "without date on it." If, however, the "reading" and the sketches given p. 231, Vol. XXXV. No. 895, which does bear a date, do not convey accurate information to this querist, I would suggest that all he has to do is to procure a copy of the specification of the patent, in which the information must be given accurately, or the patent would be invalid. At any rate, one would think that the querist ought to point out the passages in the article which puzzle him, for he can scarcely expect readers to wade through the description and then guess. NUN. DOR.

[65594.]—**Fuel and Heat Saving, &c.**—I daresay I shall "catch it hot"; but allow me timidly to suggest that, as a complete answer to this query would be of commercial advantage to the querist, he should call in an expert, who will have an opportunity (denied to readers of the query) of inspecting the plant, and who will consequently be in a position to advise. Of course, he will have to pay the expert a fee; but what of that, when he will, if possible, make a profit on the transaction? NUN. DOR.

[65602.]—**Camera Obscura.**—"J. W." should look in Ganot's "Physics," or some similar work, and let us know which form of camera obscura he requires. Porta's has a double convex lens, leading light into a box; but the ordinary form is vertical, and in that a triangular prism is used. No doubt some of our optical correspondents could give full details, but somehow the query seems to have escaped their attention. NUN. DOR.

[65609.]—**Germanium.**—This is a new metal, I believe. I remember reading something about it in the "E. M.," but have not time to look up the matter. No doubt all particulars have appeared in the *Chemical News*. F. C. S.

[65633.]—**Aquarium.**—There are plenty of aquariums described in back numbers. Perhaps the instructions in No. 900, p. 317, will suit querist. T. J.

[65635.]—**Gas Lighters.**—What is the dynamo electric gas lighter? The battery and the influence machine forms have been described; but is there one in which a dynamo is used? D. D.

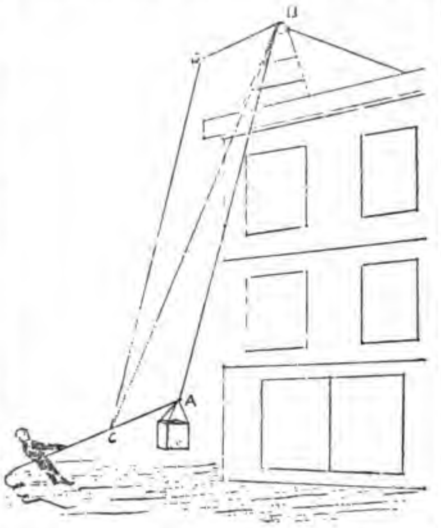
[65758.]—**Railway Gauge.**—The "Encyclopædia Britannica," ninth edition, thus accounts for the 4ft. 8½in. gauge. "The fact seems to be that the track of the original carts or trains, 5ft. wide outside the wheels, was taken as a standard for the gauge of rails, which was measured outside also. The width of the single rail at the top being originally 1¾in., the width of the two rails together is 3½in., which leaves 4ft. 8½in. for the inside measure or true gauge." T. PERKINS.

[65766.]—**Harmonium.**—The replies of "Don" and "C. W. B." (p. 461) will supply the querist with the remedy he requires; but it may be as well to point out that when the part of the bottom board carrying the leather valve is not removed, the old leather should be pulled out, as it is apt to make a noise. The simplest remedy for the disease is prevention, and that is obtained by tacking the leather down at each corner instead of allowing it to form a hinge valve. ORGANON.

[65767.]—**Mechanics.**—Noticing that I did not mark the angles on the figure (p. 462), as intended, I herewith supply them: $A\,B\,D = \theta$; $A\,D\,B = \theta$; $A\,D\,C = \theta_2$.

Portsmouth. A. M.

[65798.]—**Statics.**—Take the length A B representing the weight of load in pounds, and A C representing the pull of the man in the same proportion, which, I presume, you know how to find. Knowing weight of load—that is, B A = 80lb., represented by 2in., say; then C A = 20lb., represented by ½in. Of course, this is but supposition. Draw C D parallel to A B, and B D parallel to A C, intersecting in D. Then the diagonal B C will represent the strain on crane in magnitude and direction. BEART.



[65802.]—**American Gallon.**—The American standard gallon measures 231·00 cubic inches at 60° F. The imperial gallon measures 277·27 cubic inches at 62° F. J. M. M.

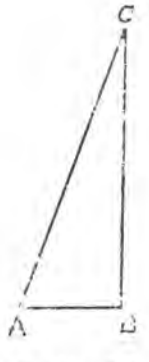
[65805.]—**Circular Saw.**—Would not the continuous roller feed-saw bench answer E. Jackson's purpose? Supplied by most makers of wood-working machinery. There are, I believe, saw-benches in America with reversing rollers to bring the timber back again ready to be sawn. I don't know of any in this country, and should there be, I should say it would be a disadvantage rather than an advantage where there is a continuous feed.

SCORRIER SAW MILLS.

[65806.]—**Trigonometry.**—It seems that the querist desires a little assistance in starting trigonometry, and as I have lately taught myself the rudiments of that intricate study, perhaps I may be better able to explain the difficulties than an advanced student would. Let us call the angles thus:—

$$C\,A\,B = a$$
$$A\,B\,C = b$$
$$B\,C\,A = c$$

Now, according to Euclid (Book I. prop. 47) $A\,C^2 = A\,B^2 + B\,C^2$. Therefore, if we square 10 (which will give 100), and also square 7,500 (giving 56,250,000), and add the two results (= 56,250,100) the sum will be the square of the hypothenuse. Extracting the square root of 56,250,100 in the usual way, we obtain 7,500·0066ft., which is the length required. So that the hypothenuse in the first case would only exceed the longer side by $\frac{792}{10,000}$ths of an inch. Now, if you turn the triangle round so that C B is lowermost, you see that the line A B would be the sine of the angle *c* referred to radius A C. The trigonometrical sine is only a fraction (decimal) which expresses the relation which the line called a sine bears to the radius. Dividing, then, 10 by 7,500·0066, we obtain ·00133333. I am not fortunate enough to possess a proper table of sines, but as the sine of 1′ is 0·0029088, the angle represented by ·00133333 would be about 4′ 35″. Of course, it is not strictly correct to obtain the sine in this manner, as arcs are not proportional to their sines; but with so small an angle the error is inappreciable. I now give the results only in the remaining five cases.



(2) Hypothenuse = 6000·00833ft.
and angle *c* = 5′ 44′ about.
(3) " = 4500·01111ft.
and angle *c* = 7′ 38″ about.
(4) " = 3000·01666ft.
and angle *c* = 11′ 28′ about.
(5) " = 1500·03333ft.
and angle *c* = 22′ 55′ about.
(6) " = 300·16662ft.
and angle *c* = 1° 55′ about.

In conclusion, allow me to recommend Hunter's "Elements of Plane Trigonometry" (Gleig's Series), price 1s., as the best possible book to use for acquiring a sound knowledge of the principles, without the help of any teacher.

YOUNG ANALYST.

[65808.]—**Boots.**—If "W. R. C." has not found a bootmaker to suit him, I would recommend him to one who works for me to my satisfaction. He makes the last and uppers according to the feet. You will find his address in Address column.

J. H. SCHUCHT.

[65808.]—**Boots.**—"W. R. C." is quite right with regard to what shoemakers promise and what they perform when making boots for feet such as he has; but I am pleased to say that if he lives in or near London, he need not any longer suffer. Mr. H. Levy makes a last the shape of the foot, and the boots according to the last; he then numbers the last, and at any future time it is only needful to give the number, and he will make the boots accordingly. BIPED.

[65808.]—**Boots.**—Some few years ago I made a number of sketches *re* boot and shoe-making, and started some articles in the "E.M.," but from a series of accidents I have been thoroughly incapacitated from carrying them through. I have nevertheless preserved the sketches, fully intending to carry them through the first opportunity. Having made some hundreds of pairs in my time, having had more than one seat of work, and therefore had a little experience, I know the difficulty there is in getting what "W. R. C." requires. These things are looked upon as a malformation. They cannot be kept in stock, and lasts cannot be made to the feet—first, there is no sale for them; secondly, if lasts were made to the feet, and the shoe made upon them, it would have to remain there, unless you ripped up through the centre of the sole, then there might be some possibility of getting the last out, and the shoe or boot, well, there it is. Now, if you will advertise your address in the "E.M.," I will do my best to fit you up a pair of lasts, and be able to assist you otherwise if you will communicate with me or pay me a visit. There were some shops that keep what was called old ladies' and old gentlemen's comfortables (i.e., broad tread shoes), but it was found that it was impossible to fit people's head and feet at the same time, and they in consequence remained on stock—old shopkeepers, until perished, a dead loss. Rather than be seen in them, people would undergo punishment out and take their pennyworth of ease at home in carpet slippers at their ease.

JACK OF ALL TRADES.

[65808.]—**Boots.**—I fancy I can put "W. R. C." in the way of getting over his difficulty, as I have often noticed in passing a shop in Leadenhall-street (facing Aldgate pump), where are some plaster casts of feet, together with some wooden lasts of a peculiar make, with announcement that lasts are made specially to fit the feet of customers, &c., &c. I think the name is C. Bond, but I am not quite sure of this. I notice in the window also some boots and shoes of unusual contour, evidently made upon lasts of exceptional form. When a young man (some 50 years ago now) I used to suffer severely—not from malformed, but from particularly tender feet, and as boots were then very unscientifically cut I was sadly troubled with corns, chafed heels, &c., which proved a constant source of irritation and discomfort. I tried boots made of buckskin: they gave some relief, but looked very dingy, would not resist wet, and quickly wore out. Then I got hold of pannus-corium, which lasted better and were tolerably easy, but would not resist the wet, and wore out quickly. However, I persevered with them, and got rid of corns. About 40 years ago I fell in with a French bootmaker, who made a last to the sole and shape of my feet—nothing exceptional. I had boots made in Paris of soft French leather, and I have never worn any other kind since, always having them made from the same last, with the only alteration of a strip of leather put on it so as to widen very slightly the tread, and make the upper leather a shade easier as I grew older. I wore Wellington boots then, and continue to wear them still. GAMMA SIGMA.

two roots, for instance, $x^2 - 5x + 6 = 0$ has two roots, $x = 2$, $x = 3$. If "Tyro" were to divide $x^2 - 5x + 6$ by $x - 2$ and set one root $x = 2$, and then he would have the factor $x - 3 = 0$ left; but surely he would not say $x = 2$, $\therefore$ substitute 2 for x and get $2 - 3 = 0$. The reasoning, however, is precisely similar to that given in his query.

T. PERKINS, M.A.

[65859.]—**A Fallacious Equation.** — The fallacy lies in the remark "But $a = x$," after having eliminated that result by dividing both sides by $a - x$. "Tyro" should study a chapter on the interpretation of equations in any good "Algebra." He will then see that he has started with the assumption $x - a = 0$. He has combined that with $x = 0$ (by multiplying both sides of his original equation by x); then, after getting his equation into a complicated form, he first eliminates his original proposition that $a = x$ (by dividing both sides by $a - x$), and then expects to find it again in the remaining terms! The fact is, that the quadratic he builds up has two roots: the fact that both sides will divide by $a - x$ shows that $a - x = 0$ is one of these roots—i.e., $x = a$. The other is contained in the remaining terms, $2a + 2x = 2a + 3x$, which, on subtracting $2a + 2x$ from each side, leaves us $x = 0$, the other root. Hence from the quadratic we have obtained the two roots from which it was built up. NEPHESH.

[65859.] — **A Fallacious Equation.** — The fallacy of the result arises from a false assumption "Tyro" makes in working it out. He supposes that, whatever be the value of the factor $a - x$, common to both sides of his equation

$$(2a + 2x)(a - x) = (2a + 3x)(a - x),$$

he may divide that factor out, and equate the remaining factors. This, however, cannot be done under the condition (previously given) that $x = a$, and, therefore, that $x - a = 0$; for the equation is in reality, putting a for x,

$$4a \textit{ times } 0 = 5a \textit{ times } 0,$$

which, since M *nothings* = N *nothings*, whatever numbers M and N may be, involves no absurdity, but gives us no right to infer that $4a = 5a$, or that $M = N$. In short, we cannot divide each side of an equation by a factor common to both sides when that factor is zero. As the equation stands, and supposing x to have no pre-determined value, it is a quadratic of which the roots are $x = a$, and $x = 0$; for either of these values substituted for x renders the two sides identical; $x = a$ gives us $0 = 0$, and $x = 0$ gives $2a^2 = 2a^2$.

Charing. J. R. C.

[65859.]—**A Fallacious Equation.**—The so-called fallacious result arises from the querist not having observed a very elementary principle of algebra—namely, that it is not correct to divide by a factor or quantity which is equal to nothing. He begins by assuming $x = a$, so that $a - x = 0$, and therefore he is wrong in dividing by $a - x$, as he afterwards does. The error involved may be made more apparent by considering that since $x = a$, and therefore $x - a = 0$, if we divide both sides of this equation by $x - a$, we obtain the absurd result $1 = 0$. This amounts to saying that because $a \times 0 = b \times 0$, therefore $a = b$, which is fallacious. The axiom that if equal quantities be divided by the seme quantity the quotients will be equal, does not apply to the case where the divisor is 0. Similarly, if we proceed to multiply an inequation by 0, the result would be to make both sides equal to 0, which of course would be erroneous. Moreover we have $a^0 = b^0$, each being equal to unity, but it does not follow that on that account that $a = b$, as would be the case if the index were a finite quantity. The error into which the querist has fallen is one which books on algebra fail to warn the student against, though it would be very necessary to do so. On this subject I take the following extract from Wood's "Algebra," by Lund, 13th ed.:—"It may be said, generally, that to speak of absolute nothing as the subject of mathematical calculation is absurd, and that it can only become so when it is taken to represent some finite quantity in that state, when by indefinite diminution it has become less than any appreciable quantity. The mathematical symbol 0 has, then, always reference to some other quantity from which it is derived; and it is this primitive quantity which must be the subject of our investigations when by becoming 0 it produces an anomalous result that requires to be explained." VLADIMIR.

[65864.]—**Blacking Inside of Brass Tubes.**—Lampblack ground up with gold size is a very good mixture for this purpose. Thin glue may be used instead of the gold size, but it is more liable to chip off. PRINCIPIA.

[65864.]—**Blacking Inside of Brass Tubes.**—If "Black" would take a little lampblack and mix it up with a little turpentine or methylated spirit and apply to inside of his brass tubes in a short time the spirit will evaporate and leave a dead-black surface. A. BARNARD.

[65864.]—**Blacking Inside of Brass Tubes.**—If your readers would only adopt the plan of having at their side a commonplace book while they are reading and jot down therein anything that they think may be useful to them, the same questions would not be asked over and over again. In my memorandum-book is the entry: "Dead Black.—See 'E. M.,' No. 1086. The recipe there given is a good one. There is another good recipe on p. 93, No. 1122." FAL.

[65864.]—**Blacking Inside of Brass Tubes.**—Put two grains lampblack in a saucer; add gold size and mix thoroughly, just enough to hold the lampblack together (about three drops); add twenty-four drops turpentine; mix, and work. Apply with a camel-hair pencil. Another recipe: Dissolve $\frac{1}{2}$oz. of carb. of copper in $\frac{1}{4}$lb. of ammonia solution, with constant stirring; add 9oz. water; polish the brass with emery, and immerse with brass or copper wire. In the case mentioned of tubes, put a cork in one end, pour in the liquid, cork up the other end, and move the tube about. When black, rinse in water, dry with sawdust, and finally rub with oil varnish diluted with turps.

Plymouth. B.Sc.

[65864.]—**Blacking Inside of Brass Tubes.**—There are several modes of doing this. 1st. Clean the inside of the tube, paint it over lightly with a brush dipped in a weak solution of bichloride of platinum. Dry. 2nd. Grind a little vegetable black on a slab with a muller along with a little thin glue, and a crystal or two of nitrate of silver. A good proportion is: Glue water 1oz., vegetable black 1 teaspoonful, nitrate of silver 10gr. Paint the inside of the tube with this, and set aside to dry. 3rd. Dry some vegetable black over a stove or hot plate. Rub it up smooth on a slab with a few drops of methylated spirits. To each teaspoonful of the mixture add 1 teaspoonful of French polish, thin it down by the addition of $\frac{1}{2}$oz. of methylated spirits. S. BOTTONE.

[65865.]—**Rendering Glue Less Brittle.**—A. Woodward has not mentioned what sort of glue he uses. But if common glue, dilute with water to the consistency he wants it; this is all that is required. But I would recommend a drachm of nitric acid (poison) to a gill of liquid glue. The reason of your glue being brittle is it is too concentrated—that is, not enough water in it. I have used glue in this fashion for all kinds of work, both hard wood, soft wood, glass, and even iron, and never found it give way. A. BARNARD.

[65866.]—**Soldering.**—Soldering aluminium has been discussed several times in the "E. M." See page 423, No. 1,138, and the other Nos. there referred to. FAL.

[65866.] — **Soldering.** — Take aluminium, 20 parts, zinc, 80 parts; or take aluminium, 90 parts, and grain tin, 10 parts. Melt and pour. The second is harder to run, but stands better in colour. See also Vol. XLIV., p. 423. DENS.

[65867.]—**Plaster Statuettes.**—Stop suction by soaking cast with boiled oil or French polish. Apply with a brush and allow to stand for a day, then more oil, and so on until it leaves off sucking. If you want to paint the cast white, mix boiled oil and moist white-lead; thin with a little turps. Give one coat of this, and when quite dry apply a coat of white lead (moist) thinned with turps only. Apply the paint with a small brush to the right thickness, then stipple with a dry sash-tool to obliterate the brush marks and bring the surface together. Two coats of the flatting will be necessary; perhaps more will be needed. If you use French polish, take care you have the white, as the ordinary will make the cast so dark you will need more paint. Boiled oil makes the paint dry rapidly. It wears well and gets very hard.

CHOPIN.

[65867.]—**Plaster Statuettes.** — No wonder your work had a "shiny appearance," when you mixed wax with your oil-paint. Oil-paint is too greasy in itself, and, of course, is made "shinier" by the addition of wax. First coat your statuette with a 10 per cent. solution of gelatine; then get zinc-white as your basis, and tint with chrome yellow and Indian red. If you want a flesh-colour, use as little oil as possible and thin with turps. After you have painted, your work should be all "flattened" to take away the greasy appearance of paint and to make it look like marble. This is done by means of sable brushes made for the purpose. One big enough to do a statuette will cost 2s. 6d.

Plymouth. B.Sc.

[65870.]—**Cement Tank and Fishes.**—The probable explanation is that the fish die from want of air. I have attempted to keep "tiddlers" in different glass vessels, the result being that if the vessel was large and open they would live for a week instead of two or three days, as was the case if the vessel was small or narrow. Perhaps if you soaked the tank with water for a few days and scrubbed it out well, and also put in some living water-plant, or else a fountain, you would succeed. PRINCIPIA.

[65872.]—**Engine.**—Make flanges $\frac{3}{16}$in. thick, and if cylinders are $\frac{1}{16}$ft., $\frac{3}{32}$ and $\frac{1}{8}$ thick will do. Lead just perceptible in h.p. cylinder and a trifle more up to $\frac{1}{32}$ in the others. Cut off in h.p. at $\frac{1}{2}$, next $\frac{5}{8}$, and l.p. at $\frac{7}{8}$. I have not worked all this out, but I think this will suit you.

Bristol. T. C.

[65874.]—**The Common House-Fly.**—The house-fly has four stages of existence—namely, the ova, larva, pupa, and imago. The imago is the complete fly as ordinarily known. It belongs to the divisions classified as Diptera and Muscidæ. Its scientific name is Musca domestica, and requires two years for its complete metamorphoses. The anatomy of this fly is singularly beautiful.

FREDERICK DAVIS.

[65874.]—**The Common House-Fly.**—These insects proceed from eggs, which are laid during the summer and autumn months. From these eggs proceed little maggots, which are famous scavengers in their way. These again form chrysalides, from which flies break forth, providing the weather be sufficiently mild. Several broods are thus hatched from the chrysalides in the course of the summer and autumn. As soon as the weather becomes cooler, the chrysalides do not come to perfection, but lie dormant throughout the whole winter to give up the contained and matured fly with the first burst of warm weather. It is possible, by the application of cold, artificially to retard indefinitely the appearance of the perfect insect—the fly. S. BOTTONE.

[65876.]—**Screws.**—If the drivers are the correct form and the full width of head, they will drive equally well; if wider than head, it will not assist. But if drivers have bevelled edges (as frequently the case), they should be as wide as head.

Bristol. T. C.

[65876.]—**Screws.**—There is more nonsense talked and written about the screw-driver than about any other tool of its size. A perfect screwdriver should not have any sharp part. Its end should be the exact cast of the slot of the screw it is to drive. It should have handle enough to enable one or both hands, arms, and shoulders to exert all the power necessary to put that screw home. A driver having, say, a $\frac{1}{4}$in. wide end for a $\frac{1}{2}$in. slotted screw would be liable to give way under strain or to spoil the screw-head. Anything wider than the screw-head is waste metal. Of course, this theory is never thoroughly carried out in practice, or we should want a separate driver for every size of screw.

NEPHESH.

[65879.]—**Pump-Valves.**—The angular idea is all nonsense. Would not the valve tend to rotate the exact amount one way when moving upward that it would rotate the other when falling? But there is no time for the rotary motion at all, and if the valves are to fit tight when down, it is an advantage for them always to drop in the same place. Rubber valves usually split from the middle, as that is where they are stretched.

Bristol. T. C.

[65880.]—**Is Total Darkness Beyond our Atmosphere?**—In an experiment of Professor Tyndall's he passed a ray of light through a vacuum, when the track of the beam both before and after was luminous, while the part actually in the vacuum was black (dark), thus proving that although the ether was capable of transmitting the light rays, it could not scatter them so as to light up the space, and very probably this is the case in space. PRINCIPIA.

[65880.]—**Is Total Darkness Beyond our Atmosphere?**—The fact that we derive light from the sun, moon, and stars would seem to indicate that the intervening space is filled with some medium that can transmit light. Hence, a body placed in that medium will receive light, except it be in the shadow of some other body. The total darkness of the night side of the moon is very striking to the observer. Our atmosphere holds and diffuses the sun's rays after he has disappeared from direct view, but that has nothing to do with the question asked. NEPHESH.

[65880.]—**Is Total Darkness Beyond our Atmosphere?**—"W. M." asks for a proof of a non-existent fact. If the earth had no atmosphere there would be light on the side of the earth turned towards the sun; but the moment any spot on the earth, owing to the earth's rotation, passed into the shadow cast by the earth, it would be in total darkness, if we except any light received from moon or stars. Twilight, and, in fact, the light seen anywhere at a place even in the day-time not directly illuminated by the sun's ray, is due to light scattered by the atmosphere; if no atmosphere existed, then shadows would be as black as those cast by lunar mountains; yet every spot on which the sun's rays fell would be illuminated. T. PERKINS, F.R.A.S.

[65881.]—**Dry and Wet Meters.**—I should like much to get authoritative information on this point also; my own experience has been greatly in favour of dry meters. No trouble with use a strong sulphate of iron developer with only one drop of sulphuric acid to the ounce of solution as a restrainer; no acetic acid. Do not hurry the development, and work in a good open light—out of doors if possible. In the case of the blue background and white letters, use a purely-iodised collodion; rather stale, or coloured with a drop of tincture of iodine, give an extremely short exposure, and develop quickly with an iron developer made up as follows:

Sulphate of iron	120 grains
Nitrate of potash	100 „
Acetic acid, glacial	120 minims
Water..................................	8 ounces.

S. BOTTONE.

[65901.]—**Preserving Greenhouse Pipes.**—Fill the pipes quite full with water. They cannot then rust, as it is only in the presence of oxygen that this occurs. FREDERICK DAVIS.

[65903.]—**Metal Engraving.**—This query is rather a wide one, and cannot be answered properly within reasonable limits. "Very Perplexed" would do well to get a little book on "The Art of Letter Engraving," by Whelpley, published by John Wiley and Sons, New York. This will give him full information on everything connected with the subject. He is quite right in thinking that the shape of the tool and method of grinding are essential to success. FAL.

[65903.]—**Metal Engraving.**—If "Very Perplexed" would put himself into the hands of a professional for two or three weeks, so as to get a practical and correct foundation upon which to work, and so start fair; patience, perseverance, and time would then do the needful. In the meantime the under sides of the gravers should not be touched; the sharpening is all done on the face. The different angles of the faces of the gravers depend upon the style of work; but for a beginner the angle as bought is as good as any. The kind of oilstone is a matter of opinion. I have found the "Arkansas" to be the best all-round oilstone.

DENS.

[65904.]—**A Mermaid.**—"This remarkable natural curiosity" is a fraud. It or others of the same species have cropped up from time to time ever since I can remember. Barnum had one in his museum, and probably has it still. They are made by carefully joining the upper part of a monkey's skin to the skin of the tail of a fish. There must be a "missing link" in the head of anyone who can be taken in by them. FAL.

[65905.]—**Absorption of Oxygen by Baryta.**—The temperature needed is a low, red heat.

WM. JOHN GREY, F.C.S.

Analytical Chemist, Newcastle-on-Tyne.

[65905.]—**Absorption of Oxygen by Baryta.**—None of the books which I possess give the exact temperature. The nearest I can get is a "low, red heat" (= about 600°C). PRINCIPIA.

[65905.]—**Absorption of Oxygen by Baryta.**—In practice, oxygen is absorbed from purified air by baryta under a pressure of 15lb. per square inch, and at a temperature of 600° C., and is given off again from the dioxide under a partial vacuum (about 20in. mercury), and of a temperature of 800° C. For a full description, with drawings of the apparatus used in the manufacture of oxygen by means of baryta, known as "Brin's process," see *Industries*, Oct. 21, 1887, published at 22, Wellington-street, Strand, W.C. OXYGEN.

[65906.]—**Condensing Gases.**—The querist had best leave this alone until he is further advanced, or the results of the experiments might be very disagreeable. It is a curious fact that the less a man knows about chemistry the more ready he is to attempt experiments involving danger. A junior student of mine once proposed to investigate the composition of chloride of nitrogen! WM. JOHN GREY, F.C.S.

Analytical Chemist, Newcastle-on-Tyne.

[65908.]—**Electricity and Crystals.**—If you can get a work entitled "Memorials: Scientific and Literary," by Andrew Cross, I think you will find something concerning the above subject in it.

PRINCIPIA.

[65908.]—**Electricity and Crystals.**—Dr. Ure, in the first decade of this century, made a series of experiments, an excerpt of which may be found in Colin Mackenzie's "One Thousand Processes in Manufactures," 1834 edition, p. 197 et seq., from which it is evident that the passage of an electric current in a fluid containing a crystallisable body, decides the crystallisation of that body. Whether this crystallisation depends on the agitation set up by the liberation at the poles or simply on the orientation of the molecules of the salt under the influence of the current, it is difficult to say; but there can be no doubt that in a closed tube containing a saturated solution of the salt under examination, with a platinum wire sealed in at each end, the passage of a current from a voltaic battery of 50 pairs of 4in. plates causes crystallisation to commence at once at the negative end, and to proceed slowly to the positive. If "Dabbler in Science" cannot refer to the above-mentioned work, and our kind Editor deems the matter of sufficient general interest, I shall be pleased to furnish an account of the whole series of Dr. Ure's experiments. It is doubtful, however, whether it is in our power to cause substances to crystallise abnormally. S. BOTTONE.

[65909.]—**Perspiring Watchmakers' Hands.**—If James R. Elwell will write to me, I will repeat the medical advice I had on the subject not long since. I used to find it a very serious inconvenience.

61, High-street, Battle. E. KEMP.

[65909.]—**Perspiring Watchmakers' Hands.**—Wash the hands often in hot water and dry thoroughly. At night cover the hands with an ointment of burnt alum and glycerine, wearing gloves.

Plymouth. B.SC.

[65911.]—**Dry-Plate Negatives.**—If by the terms "the image is shown distinctly in the positive colours," "Negative" means to imply that he has succeeded in getting pictures showing the real colours of the objects he has photographed, I can but congratulate him on his discovery, which I would advise him to patent at once, as it means a fortune. If, however, as I seriously suspect, he means simply that by holding the picture in a slanting position he can see the image as a positive, then I need only say that this is nearly always the case in a fairly exposed and fairly developed negative, in which the development has not been pushed so far as to veil the shadows, and it depends on this fact, that the deposited silver reflects more light—*i.e.*, looks lighter, than the almost bare glass in that particular position. S. BOTTONE.

[65912.]—**Wheels.**—Large wheel will revolve 55 times, and small one 144 times before the same teeth are in contact. This is a simple case of what is known in arithmetic as the "least common multiple."

Bristol. T. C.

[65913.]—**Saccharin.**—I am afraid "Toluol" cannot manufacture saccharine, not only because the necessary plant is expensive, but because I understand that the syndicate who possess the German patents had the process carefully patented in England as well.

Plymouth. B.SC.

[65914.]—**Lancaster's Instantograph.**—In reply to "Instanto," I may say I have used one of Lancaster's instantographs for two years and found it to work very well; but, on the other hand, it will depend greatly on the speed of plates used and strength of bands for the different exposures. This is a class of work that is difficult, and, at the same time, easy to accomplish; but it is useless going into detail. Here are the plates and method to use: Plates, Ilford extra rapid series, elastic bands, $\frac{3}{4}$in. diam. $\frac{1}{32}$in. thick; arm of shutter to be moved one click; the day to be bright and clear, midday; subject, sea and sky. But your best plan is, if you want to be saving with the plates you intend to use, to cut one into four pieces and make a small carrier for your slide to fit them, and expose one click 2, 3, and 4, and develop according to formula given with plates. Some of them will be right; if, not, try more, and quicker. This is the sure road to success.

A. BARNARD.

[65917.]—**Angle Rings.**—Make the pattern of lead, or type metal, if you are unable to manage it in wood.

Bristol. T. C.

[65918.]—**Leclanche Cells.**—1. Heat gently over a gas flame until loose, and then pull out the carbons. 2. Equal bulks of each, shake in a thin layer of carbon, then one of manganese, and so on. It depends on the size of porous cells. 3. The carbon plates will be all right, provided they are not broken. If everything is well cleaned and carefully put together, I should certainly not buy new cells. PRINCIPIA.

[65921.]—**Archery.**—The querist asks six questions under the above head, some of which would require an essay in reply. It is very probable that the accounts of ancient archery feats are "snake stories." Mr. Rigby armed with an "any rifle" could hardly have accomplished some of these wonderful performances.

WM. JOHN GREY.

Analytical Chemist, Newcastle-on-Tyne.

[65923.]—**Electric Light.**—The amount of battery power you will need will depend entirely on the resistance and efficiency of your lamp. Suppose it be one of the low-resistance battery lamps of about 12 to 15 ohms resistance, which require about 1 to $1\frac{1}{2}$ ampère of current to light them, then you will need from 6 to 8 cells of a single zinc, double-carbon battery, the zincs being arranged like sandwich fashion between the two carbons, but not touching. The size of the plates should be 7in. by 3in. and these may be arranged
to fit very nicely in the 2lb. glass plum ja
are sent over from Bordeaux by Viole
Clark. To work the batteries economi
elements should be attached to an inch b
wide by 24in. or 32in. long, so that the
can be removed from the acid by a ra
pawl arrangement when not in use. Th
cells should be charged with a solutio
chromic acid to 20lb. of water, into whicl
poured in a fine stream, with constant sti
of brown oil of vitriol. This mixture m
used until it is quite cold. Should the la
higher resistance—say 48 ohms (usually c
volt lamps")—more cells must be used.
cell for every two volts. You may see tha
batteries, &c., if you refer to my adverti
the "Sale Column." If you wish to c
battery yourself, consult my book on
Instrument Making for Amateurs," p. 1
edition. S. BO

[65924.] — **Repairing Vulcanite**
Must go to the dentist, as the artificial
have to go into the vulcaniser to be
repaired.

[65924.]—**Repairing Vulcanite in A**
Teeth.—You cannot repair it yourself, as
must fit exactly to the convolutions of t
Take it to a practical dentist.
FREDERICK

[65926.]—**Acetic Acid and Tumou**
pamphlets by Dr. Dick used to be obtai
the *Christian News* office, Glasgow, of wh
he was at one time editor. If this pap
non-existent, pamphlets on the subject ca
tained from the Superintendent of the Sa
Seamill, by Ardrossan, N.B.
Plymouth.

[65927.]—**Speed of Engine.**—You do
the most important particulars — viz.,
required and size of ports. It will not hu
to 200 revolutions.
Bristol.

[65928.]—**Mangold.**—The mangold is
species of beetroot. Its botanical name
vulgaris macrorhiza; natural order, Chenopo
Used largely to feed cattle, and for the
facture of beet-sugar. FREDERICK D

[65928.]—**Mangold**—Should be written
wurzel (Ger. Want root), is merely a lar
coarser variety of the common beet (Beta vu
and belongs to the natural order Chenopo
"Foreigner" is under a mistake in stati
this word "is not to be found in dictionar
on looking up mine—"Stormonth's"—I fou
once.
Plymouth.

[65928.] — **Mangold.** — This word, w
variant *mangel* or *mangold-wurzel*, will b
in almost all good modern dictionari
Chambers's "Etymological English Dictio
It is a purely German word, mangold mea
beet, wurzel, *root*. Its scientific name
altissima. It belongs to the natural
Chenopodiaceæ. It is closely allied to the
beet-root. Boussingault considers it to be
a variety thereof. French name, Bett-r
champs; Italian, Biettola da bestiame, Pied
biarava. S. BOTT

[65928.] — **Mangold** — Should be "
worzel." Webster's definition of the name
the German "mangel" = want, and "worzel
and has the botanical name as "Beta
Cassell's French dictionary gives it the n
"Beet" or "Betterave." The Spanish A
dictionary calls it "Acelga" (Beta cy
"Remolacha" (Beta rubra). Velasquez's
dictionary calls it "Acelga," and gives the b
name as "Beta vulgaris." "Foreigner" w
that the "mangel worzel" is a species of
root," and will no doubt get all the infor
he requires by seeking under that head.
TRAVEL

[65929.]—**Lighting Oils.**—With the exc
of camphine, which is another name for re
oil of turpentine, French huile de terebe
Italian, essenza di tormentina, the others me
are either gas-tar or petroleum products, F
huile de goudron, petrole; Spanish, aceite pe
Kerosine and paraffin crystal oil, &c., are
the heavier petroleum oils that do not vapo
a low temperature, while benzoline, ga
petroleum spirit, &c., French benzine, I
benzina, lucilina, are those which distil ove
much lower temperature. As you are dou
aware, these oils, whether obtained from
from natural oil wells of Baku, Russia, or
America, are all carbohydrogen, closely all
the solid paraffin wax. The Latin and E
names for these bodies, in the crude state,
with sufficient clearness to their origin
petroleum or rock oil. S. BOTTO

[65930.]—**Photo. Negatives.**—It is no
that a negative can be converted into a posit
treatment with alabaster in solution. "Alab

ıs a trade name for collodion positives; : has nothing to do with the process.
S. BOTTONE.

Electric Bell.—TO MR. ALLSOP OR ONE.—Supposing you to be using a ı, about $3\frac{3}{4}$in. long, $\frac{3}{4}$in. in diameter, ı $8\frac{1}{2}$in. long, you will need about 5oz. 6ft. to 28ft. of No. 16 wire, to get the unless the distance is very great, in a larger number of coils (about the) of a finer gauge, would be prefer-
S. BOTTONE.

Speed of Wheels.—Count the teeth eel, and divide the number of large e number of the others. The small hen turn the number of times of the ch revolution of the large wheel.
T. C.

Speed of Wheels.—To find speed of n, multiply diameter of driver by its ivide by diam. of driven, the answer l of driven. To find diam. of wheel to e will suppose "Dusty Miller" has a n diam. running at 75 revs. per minute. know what diam. of wheel he requires revs. per minute. Multiply 40 by 75, y 100. The answer will be diam. of ed. SCORRIER SAW MILLS.

Soldering Platinum.—This can be vith ordinary soft solder.
S. BOTTONE.

Soldering Platinum.—Platinum can vith any of the common solders, from ft solder to the solder used for gold; lders permeate the platinum more or der it liable to be acted on by the air, e to attach other metals to it either by ets.
FAL.

Soldering Platinum.—Use an ordi- bit, very hot, and finish the job as ssible—that is, just touch the iron elt the solder well, and don't keep it r, or else the solder will alloy with the d become rotten. Afterwards coat the ealing-wax varnish. Use zinc chloride
PRINCIPIA.

Terre Verte.—This is an earth of a -green colour, said to contain iron clay, and sometimes chalk and pyrites. n France, Italy, and Cyprus, and is used . I am using some now for staining shionable green colour. The colour s very true and lasting.
FAL.

Terre Verte.—Schützenberger, in his ork on colouring materials, says:— name are known several kinds of s, more or less aggregated and tender. uminous, others contain no alumina. lepends on the presence of a hydrated rotoxide of iron. The best kinds come ia. They are employed in painting work, buildings, ships, &c., sometimes white colours. The tint is neither or brilliant, but resists well atmo- ence. Terre verte is a natural product
S. BOTTONE.

Hydroxylamine.—I have not at ite equation representing the action of ogen on ammonium nitrate; but the en by "H. G." is at least fairly prob- tin may be precipitated by a current ted hydrogen. There is an article on ce on page 409 current volume, which querist further information concern-
WM. JOHN GREY, F.C.S.
Chemist, Newcastle-on-Tyne.

SWERED QUERIES.

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s and titles of queries which remain unan- weeks are inserted in this list, and if still e repeated four weeks afterwards. We trust ll look over the list, and send what information s benefit of their fellow contributors.

ast "A. J. H." has replied to 65294; J. F.

ing Gold-fish, p. 266.
ical Gilding, 267.
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te or Petroleum as Engine Fuel, 267.
inting, 267.
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ng, 361.
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cising, 362.
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QUERIES.

◆◆◆

[65945.]—**Flexible Steam Pipe.**—Is there a flexible steam pipe that answers tolerably well? What is the material and mode of manufacture? What pressure and temperature will it stand?—J. W.

[65946.]—**English Concertina.**—How are the keys arranged on Lachenal's patent duet concertina, and can an ordinary English 48-key instrument be altered to same arrangement?—PLATINOID.

[65947.]—**Emery Wheels.**—Will some reader inform me how these wheels are made, what the emery is mixed with, and if pressure is used to form them into shape?—RAZOR.

[65948.]—**Glazier's Lead Vice.**—I am making a pair of spindle wheels for window lead vice. Will some one kindly say how to put the creases on the sides of the wheels, and with what tools?—J. C. T.

[65949.]—**Photographic.**—1. I have a lens 14in. focus, another 5in. focus. I use both for studio work, but get a much more brilliant picture with the short one. Why are long focus instruments recommended? Mine give feeble images unless light is very strong (which is very seldom, especially of late). 2. How can I make a good spotting medium for finished prints?—H. WALKER.

[65950.]—**Steam Pump.**—Can any of our friends tell me the best way to work the slide for a steam pump about 12in. stroke? Can it be done properly without shaft and eccentric or is it best to have one. or could it be worked by two steam cocks in any way?—STEAM PUMP.

[65951.]—**Pulp.**—Can any of our readers refer me to any makers of vessels in pulp, generally known as unbreakable wares, such as jars, bottles, and bowls?—E. P.

[65952.]—**Ancient Coin.**—What is the age and value of a copper coin about the size of our half-sovereign? It bears on one side the bust of a crowned king with the inscription IXID C OLAVDIVS AVC, and ob., a draped figure holding a spear or trident in one hand and a small branch of a tree in the other, with the inscription FELI CITHSKVC. The coin is in good preservation, and was lately dug up on a common.—E. P.

[65953.]—**Incandescent.**—TO MR. BOTTONE.—I wish to construct a four-cell battery for electric lighting. Each cell to be composed of a zinc plate and two graphite plates separated by two strips of ebonite. Would hard wood varnished with sealing wax dissolved in methylated spirits do instead of ebonite? I have lost the number of the "E. M." giving composition of the exciting liquids. Kindly say what would give the most E.M.F. giving full directions as to quantities, &c.? I think chromic acid was mentioned. How is graphite procured?—BEGINNER.

[65954.]—**Electro-Plating.**—How is it in Birmingham the electro-platers can deposit a certain amount of silver in a certain time? I find if I use too large an anode, or too much battery power, the deposit is rough and dirty. Of course I can get a better one by leaving it a matter of two days in the vat, but I should prefer doing it quicker if anyone would explain the way.—G. D.

[65955.]—**Patterns of Paper.**—Will some of "ours" tell me the best way for cutting various patterns in paper, similar to the transfer pictures we see in shop windows so cheap? How do the manufacturers of these cut them out? Should like to learn, as I want to cut out quickly various and intricate designs, and should be glad to learn the tools required for the purpose and how to make the same.—PAPER.

[65956.]—**Lime Precipitate.**—What can be recommanded as a cheap material for precipitating lime from hard water? Can any such thing be added to soap for hard water districts—must be cheap, free from smell, not stain linen? Have had recommended sulphate of soda, but does not seem to do.—J. W. SYKES.

[65957.]—**Voltage of Gramme Dynamo.**—I have been using a Gramme dynamo made by the Consolidated Electric Co., Ltd., supposed to give 50 am. and 16 volts. I find on working at the required speed, 1,500, I get scarcely any voltage out of it. Can anyone tell me the reason why? It has been used as an exciter for B Gramme machine. Also I should like to know if I can increase the voltage (without rewinding). I have no objection to reducing the ampère current to 20 am., or thereabouts.—A. BROWN.

[65958.] — **Crystals on Zincs and Carbon Plates.**—Will some electrical authority please inform me why on using some agglomerated Leclanché cells (Judson's corrugated agglomerated plates) with saturated solution of salammoniac and no porous cells, I find after running half an hour with a glow lamp taking about 1 am. current, they rapidly run down, and on examination I find the zincs and carbon plates coated with white crystals some more or less tinged with red; very insoluble in water? They are more or less transparent. What are these crystals, and can they be prevented forming and thus polarising the battery?—A. BROWN.

[65959.]—**Small Organ.**—About £100 or £120 is to be spent on an organ for small mission church. Will some able correspondent advise as to whether for this moderate sum a two manual should be sought, or would it be better to content ourselves with a single manual, all being inclosed in a swell box? Perhaps some adept will name a suitable specification for a limited instrument.—G. J. J.

[65960.]—**Sleetover.**—In a short notice in the *Manchester Guardian* some time ago (about Sept, 1887) I saw a new explosive noticed. This, like most newly-discovered explosives, was to revolutionise the present system of ammunition, but I have not heard anything of it since. Could any reader tell us anything of this wonderful substance, for according to newspaper accounts "ball cartridges loaded with it have been fired out of cardboard barrels without the least injury to the latter." I find some difficulty in swallowing this. I should also be much obliged for any information as to the composition and properties of any modern explosive—e.g., securite, bellite, carbonite.—BREECH LOADER.

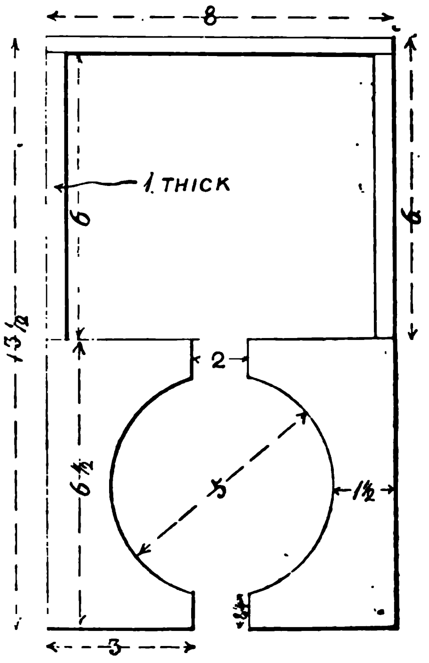
[65961.]—**Infinite Series.**—In my studies I have come across a remarkable series of numbers, every term of which equals the sum of the two preceding. Thus:—1, 2, 3, 5, 8, 13, 21, 34, 55, 89, 144, and so on. Am I right in saying that there is no formula, algebraic or otherwise, that will express the value of the n^{th} term? If there is, I should like to see it. Again, if this series commencing at 1, be placed above the same series commencing at 2, we get an infinite series of fractions, $(\frac{1}{2}, \frac{2}{3}, \frac{3}{5}, \frac{5}{8})$, the differences between which are continually diminishing. Am I also right in saying that no exact fraction can be given as the limit to which the terms of the series are for ever approaching? If there is, the question may be put in another way. Let us form a series consisting of the products of the consecutive terms of the original series—i.e., 1·2, 2·3, 3·5, 5·8, and so on. Now the limit mentioned above is equal to the sum of the infinite series consisting of the reciprocals of these products, with signs alternately positive and negative. Thus—

$$\frac{1}{2} + \frac{1}{6} - \frac{1}{15} \ldots \text{ \&c., } \textit{ad infinitum.}$$

What is the sum of this infinite series?—PHILOMATH.

[65962.]—**Signalling.**—What would be the best way of signalling by wire between two points a mile apart? A 3in. water pipe is about to be laid from one to the other, and it is desired to know when a tank at one end is empty or full—that is, when pumps at the other end are to be set to work or stopped. If an electric bell be used would the pipe serve for a return wire, and what battery strength and gauge of wire would be necessary for this distance? A telephone would be costly, and would require the bell besides.—ANTARES.

[65963.] — **Manchester Dynamo — Edison Pattern.**—TO S. R. BOTTONE.—I am about making a small dynamo as per sketch and measures, of best Swedish iron. Armature built up of punchings 1-20 thick, $4\frac{7}{8}$ diam., with 12 cogs. To what depth must I build the armature? Must the pole pieces of magnets be same length as armature core? Also what is the best quantity and gauge of wire to wind armature and magnets with to get a current of 6 amps. at an E.M.F. of 16 volts. Do you think above sufficient current to charge a secondary battery of 6 cells, where the discharge rate is 3 amps. for 40 hours? How long would it take to charge them? I have a ½H.P. gas-engine. Will that be sufficient power?—DYNAMO.



[65964.]—**Skin Disease.**—Would any one of our medical contributors assist me or supply the information as to the treatment the following symptoms ought to receive? A female friend of mine has been troubled for the past four years with a peculiar kind of skin erruption, which first began by washing in cold water while flushed with heat. Medicines internal and external up to the present seem simply futile. This trouble is wholly confined to face, and extends only as far as the malar, zygomoid, maxilla, and larynx sites. There appears and disappears at no stated periods a series of small red points, which develop into a bead-shaped cell containing a white nucleus, which wither and fall off in flattened squemious cells.—NITRAM.

[65965.]—**Dynamo.**—TO S. BOTTONE.—I have made a dynamo of the following sizes—Edison-Hopkinson pattern:—Armature, core 2·1in. diam., 5in. long, wound with 14oz. No. 18, 14 sections in commutator, 14 sections in armature, 2 layers of wire, each section 2 wires in parallel 3 times round, bore $2\frac{1}{2}$in. Magnets of wrought-iron with cast-iron pole pieces, size 4in. by $\frac{3}{4}$in. by $3\frac{3}{4}$in. high. Each limb wound with 2lb. 6oz. of No. 18. The magnets are connected in series. I have driven the armature at 2,000 revs. and when connected as a shunt machine cannot get any current. I have also tried separately exciting, when a current much smaller than the exciting current is produced at the armature. Have tried running in both directions, but with no avail. Have I got the wrong proportions between the armature and magnets anywhere? If not, can you suggest any method for making the machine act?—ALPHA.

[65966.]—**Chemical Weather Glass.**—I have made several weather glasses after the ordinary recipe:—$2\frac{1}{2}$dr. camphor dissolved in 11dr. of spirits of wine, 37gr. salammoniac, and 37gr. of saltpetre dissolved in 9dr. of distilled water. The spirit and water are now mixed and well shaken, put into a test tube, and sealed. Would any practical man tell me if these weather glasses are any good? I never found them to act. Also what is the principle upon which they act? Although the recipe says to perforate the cork well by a small hole, the instruments in the opticians' shops are all securely sealed, I suppose to prevent evaporation, which I assume is the proper thing to do. I find the solid matter in the tube never moves, unless the tube is fixed in the open air, and then not at all in agreement with the indications of the mercury barometer. I have always found the glass when hanging in the house an utter failure.—CHEMICAL WEATHER GLASS.

[65967.]—**Fleas in Carpets, Furniture, &c.**—Through storage or other means I am vexed with above annoyance. As all powders fail, what solution can I use to effectually destroy both life and germ or larvæ? Some wash to brush over all is needed that will destroy insect life and germ, but not destroy the material. Do these pests in their first stage drop on the face as particles of white or black dust, or would that be the first stage of the moth or house-fly?—VEXATION.

[65968.]—**Temperature of Season.**—Can anyone with access to recorded observations say whether the temperature for the period between 21st June and the 15th July has in any year been lower than during the present year?—A. W.

[65969.]—**Timber Sawing and Saw Hammering.**—Can any reader give any information on the above subject? Is there any book on the subject?—SAWER.

[65970.]—**Petroleum Engines.**—The *Engineer* for May 18th, in describing the petroleum-worked engines recently invented by Mr. Yarrow and applied by him to several launches, says:—"The petroleum spirit is forced by a feed pump into the boiler coils, evaporated, and the resulting vapour or petroleum steam is used in the engine precisely like steam. The exhaust vapour passes into two copper pipes lying along the garboard strakes of the hull. These terminate in a small strong tank in the bows of the boat, which is the equivalent of a hot well, and from which by another pipe the spirit condensed in the two submerged tubes is led back to the feed pump." Now what I wish to know is, How can the condensed spirit get into the tank without being pumped in, since the tank must necessarily be higher than the pipes in the water outside? And if a pump equivalent to the air pump of the ordinary engine is used, would it not be better to have the tank in the stern of the boat, and close to the pump, &c., instead of in the bows of the boat?—R. DAVIS.

[65971.]—**Smelting Metallic Oxides.**—Will any metallurgical friend kindly assist me? I wish to reduce zinc oxide and lead oxide to metal, but do not know what flux to use. Borax, I suppose, would do, but is quite out of the question on account of cost. Both the oxides when they reach me are contaminated with soda, and the lead is a much lower oxide than litharge. The zinc is precipitated and fairly pure. I should like to deal with these in quantities of about 2cwt. at a time. I have a coke furnace and one of Fletcher's high-temperature furnaces for gas, and if I can succeed experimentally would build a suitable furnace for large quantities. As I am only an amateur as regards metallurgy and chemistry, I shall be much obliged for any hints on the subject, especially as regards flux required, quantity of same per ounce or pound of oxide, temperature, &c., and method of smelting.—IXION.

[65972.]—**G.N.R. No. 236.**—Can any reader give me a sketch of this express engine? I wish to make a model and have the drawing of the front portion of double frame and cylinders, but this does not show the smoke-box or firebox. The cylinders are inside the inner frame, and will be bolted to it, but I do not understand the way to fix the smoke-box. I have made the frame alike at either end, but it looks too long in the rear part, the distance between leading and trailing wheels being 2ft., diameter of driving 10in., stroke 3in.—DYNAMITE.

[65973.]—**American Organ.**—I am desirous of building a two manual and pedal American organ, having two rows of reeds on lower manual, one row on upper, and one on pedal (four rows in all). Can any fellow-reader help me as to the following? 1. What is the best action for coupling the two manuals to the pedals? Will a roller-board (as in a pipe organ) be necessary, or can a set of splay backfalls be employed? 2. Are the reeds of the pedal organ placed the same distance apart as those of the manuals, or are they put each perpendicularly over the respective pedal key which acts upon it? 3. Is more than one wind chest employed, or are all the reeds arranged over the same one? If the former, how are the various connections with the bellows obtained? 4. What are the relative positions of the two manual keyboards and the pedal keyboard? 5. How are the keys of upper manual caused to act on their plungers? I suppose both rows of keys must be centre hung, in order to couple to pedal, and if so, is a hole bored through each key of the lower set to allow a rod from upper key to operate on plunger? How are the pedal keys caused to act on their plungers? 6. How are the pedals arranged so as to slide under the organ when not in use? A sketch of any of these actions would greatly oblige.—E. L. SNILLOC.

[65974.]—**Mowing Machines.**—Will some one kindly give the most important conditions to insure good cutting qualities and ease of draught in Wood's machines? We sharpen our knives with the file. Is it best to file against or with the edge? I am told that the sections should be worked back to a long level. But does it not weaken them? I find that they quite lose their edge in about twenty minutes, and it is all one man's work to sharpen fast enough. The claws which bear on the knives are much worn. In our machine there is nearly ⅛in. play between the finger plates and the face of the knife. Is not the action the same as a pair of scissors? If so, should not the finger plates have sharp edges and the knives bear hard on them? Also which is geared to work fastest, the inclosed gear or outside gear with cogs on inside of driving wheels? I have always fancied the outside gear to be the best machines.—A POOR FARMER.

[65975.]—**Microscopical Lecture.**—I purpose when the dark winter evenings approach giving some simple lectures to a working men's society upon scientific subjects, such as astronomy, &c. One evening I propose exhibiting the oxyhydrogen microscope, but am in a difficulty as to what classes of objects to show them. If any of our correspondents would kindly suggest any hints, I should be very grateful, as I have had no experience with lantern microscopes, and my collection of slides is limited to anatomical objects, &c., size 3 by 1, which I use with a small monocular.—HERBERT WILKINS.

[65976.]—**Gunnery.**—I want to know the least weight a steel gun would have to be to send a shot through a mild steel plate 1in. thick, size of bore, 5in. or 6in. diam.? The difference the length of barrel makes to the shot when fired and method of calculation for different thickness of plate and bore of gun. Also how guns are fired by electricity, and if there are any books published on the above giving accounts of experiments?—GUN.

[65977.]—**To Mr. Wimshurst.**—I have made one of your machines with 17in. plates. When first started it gave 7in. sparks of great power. After a week's time it would hardly work. I then took it to pieces and revarnished the plates, and it again gave splendid results, but went off again after a few days. What can be the cause of this? Is it because the brushes scratch the varnish, which I notice they do? What is the best thing to make the brushes of and where can I get it?—G. H. D.

[65978.]—**Motor for Dynamo.**—Could any of our readers who have experienced this want help me? I have a hand dynamo, compound wound, about 4 ampères current. I have frequently shown experiments with Rhumkorff coil, &c., at lectures with it. It is a considerable exertion to work it, especially in showing incandescent lamps when people like to see it working some minutes, and to try to speak directly after is very exhausting. Has there ever been devised a clockwork arrangement which would keep the motor in work, say, 20 minutes or half an hour at a time? The dynamo revolves 2,500 per min., ⅓H.P., volts 26, ampères 5.—J. H. D.

[65979.]—**To "Principia" or "Chemist."**—I would be glad if you would give me a bit of your advice? I cannot make it out how I failed. I have had a strong iron casting made for condensing gases, 9in. by 5in. The other day I tried to make some $2HNO_3$, but somehow I failed. I put potash nitrate in iron casting, and then after connecting generator with condenser (glass bottle) by a tee pipe, I poured the $2HSO_4$ on and corked it up tight. But although I kept a stream of water pouring on the bottle for half an hour I could not get a drop of it condensed, not even by applying heat. What I want to know is, How to condense the following gases with safety? O, HCl, HFe, $2HNO_3$, CO_2. I know what salts to employ, but do not know what quantities to use. I forgot to mention the iron casting is cylindrical form.—A. H.

[65980.]—**Legal.**—Will some legal friend advise me on the following point? Some three years ago I lent to an individual some plant on the hire system. It was to become his on the regular payment of 10s. per week till £50 had been paid. The payments have not been kept up regularly, as during the last year only £1 has been paid, and the total payments have amounted to about £20. The hirer is now in gaol for defrauding the Inland Revenue and the landlord is in possession of the premises on account of rent. He has taken over my plant (not fixed) and also the fixed plant of the tenant. What am I to do under the circumstances? Can I claim my plant from the landlord, and what is the law on the subject?—A VICTIM OF A LONG FIRM.

[65981.]—**Photographic Lenses.**—Can any reader inform me as to the longest focal length of lenses that I can use with Lancaster's "Meritoire," ½ plate, extreme length from lens to ground glass 8¾in., and state what lens would be most suitable for instantaneous views—marine and street—and within the bounds of a working man's pocket? The above wanted mainly for the production of lantern slides.—J. W.

[65982.]—**Organ Query.**—Will "J. E. M." or any other reader enlighten me as to the action of the small bellows in Roosevelt's system? Do they, when the air is shut out of the pallet and bellows chamber, blow their folds inside out with the pressure in the tube? If so, do they return to their former state when the stop is drawn again?—H. B.

[65983.]—**G.W.R. and M.S. and L. Locos.**—Have any of the journals published full dimensions of the G.W.R. broad guage express engines, and M.S. and L.R. 4-coupled bogie express engines (No. 441 type)? Can any reader give full measurements and weight, or number of vol. containing such?—W. H. P.

[65984.]—**Opticians' Testing Glasses.**—Opticians use a pair of lenses mounted on a rod for testing the eyesight of intending purchasers of spectacles. Can anyone inform me on what principle the rod is graduated, and what focus the lenses ought to have?—LUCIGEN.

[65985.]—**Electric Light Meter.**—Will anyone help me in this difficulty. We are burning the electric light, incandescent, in our club, and although we know the lights have not been so much used this quarter as last, the charge is double. This charge is calculated by a so-called meter, which seems to be that the current is passed through two pieces of copper held in some solution, both of which pieces of copper are weighed separately, and according to the amount one has gained from the other so the charge is made. Is this kind of meter infallible?—J. R.

[65986.]—**Connecting Bells on Galvanic Battery.**—Will Mr. Bottone or some other electrical reader inform me the way to put two bells into circuit on a galvanic battery to ring at the same time as the battery is being used for shocks? I want to fix them behind the coil on the base to attract attention. Also how to connect four handles on to same in the place of two.—ANXIOUS ENQUIRER.

[65987.]—**L. and S.W.R., No. 527 Class.**—Can any reader tell me if the "new mixed traffic" engines of the above line fulfil all that was expected of them? Are they more powerful than the 365 class? What are the numbers of the old mixed traffics, and what brake is fitted to them? I see that the company are painting all their engines now a light green, whereas before they were either chocolate or dark green. Wherefore this change?—METEOR.

[65988.]—**Patent.**—Will some reader kindly answer this? A invents a new plan of propelling ships. B pays expenses of taking out patents. What are the customary claims of B if patent is sold? How to proceed to find capitalist. A will give no explanation about patent to B till after securing provisional protection.
countries should such an invention be
patent? What would be probable cost?—A

[65989.]—**Port Holes in Cylinder.**—
BRISTOL."—Please show me in plain figures
to get the port holes in a steam cylinder? A
cylinder, diam. ⅞in. diam., what width will the
be? Also the width of the bars. Also the
Length of valve box ⅞in. Also travel of valve

[65990.]—**Keeping Machine Tools**
Will some experienced reader kindly inform
the best dust-preventing cloth covering for
and the best means for keeping the brigh
machines of this kind from rusting if standi
months? Also the best lubricant for the

[65991.]—**Paint Manufacture.**—Can
readers give me a few wrinkles on paint
you use boiled or unboiled linseed oil, and
names of the colouring materials? I suppose
cheaper to make one's own paint than to buy
METEOR.

[65992.]—**Manganese.**—Can any of your
form me of a method of testing a mixture in
of Mn? I find when I add NH_4Cl and NH_4
to drive off the excess of NH_4OH, so
$Cr_2(HO)_6$ will be thrown down, I always get
along with it.—YOUNG STUDENT IN A FIX.

[65993.]—**Hydrochloric Acid.**—In
College Course of Practical Chemistry I find it
to add an equal bulk of HCl to the filtrate
group and boil down nearly to dryness. Then
H_2O before passing H_2S through. Could
readers state the reasons for adding the HC
STUDENT IN A FIX.

[65994.]—**Vacuum.**—A barometer stands
the vacuum above the mercury being perfect.
of the cross section of the tube is ½sq.in. If
external air is allowed to get into the baromet
mercury is found to fall 4in., what was the vol
original vacuum?—MECHANIC.

[65995.]—**Deflection.**—A beam will safel
stationary load of 5 tons with a deflection of
what height may a weight of 200lb. be let drop
same beam without deflecting it to a great
MECHANIC.

[65996.]—**Stress Diagram.**—Draw the
moment and shearing stress diagrams for a
long, supported at both ends, and loaded with
4 and 6 tons at distances of 3ft. and 8ft. respect
one end of the beam. Explain fully the mode
at these diagrams.—MECHANIC.

[65997.]—**Shock.**—Will any of your electric
kind as to give me a hint how the automati
machines to give a shock when a penny is put in
I understand that when the penny is put in that
made with the battery. But how is the penny
contact?—A FORTH BRIDGE WORKMAN.

[65998.]—**Preserving Leaves.**—I wish to
some foliage plant leaves (of various colours).
that in the ordinary method of pressing and
colour is entirely lost. If any of the numerous
the "E. M." can inform me of a method of prese
leaves so that they will not lose their beautiful
they will greatly oblige.—H. H. L.

[65999.]—**Filtering Paper.**—Will some
chemist kindly furnish me with a comparative
of the points of advantage and disadvantage of
Rhenish, and Swedish respectively, and the
occasions on which they are severally most
YOUNG ANALYST.

[66000.]—**Preserving Stone Work.**—I ha
some stone work with a solution of silicate of so
view to preserving it, but instead of presentin
like appearance upon the surface it is covered
crystals. Can any reader tell me the caus
crystallisation and what will prevent it?—SILIC

[66001.]—**Organ.**—Will Mr. Robinson oblige
me the size of the holes in the soundboard for
gamba 2in.? In making a clarabella, should they
a little wider in the middle? The clarabella is
Should the lieblich gedact be cut the same lengt
principal, only allowing length for stoppers?
DIAPASON.

[66002.]—**High Ground.**—I wish to find
relative height of the various districts north of
Can anyone tell me how to obtain the informat
whether there is any model of the ground of L
the museums or elsewhere?—W. A. L.

[66003.]—**Back-Supporting and Ches
panding Braces.**—Could any reader give me
sketch of the best back-supporting and chest-ex
braces to work with? Also best material to
with.—COUNTRY MILLWRIGHT.

[66004.]—**Test for Platinum.**—Will so
reader give a simple recipe for testing platinum.
a chance of buying something of the kind lately,
unable to tell whether it was platinum or not?—
INQUIRER.

[66005.]—**Preserving Flowers.**—Can any
reader give any hints on the above subject? I
means of preserving flowers in hot sand for grea
of time, but have lost the recipe.—R. A. T.

[66006.]—**Mitis Metal.**—Can any of "our
information in regard to mitis metal, as invente
Peter Ostberg, quantity of aluminium, &c.?—Ca

[66007.]—**Banjo.**—I should feel obliged if "B
would send the sketch he promised?—JAMES K

[66008.]—**Blowing off Boilers.**—I should be
if any reader can explain the following:—Why
when blowing off water from a boiler while wor
reduction in the steam pressure takes place, alth
steam room in the boiler is often more than d
a few minutes? I have tried the experiment on a
boiler lately several times, and always with the s
sult. The diam. of boiler is 6ft. by [illegible] long.
tance between the water level and top of boile
blowing off is about 12in., after blowing off
work is constant, and the damper regulated so

Will exchange **Electric Gas Lighter**, good as new, cost 30s. Offers.—J. KIELL, High-street, Barnstaple.

Vols. XXXIX. to XLIII. "**English Mechanic**." bound, complete. Exchange for Ritter von Urbanitzky's "Electricity in the Service of Man."—BUSHELL, 36, Queen's-road, Bayswater.

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"**Lord Macaulay's Writings and Speeches**," "Planetary and Stellar Worlds," "Smith's Wealth of Nations," "Gatty's Natural History," &c. Offers wanted.—ROBERT SMITH, East Wall, Londonderry.

Wanted, shunt-wound **Dynamo** that will deposit 1oz. of silver per hour. Good exchange given. Give particulars.—26, Parliament-terrace, Wollaton-street, Nottingham.

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I will exchange forty-five 1s. numbers of "**Cassell's** ENCYCLOPÆDIC DICTIONARY," now publishing, for Mathematical Instruments. What offers? State maker.—ADVERTISER, 112, Stewarts-road, Battersea.

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Will exchange for **Model Engine and Boiler**, my 50in. Hillman, Herbert, and Cooper's BICYCLE, in good condition.—E. FITTON, 7, Ashworth-terrace, Dewsbury.

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Wanted, **Chuck**, self-centring, suitable for 3in. lathe, also Drill Chuck. Exchange Rook, Rabbit Rifle, 9C ball, 200 empty cartridges.—D. TAYLOR, Ilminster.

Wanted, pair good **Field Glasses**, in case, or other offers, for Medical Coil, in box, with handles, complete.—GEORGE PEERS, Little Hulton, Bolton, Lancashire.

What offers in exchange for a job lot of **Morse and** WHEATSTONE INSTRUMENTS, Relays, Duplex Keys, Indicators, &c.?—Particulars of HUDDLESTON, 97, High-street, Plumstead.

Queen Elizabeth Sixpence, dated 1575; scientific exchange offers wanted.—J. SIMONS, Telegraph Department, Post Office, Deal, Kent.

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54in. Coventry **Bicycle**, in good condition, suit learner. Exchange small drilling machine or other mechanical tools.—CYCLIST, 20, Windmill-street, Gravesend.

52in. **Bicycle**, balls throughout, value £8, cost £14; also 3 draw telescope, plated, by Mackenzie, Strand. Wanted lathe 5 or 6in.—C. OSBORNE, Electric Light Department, Aquarium, Westminster.

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1-horse-power **Horizontal Engine and Boiler**, guaranteed perfect order, all fittings complete. Great bargain. Offers, together or separate.—166, Siddals-road, Derby.

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Astronomical Telescopes.—Apparatus and parts made to order.—A. CLARKSON, 28, Bartlett's Buildings, Holborn Circus, London.

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New **Waster Files**. Engineers, &c., send for quotations. State sizes.—WILLIAM Sheffield

he English Mechanic
D WORLD OF SCIENCE AND ART.
FRIDAY, AUGUST 3, 1888.

TRACTS FROM BERGERON.—X.

Inlaid Boxes (*continued*).

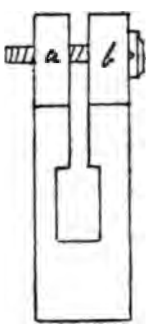
HERE must be formed in the lathe, with a small parting tool, a recess at the edge he cover to receive a ring; and in order t this ring may hold firmly in place, the ss is to be made slightly deeper at bottom n at the top—that is to say, instead of a ht angle, it should show an acute angle. ficient thickness of wood must be left to interfere with the strength of the er. A kind of chuck must be turned, ed a triblet, which is but a very nded cone—that is to say, it dimin- s very gradually in size towards the end. ing of shell is to be placed on this of a suitable to the recess, so that it will enter ttle tightly. The two sides of the ring t be trued up accurately, and, having been oved from the triplet, it is to be soaked epid water, so as to slightly to soften it. ttle thoroughly hot and rather thick glue be placed in the recess; the ring is to nserted with care lest it should break, and ust rest very truly against the wood in ry part, so that it may be fixed very rely upon it, and that it may take the n of the recess. A bit of iron is to be lied to the outside, heated to about the e degree as a soldering iron, and this is to nade to pass round it several times. The l must be left to cool, and, lastly, the must be turned truly circular, especially part which should be flush with the box. cover is to be now removed from the k and mounted upon another, so as to on its mouth; but it must not be forced est it become enlarged so as to have too n play when placed upon the box.

would be much more natural to e it inside a chuck, so that it might be by the outside; but as it could not be e to hold firmly unless it entered some- tightly, the ring that has been put upon uld be certain to be pulled off. It could, ever, be placed in a split chuck, such as have already spoken of; but unless workman is thoroughly *au fait* in the e of working with this kind of chuck, n setting the work very true in tighten- p the ring, we should not advise him to t, although such may be absolutely the method.

t, therefore, that plan be chosen which s the best prospect of success. A recess be made at the exterior angle of the r, and equal depth and width is to be n to it, so that the ring may be equal on op and side. This recess is to be made ven sharper angle at the bottom than the

This is the one which gets the most , since if the cover is a little tight, and tempt is made to open the box, the a tends to move the ring out of place. ust be made to enter the recess as accu- y as possible, and it must be fixed in manner already indicated. There may aced on the outside of the cover one or nlaid rings, as may be deemed necessary. best plan is to put a single very narrow nly, placed near the ring on the angle of over at a distance equal to the width of nlaid ring. This operation is sufficiently ult. It is necessary to form the groove a very narrow parting tool well tem- d so as not to bend, and so that it may he groove very neatly, and rather deeply. also necessary to have a very sure hand, not to spoil the work. A ring is to be ed on the triblet larger than will be re- ed, and it is its thickness that will enter groove. It is necessary to regulate this

Fig K



M

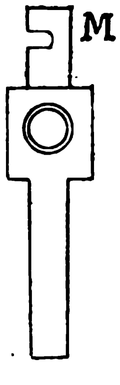
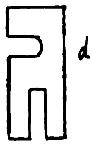


Fig L



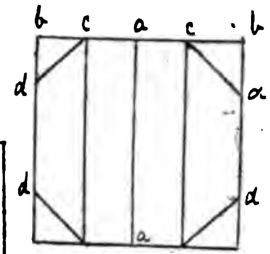
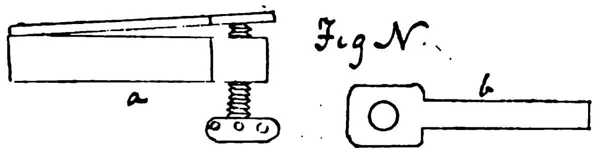


Fig O

Fig N.



thickness with great care so that it shall exactly fit the groove. As regards diameter it is sufficient that it exceed that of the groove, because the ring will be divided before being placed in position and it is easy to remove the surplus. The ring is to be glued into place by pressing against its entire circumference while the article is revolving in the lathe.

Rings are to be inserted at pleasure, at suitable distances from the centre, and at the centre itself a disc may be placed, similar precautions being taken. When these are dry they are to be levelled down, and the whole polished. While the rings in the cover are drying, the same work is to be done on the box, but no ring must be put high up on the box, because the meeting of that on the cover with that placed in such position would double its width, which would have a bad effect, although the two would only have the effect of a single one. As regards the outside shape of boxes, we can lay down no rule, since it varies continually and follows the rule of fashion. In describing, in the second volume, eccentric and epicycloidal machines, we shall give the method of ornamenting the tops of boxes with fillets, interlacing in a very agreeable manner. Very generally a stain is applied to these kind of boxes, which, penetrating the pores, and especially the little intervals which each excrescence leaves between its neighbours, adds to the natural yellow of boxwood a colour which brings out the pattern which nature has produced. We can use red, blue, or green, or, even better, umber, which does but deepen the colour which is natural to a log of boxwood.

We shall give in another place the manner of employing these stains, and in order not to lose by an infinity of digressions which take us away from the main subject, it suffices to say that at our shop all these stains can be had in bottles ready for use. . . . . Very often, in turning on a chuck lathe a piece that is rather long and slender, which would be too weak, or if there is reason to fear that the end will not be stiff enough to retain its centrality, which would cause the tool to chatter, there must be made on the end with a point tool a hollow centre in which the point of the poppet may be placed; but although the poppets of the pole lathe ought to be of the same height of centre as the chuck lathe, there is generally a lighter and more convenient one supplied than those in common use. This is nothing more than the boring collar, to which a piece of wood is added, through the thickness of which passes a pointed screw that can be advanced or withdrawn at pleasure. In this way one poppet is made to serve instead of a number, which are only in the way, and there is a capability of varying to some extent the height of centre according to need.

Split Poppets with Movable Wedges to Support Long and Slender Work.—There should always be provided two or three poppets fitted to hold wedges at the height necessary to support work while it is being turned, and the following is the way in which these poppets ought to be made. They do not resemble those already described. Fig. K represents the poppet. It is slotted nearly its entire length to the thickness of the wedge, which is four or five lines. A wooden screw with a large head passes through its thickness. The part *a* contains the screw, and the part *b* a smooth hole of the external diameter of the screw. It can be seen by inspecting the figure that when the screw is turned the two jaws will be brought together, or separated the one from the other, and press against the wedge Fig. L, in which is a notch which holds the piece that is being turned. In Fig. M is represented the same poppet seen in profile and the wedge in position. There can be placed along the length of the work two or three poppets of a similar character, as need may require. On inspection of the figure our readers will perhaps imagine that the poppet can only be fixed to the lathe-bed by a wedge, and recalling what we have said as to the inconvenience of this method employed by turners in common work—as, for instance, the noise and shaking of the floor—they will be surprised at our proposing it; but there is another plan of fixing the poppet to the lathe-bed less secure, indeed, than the wedge, but which suffices, because it does not have to meet a great strain. A key has to be made (Fig. N, *a* and *b*), of a thickness suitable to the mortise it has to enter, and about a foot long, having a head at one end, in the middle (of its width) in the face of which is a hole tapped to take a screw of about an inch in size. On the top of this key is a sole-plate of sound wood of the same form as the key, and fixed to it at its straight edge by means of some wire nails. This sole-plate takes the place of a washer.

The key is placed in the mortise of the poppet, the screw is turned which presses against the sole-plate, which bears against the bed of the lathe, and at the same time causes the key to descend, and in this way the poppet will become fixed without any noise or strain. This plan is a very good one even for poppets of centre lathes if large pieces are not to be turned; much more is it advantageous merely for fixing back-stay poppets. Care must be taken to leave plenty of wood at the tail end of the poppet below the slot, to enable it to resist the force of the

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screw as well as the motion of the jaws' which tend to split the wood.

To Turn a Ball.

Previously to speaking of works that are rather complicated, it appears to us proper to teach how to make certain things which, although very simple, present certain difficulties which try the skill of an amateur, and we begin with a ball. A ball, called in geometry a sphere, is a solid formed by the revolution of a semicircle about a right line which is called the axis, and of which the centre situated at the middle of this line is equidistant from all points of the surface. We advise that this ball be made at first of some hard wood, such as box, before attempting it in ivory.

A cylinder is to be turned in the chuck-lathe, which is to have for its diameter that which is to be given to the ball. It is to be dressed at the end truly level, and accurately at right angles. Then, having determined its total length by marking it with a point tool, such length being equal to its diameter, it must be accurately cut off at right angles with a chisel. It will even be better to finish this face by putting the piece either in an ordinary chuck, or in a spring one. Measurement must be taken by calipers as to whether the total length is equal to the diameter of the cylinder. It is necessary, in order to carry out these operations, to be capable of putting work back into the lathe accurately and with truth. In the middle of its length a very fine mark is to be made with a point tool or pencil, to serve in the following operation.

A chuck must be hollowed out so that the cylinder may enter it crosswise—that is to say, its length is to be placed across it; but care must be taken that half of the cylinder shall be outside the chuck, and further, that it be placed quite straight. To test this, a point tool is to be presented to the extremities, and examination made whether it touches them equally. The tool is then to be presented to the mark of the point tool or pencil, of which we have just spoken, and if the cylinder is quite straight in the chuck, it should only make a dot. If, on the contrary, it traces a small circle eccentric to this line, the cylinder is not accurately placed, and the ball resulting from this operation would not be a sphere, but a spheroid, flattened at the poles.

All that part which forms the angle must be worked off very gently, and after the angles are removed, the work must be carried on with a chisel which cuts keenly, until the circle traced on the middle of the cylinder is reached. This operation is an exceedingly delicate one; it must not be carried more deeply in one part than another, and it is for that reason we recommended the making a very fine line with the point tool or pencil. After the work has been evenly done throughout, the piece is to be removed from the lathe, and it will have the form of a hemisphere upon a plane, which is the half of the cylinder. Another chuck must be hollowed out in such a manner that the half-ball will enter tightly, and that the straight remaining part of the cylinder shall rest upon the face of the chuck, which must have been trued up for this very purpose. In order to fix it without driving, a drop or two may be placed between the chuck and the remaining angles. The same operation is to be carried on upon this part as on the preceding one, and if the work has been well done the ball should prove to be a true sphere.

We have directed to place the cylinder in the chuck by its four angles. This method causes certain difficulties in securing it firmly, since the shock caused by the tool in removing these angles shakes the piece which, as it is only feebly held, easily escapes from the *chuck. We will,* therefore, give the means *of remedying this* defect.

The lines dotted in Fig. O represent the cylinder turned as we have described. The line *a* lightly traced is the middle of the cylinder, the lines *b b* are the ends cut at right angles, the lines *c c* divide the cylinder lengthwise into four equal parts. Concentric circles *d* are to be traced on the ends or extremities at the same distance from the angles as the lines *c c*, all the material between the lines *c* and *d* is to be removed, and after the angles have been thus lowered, the work will appear as two truncated cones applied to the ends of a cylinder. In this way the points of contact with the chuck are doubled, and it becomes far more easy to turn it, owing to the disappearance of the angles, which cause the shocks, and often cause splintering. We advise, in the carrying out of this work, always to attack the wood from the centre towards the extremities. In this way the cut will be more uniform, and there will be no fear of chipping it.

O. J. L.

COMBINED SPANNER AND PLIERS.

THE combined spanner and pliers illustrated in the figure annexed forms the subject of a patent granted to Mr. S. Snell and Mr. A. W. Sanderson, of Birmingham, the object being to combine in one instrument an "all-nut" spanner and a pair of pliers, the latter having either plain, gas, nipping, or cutting jaws. The invention consists in making the spanner in two parts, divided longitudinally about its middle, and jointed near its upper end, while its lower end, when the instrument is in use as a spanner is secured by a jointed loop or other like fastener. Thus the combined instrument is separated or divided down its middle, from its lower end to near its upper jointed end. That part of the instrument which is disposed above the joint pin, forms plier, or other like jaws, which may be either for cutting, gripping, or wrenching. The joint is made like that of an ordinary pair of pliers, cranked to the reverse side of its handle part. The lower halves of the instrument (when used as a pair of pliers) form the handle, while the upper parts constitute the jaws; and by the crossing of the upper parts, the jaws are made to lie on the reverse sides to the handles, to which they are connected. To use the apparatus or instrument as a pair of [illegible] or as a wrench, remove the loop from [illegible]er end of one side, then open out the lower divided part of the instrumen
open upper jaws above the joint
for the gripping, holding, or cut
object. To convert the instrum
spanner, close the lower divided p
bring the inside faces into juxta p
we have a flat bar, with varying sid
running longitudinally from near
the lower part. The jointed halves
together by the loop, as show
represents the tool in front ele
Fig. 2 is an underside view of
a a is the handle and spanner p
when closed, forms an all-nut spa
hexagonal-shaped holes a^2, for taki
sized nuts, when the combined a
required to be used as a spanner.
handle parts, or arms *a a*, are ke
closed positions by a jointed loop
jointed at b^2, and having a hole b^3
which takes upon a corresponding
tended end a^3 of the opposite half.
jaws of the plier part, which are ex
the half-handle parts, and which pa
nected together by a joint pin *d*. Th
a^4 of the plier parts with the spanne
parts are respectively provided wi
notches *e* for the cutting or shearin

FIG. 1

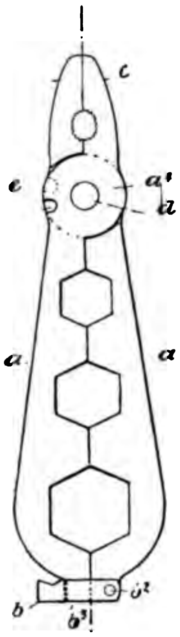
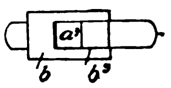
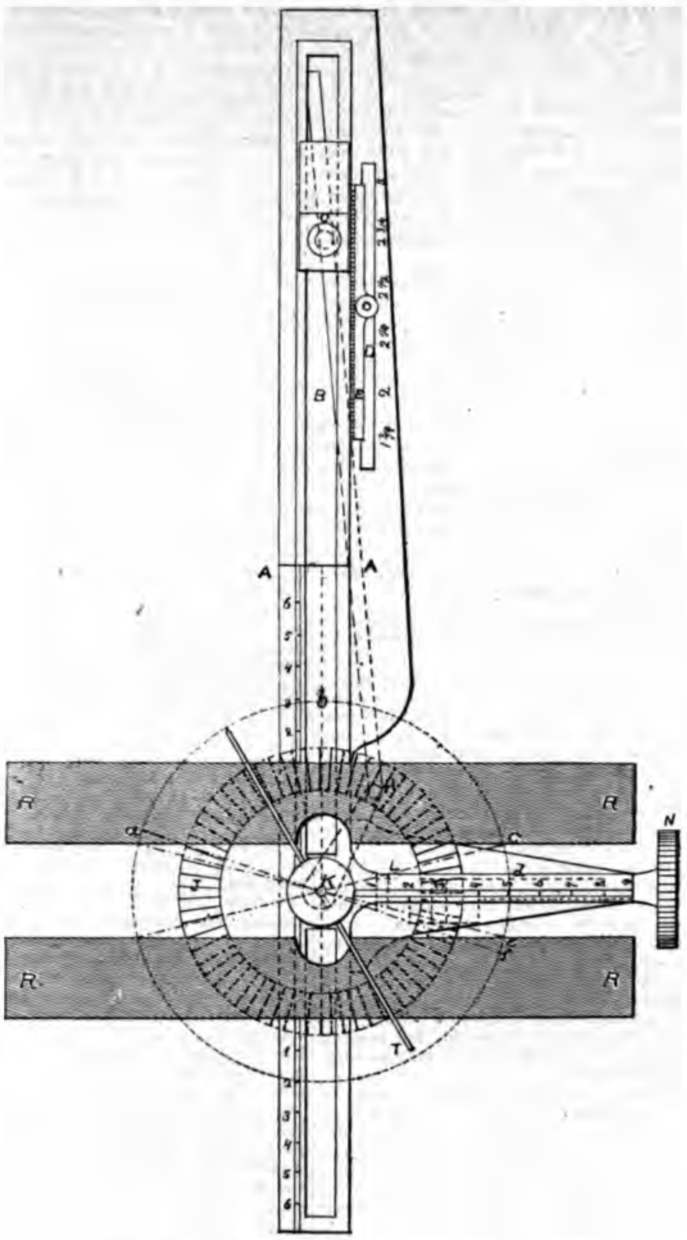


FIG. 2



PAPER BOTTLES.

THE following description of a
making paper bottles and bo
has been patented by Mr. G. A.
Billiter-square, E.C., may interest
and be of some service to the querist
on p. 487 about makers of vessels in
invention relates to the manufactur
and boxes of paper, and to the coati
treatment thereof with inodorous su
render them impervious to oils or ot
or substances for which they may b
The main object is the manufactur
gated paper bottles or boxes coated
wise treated with inodorous substan
bottles and boxes are made by formi
or tubular body from a sheet o
rolling (the number of convoluti
varied according to the desired st
thickness of the bottle or box), and
an end-piece, or end-pieces, in the
tubular body. In making bottles, o
end-pieces is formed with a suitab
for the introduction into the bottle o
or other substance which it is to c
making the paper boxes, a bottom
the hollow or tubular body and a lid
made for the top thereof. Sometim
thread is formed in or upon one
tubular body and a screw-cap or scr
which fits into or upon the screw-th
thereof is provided. The bottles or
made with corrugations extending ei
tudinally, circumferentially, or sp
the bottle or box may be corrugated
to end, or only partially throughout
of the same, leaving the ends smooth
rugated. Bottles or boxes having lo
corrugations extending from end to e
can be made by means of a machine
with a corrugated mandrel upon
paper is rolled and a corresponding c
roller between which and the ma
paper is passed. These bottles and
moreover, be made in series—that is
long corrugated hollow cylinder or
be made and cut into lengths or piece
several bodies of bottles or boxes. Th
the bottles or boxes are made by mea
ting dies of such form that they wi
the requisite shape or configuration to
so that the latter will fit the corruga
In making bottles or boxes with cor
extending circumferentially or spiral
the same, or extending longitudin
partially throughout the length of
or box, an expansible mandrel of th
shape is employed in combination w
of corresponding shape. When the
box is completed, it is coated or
treated with pitch, paraffin, or othe
material which is capable of rend
bottle or box impervious to water, oi
liquids or substances, and which i
odorous should, when the bottle or bo
used for containing food, be deodoris
well known or suitable manner. A
light vessel is thus produced for



and other substances, and one which is ·le to breakage and which will not affect fected by the contents thereof.

PER'S SLIDE-VALVE INDICATOR.

invention which has been patented by [r. W. Cooper, consulting engineer, of Chambers, Newcastle-on-Tyne, is into furnish engineers, managers, and all ed in the economical use of steam with of readily and accurately ascertaining tion and action of a slide-valve, and abling them to see, at a glance, as it e distribution of the steam in any existine, as the apparatus can be used for all lves driven the ordinary way. By its motion of the slide-valve in relation to am and exhaust ports is, in a few shown clearly in every position, r the valve is coupled direct to the ic rod, or by levers, or by link motion. strument is so arranged that the con-·-rod of the engine may vary from 1¾ to es' length, and it will be of much use in g the designer to get out a slide-valve lapted to any given engine. Thus s slide-valve indicator will show how piston has travelled when steam full open; the amount of port s, and (if there is a link motion) rying amount with different grades ansion; the point in the stroke at he valve closes and expansion begins, o the point when the exhaust opens; tion of the stroke completed under expansion; the point when compression begins, and the portion of the stroke performed against the compressed steam. It also shows how much the steam port opens by lead before the piston has completed its stroke and compression ceases, and what portion of the stroke is performed against the steam admitted by lead. Thus, in designing a slide-valve, the point of cut-off, lead, and stroke of valve being given, the instrument will show at once the lap required; or if the lap is known, the stroke of the valve will be indicated at once: so that with such data all the information necessary for the designer can be found in a few seconds with absolute certainty and for any length of connecting-rod. The instrument also enables the designer to compare the action of one valve with that of another, and therefore to choose the one best suited to his purpose. The patentee has issued a pamphlet with diagrams describing the instrument and its capabilities in detail; but it will be sufficient if we explain it with the help of the annexed illustration, which is about one-fourth real size of the apparatus.

A A is the frame carrying the moving parts. B is a long slot in which slides the block C, corresponding to the piston of an ordinary engine. D is a small slot parallel with the long slot B, and graduated on one side, giving various lengths of connecting-rod relative to the length of the stroke. E is an adjustable graduated scale, on which may be read off the various positions of the piston C, either on the in or out stroke. F is a swivel coupling for fixing any length of connecting-rod in relation to the stroke of the engine. H is a crank pin for giving motion to the connecting-rod, and is fixed to the bevel-wheel J, shown partly in dotted lines. K is a centre stud carrying the bevel-wheel and pinion gearing into and driving the bevel-wheel and crank. The milled wheel N works the whole instrument. There is a centre slot, in which are placed R R transverse sliding plates, to indicate the lap and lead of the valve. T is a sliding pointer, adjustable in length by a small screw, and fixed to turn with the crank; it may be set at any angle to the crank, as required by a milled nut. An arm graduated in inches is used for adjusting the length of the pointer T. To use the instrument, turn the crank on to the centre, either the top or bottom, then adjust the scale E to the required length of connecting-rod, by bringing the centre of the scale opposite the proper length of rod, then ease the set-screw and adjust the piston to the zero on the scale E. The zero on this scale is either at the top or bottom, as the crank is either on the top or bottom centre, and E is doubly marked, reading both up or down, as the case may require. Next move the two plates R R from the centre, a distance equal to the lap of the valve. If we suppose the crank to be on the bottom centre, then move the pointer T across, and set it to half the travel of the valve, and fix it by its centre screw; turn the bent point up towards the piston until it crosses the first edge of the lead plate R such a distance as will equal the lead required, and fix it there by the milled nut. It will be seen that the point of the needle now actually becomes the centre of an eccentric, and its position with regard to the crank is the same. The instrument is now ready for taking the whole or any of the data. By turning the wheel N, the needle moves from its position towards the top of the circle which it describes. When it reaches *b* the valve is full open, and the distance from R to end of needle is the opening the port has. When the needle reaches the edge of the plate R at *c*, the valve is closed, and when by continuing the motion the needle reaches the centre line at *d*, the exhaust (if the valve has neither inside lead or lap) begins on one side and compression on the other. Again, when the needle reaches *e* compression ceases, and lead begins before the crank is on the centre. Finish the stroke by turning the wheel a little further, bringing the crank on the other centre. The needle will then be at *f*, and the distance from *f* to the edge *e* will be the lead the valve has at the other end. Continue the motion for the other stroke, and at each of the points abovenamed the position of the piston with regard to the scale E is to be read off.

GEARING.—XIX.

HAVING described and illustrated the principles upon which gear-wheels are constructed, I now purpose explaining the practice of their manufacture, both as regards cast gears and cut gears. The teeth of the larger wheels are almost invariably made by casting, those of the smaller are either cut from solid blanks or else cast from cut metal patterns. It will be necessary to preface what I have to say on these matters by a few remarks on diametrical pitches, and on the subject of interchangeable or standard gears.

Diametrical Pitch.

The relations of diameter and circumference derived from circumferential pitch were fully explained in Vol. XLVI. p. 384, that being the system employed in cast gears. The system of what is called diametral, or diametrical, pitches is one which, though not of any practical service for cast gears made from patterns or by machine, is eminently convenient for those of fine pitch cut from blanks, and is the one therefore commonly employed for these. The principle is termed the "Manchester principle." All change-wheels and wheels of small pitch made in sets on this principle are denominated by their diametral pitches, as "2 pitch," "4 pitch," &c.

The basis of the system is as follows:—The ratio of diameter to circumference is represented by $\frac{1}{3{\cdot}1416} = {\cdot}3183$. That is, ·3183 represents the diameter of a circle whose circumference is one or unity. Consequently, if a circular pitch is represented by 1, that which we term a diametral pitch is represented by ·3183. Hence, if there are 50 teeth of 1in. circumferential pitch in a wheel, the diameter will be 50 × ·3183 = 15·9150in., and the diametral pitch will be one-fiftieth part of this diameter, just as the circumferential pitch is one-fiftieth part of the circumference. The diameter of the pitch circle, therefore, divided by the number of teeth, gives the diametral pitch; or, in other words, the pitch is denoted by the number of teeth *in each inch* of the diameter of the pitch circle, the denominator of the fraction being synonymous with the pitch: thus $\frac{1}{4}$in. diameter pitch would be called 4 pitch.

In these wheels it is more desirable that the diameters should be even numbers, than that the circumferential pitches should be even, as is the case with cast wheels. Hence, the diametral pitches are "2," "4," "8," &c., representing respectively $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{8}$th divisions of the inch, or 2, 4, 8 teeth per diametral inch. Then, while the diameters of the wheels are represented by even numbers, the circumferential pitches, being in the proportions of 3·1416, are not even, but irrational numbers, which in these gears is a matter of no consequence. In cast gears, on the other hand, it would be very inconvenient to have fractional dimensions in the circular pitches.

By the use of diametral pitch, calculation is simplified, thus:—The diameter of pitch circle multiplied by diametral pitch equals the number of teeth in the wheel. A wheel of 4 pitch, 6in. diameter would have 6 × 4 = 24 teeth, The number of teeth divided by the diameter gives the diametral pitch, as $\frac{24 \text{ teeth}}{6\text{in. dia.}}$ = 4 pitch.

Again, giving determinate proportional values to the tooth lengths, the system of diametral pitches affords a ready means of determing the exact sizes of wheel blanks. The diameter of a blank is obtained at once by adding twice the length of addendum or distance from pitch-line to point to the pitch diameter. If this distance is taken as equal to *one diametral pitch*, which is a good proportion, very nearly corresponding with the 5½-15ths of Art. V., the work is simplified, and the total diameter of blank then equal the number of teeth, multiplied by the diameter pitch, plus two diameter pitches.

The following table, convenient for reference, gives corresponding circular pitches for the commoner diametral pitches. The circular pitches, it will be noted, are all fractions, and diametral pitches would be fractional also if based on even circumferential pitches.

TABLE OF DIAMETRICAL AND CIRCUMFERENTIAL PITCHES.

Diametrical Pitch.	Circumferential Pitch.	Diametrical Pitch.	Circumferential Pitch.
1	3·1416	11	·2856
2	1·5708	12	·2618
3	1·0472	13	·2417
4	·7854	14	·2244
5	·6283	15	·2094
6	·5236	16	·1963
7	·4488	17	·1848
8	·3927	18	·1745
9	·3491	19	·1653
10	·3142	20	·1571

Interchangeable Gears.

In a previous article we saw that it is possible to impart almost any profile outlines to the teeth of cycloidal gears by a selection of generating circles of suitable sizes. Bearing in mind the fact that in order to mutual gear a constant size of describing circle should be used, and taking the conditions of manufacture into account, we see that variation in the sizes of circles, however convenient in special cases, is inadmissible for general work, in which all the wheels of a manufacturer's set should gear equally well with one another. This applies both to cast and to cut gears, and the necessary conditions can only be secured by selecting a constant size of rolling circle, both for flanks and faces, and one also chosen with reference to the smallest wheel of a set. For if we take a small generating circle with which to strike the flanks and faces of a small pinion of 10 or 12 teeth—one, say, that shall make strong roots, we shall find that it will be quite unsuitable for *a large* wheel, inasmuch as it makes its points *narrow, and its roots* very wide, causing much *obliquity of pressure*. If, on the other hand, we take a large circle for a wheel of large diameter, we shall find that it will make the points of a small pinion too broad, and the roots too narrow. The rule is, therefore, to make the generating circle equal in diameter to the radius of the pinion which is taken as the *base* of a set, that is, in every case, the smallest. We have seen (Art. III. Vol. XLVI. p. 247), that such a circle gives radial flanks. The smallest pinion is usually taken as one of 11 or 12 teeth, in cast gears, and 15 or 16 in cut gears. Then, any pinions with a less number of teeth, would have undercut and convex flanks.

Having once decided to adopt a uniform size of describing circle for all wheels of the same pitch, the labour of cutting templets for every pitch circle may be avoided by the use of the instrument invented by Prof. Willis, and called, from its use, the Odontograph. Upon this instrument suitable radii for all ordinary numbers of teeth are given, and the edge is sloped in such a manner that when laid in certain definite positions relatively to the pitch and pitch line of the wheel, the positions of the centres of the radii are also indicated. The description of this instrument, together with the principle on which it is based, will occupy the next article.

J. H.

KITE BALLOONS AND KITE TANDEMS.

THE chief obstacle to the general use of captive balloons hitherto has been their extreme sensitiveness, and liability to damage by the action of wind. It is with a view to remedy these defects, and at the same time to gain extra lifting power by converting an enemy into a friend, that I have been led to construct the kite balloon.

The principal defects which captive balloons display under the action of wind are—

(1) Depression and vertical oscillation.

(2) Rotation on their axes.

(3) Jerking and uneven tension on their cables.

(4) Inability to withstand the wind on more than a limited number of days per annum.

(5) Danger of balloon fabric being destroyed by a sudden gust.

On the other hand, when the balloon is fastened on to the back of a kite in the manner I have proposed in my patented design, not only are all these defects to a large extent remedied, but several positive advantages are gained, which may be summarised as follows:—

(A) To raise the same weight a smaller balloon can be employed, since, if the balloon be properly sheltered and attached to the kite, the combination gives us nearly the sum total of the lifting powers of both the balloon and the kite; while by being placed in the rear of the kite the balloon fabric is *always* sheltered from the destructive action of the wind.

(B) When being hauled in, the combination, instead of descending towards the earth, tends to rise by virtue of the increased lift of the kite.

(C) The aëronaut, by manipulation of the strings of the kite, can alter his elevation at will, without being hauled in or let up from below.

(D) The increased steadiness allows him to make observations with greater ease.

(E) Observations can be made at sea between ships or on exposed coasts, where at present captive balloons can hardly be employed at all.

(F) A greater altitude can be attained, since the velocity of the wind is always found to increase with the height above the surface, the general law deduced (from a number of observations, the results of which have been published in the British Association Reports for 1884-5) by the present writer being—

$$\frac{V}{v} = \sqrt[4]{\frac{H}{h}}$$

for heights above 400ft. above sea level.

I propose in the present paper—

(α) To give an account of the kite balloon itself.

(β) To exhibit the defects of the ordinary captive balloon.

(γ) To show how they are remedied by the kite balloon, and finally to give some accounts of previous kite experiments, and a plan for raising instruments or men safely by means of kite tandems, either for scientific or military purposes.

(α) Kite balloon. The full description is given in specification No. 15,627, 1885.

(β) Then with regard to the defects of the captive balloon when used alone.

(1) The most serious of all are the depression and vertical oscillation. The former alone renders the balloon useless in a wind of any sensible strength, and is often very deceptive, since, while the captive balloon is being paid out, it rises like a free balloon, and all apparently goes well. As soon, however, as the line is checked and tightens
up, the balloon rapidly descends until
sional force is equal to the component
resolved normal to the direction of th
in the position of temporary equilibriu
most favourable hypothesis, this press
to half that which would be encountere
surface equal to that of a diamet
placed normal to the wind, so that fo
30ft. in diameter the wind pressure
equal to 176lb. in a 14-mile wind, and
20-mile wind, and this pressure would
acting so as to drive the balloon d
because the balloon would be fastened a
extremity.

Now, if we take the capacity of suc
at 13,500c.ft., and its ascensional power
roughly (with coal gas), we have about
its power lost at 14 miles an hour, and
at 20 miles an hour.

Besides permanent depression, the ba
is very sensitive to variations in the
the wind, dropping as it increases, and
denly when it lulls, so that there ensues a
battle between the wind and balloon, oft
ing in the complete defeat of the latte
final entanglement in trees and other
projections. The other day this beha
balloons was forcibly presented to my no
an experiment at Lidsing, in which Major
let up two captive balloons, tandem, on
support a photographic camera, which w
a series of running instantographs of th
it passed over. The balloons went up ma
and all seemed very satisfactory until
cable had been run out and the winder lo
balloons then rapidly sank, and the cam
knocked about by the trees that the pho
told me he thought it most probable that
were all smashed, and thus the result of t
ment a failure. During all this time a
which I had made for Mr. Eric Bruce
steadily at one level, and would have
whole business vastly better and witho
down when checked.

(2) The jerking or longitudinal oscill
balloon is another great drawback t
ballooning, especially in the case of a m
Whenever the wind blows in gusts, wh
quently the case in certain winds and
earth, the balloon, by reason of the oppo
acting on it, is continually rising and
its rope during a lull, until it meets a g
again drives it downward, and horizonta
end of its tether, which it reaches with a
a report which to the aeronaut sounds
like bursting. The effect of this jerki
nerves is most destructive, and a plac
officer of the Balloon Corps, who ha
what nerves are, told me that after an h
this banging became insupportable, not
well known cumulative effect, men
Tyndall, of walking along a dangerous
the Alps.

(3) The rotation of a balloon on it
always been a great source of discomfo
free and captive balloons; but in the la
not fail to operate disadvantageously if
be used for reconnoitring purposes. It
this case from the fact that the wind
top of the balloon to assume a cup-shap
from which a moment of rotation re
round one way and then round the
slightest departure from symmetry s
produce instability and motion round
the balloon.

(4) Owing to its fragility, and the sim
occurrence of the foregoing drawbacks,
balloon can only be flown on a ver
number of days per annum. Though
able to give accurate data on this poin
been voluntarily informed by balloonist
tive balloons cannot be flown successfull
than four or five days per month throu
year. As soon, however, as I ventured to
this fact in print (which I certainly di
vent, since it considerably surprised me
tive balloonist hastened to rescue his ba
disrepute by alleging that he had worked
successfully on 15 days out of 28 in July.
asserts to be "by no means the stille
summer months." Whether this be tr
July is certainly below the mean of the
very far below that of the windiest mo
following figures show the average me
velocity of the wind at Greenwich for
July the year, and the windiest month. M
velocity (miles per hour) of wind: 1883-
windiest month, 15¼, year, 12. Also
the year 1885 as an example, we find
156 days at Greenwich on which the av
velocity during the 24 hours was 10
under.

Considering that the average of the
was exactly 12 miles an hour, it is see
that on more than half of these (takin
proportion as my captive balloonist wa
in July when the wind was 10 miles an
a captive balloon have been raised with

out of the 365 days, and if we add on r luck, we get 100 days out of the 365, ne year.

in a country where the average wind hroughout the year is about 10 to 12 hour; but while in the interiors of large the wind is less than this, being on the of a large number of observations, lude the interior: in Europe 10 miles America 9·5, S. Asia 6·5, W. Indies 6·2, at ons it is considerably more. For example, it varies at 12 coast stations from 11 uly to 19 in January; at Bombay and er coast stations in India from 9¾ miles ber to 19 miles in July, and in the N. its *mean* velocity throughout the year ed from numerous observations at about er hour, varying from 25 in summer to ter. In such localities, therefore, the days on which captive balloons could would be considerably less than in places nland. For military manœuvring near or for coast and naval purposes, then, it s that captive balloons, as at present uld be almost useless, except on one or d days.

hope to show subsequently that by the of the kite attachment in moderate and the substitution of the kite by itself lloon in higher winds, observations could such localities with success and safety.

possibility of the wind acting destruc- the fabric of a balloon, especially in a st, is, I imagine, an element of some im- At all events, it has always been o the kite-balloon that the junction of ould expose the latter to a strain which d it. If this be so, then there must be ger of rupture taking place in the bal- e, either through jerking or a sudden my kite-balloon all danger of rupture is by keeping the balloon as nearly as pos- w the level of the top of the kite, and vering one-half of its upper surface with stened to the kite, which takes off the l also prevents the air from eddying into -shaped space between the plane of the the sphere of the balloon.

idering the advantages introduced by the ion of the kite and balloon, I shall first fly allude to the way in which the fore- wbacks to the captive balloon alone, are

e addition of the kite almost entirely depression and vertical oscillation in a ce the balloon and kite are oppositely and while a lull tends to reduce the nearly t angle of the kite, it allows the vertical of the balloon to assert itself, and thus y downward tendency due to the weight e, which in any case is relatively small. her hand, a rise in the wind allows the tion to come into play, and prevents eyond a certain point. The addition of f conical cups also greatly tends to insure s, this kind of tail being self-regulating, next to nothing in a light wind, and in- in pull as the wind rises.

e rotation of the balloon on its axis is prevented by the kite attachment, since always flies with its face to the wind, and ly adjusted, with its principal axis in the plane through the direction of the wind oint of attachment to the earth.

king or uneven tension on the cable is vented, since, even during a lull, the on the kite suffices to stretch the cable or y taut. The action of the kite in keeping taut, is well exemplified in a preliminary nt made at the Tunbridge Wells Gas- the presence of Mr. Eric Bruce, on June reported in *Nature* of July 21, 1887. The f this experiment are exhibited in the table:—

	Angle of Balloon.	Wire near Ground.	Height attained in in feet.
lone	38°	18°	693
nd kite .	41½	35	789

of Wire.
balloon alone, 20°
kite balloon, 6½°
f height in latter ....96ft.
Greenwich dur-
rial, 12 miles an
.

Weight of
(1) Wire 4lb.
(2) Kite 2¼lb.
Raising power of balloon with hydrogen = 5lb.

eriment took place in the bottom of a 0ft. above the sea, and surrounded by hills 500ft. Even under these unfavourable ances, and with a very rough imitation of t, the addition of the kite—

sed its own weight.

reased the vertical height of the com- by 96ft.

inished the curve of the wire by 13½°, howing the existence of a greatly-increased wer.

(4) Again with respect to the number of days on which the combination can fly. We have already seen that the captive balloon alone cannot fly on more than 100 days per annum, the majority of which must be during the summer. Now, from a series of observations which I made with kites alone, on the velocity of the wind at different heights above the ground in 1883-4-5, I found myself able to raise, by means of two kites spreading together, about 19sq.ft., four instruments, each weighing 1½lb., to heights varying from 200 to 1,500ft., in winds ranging from 7 to 30 miles per hour (at a mean of 700ft. above the ground—1,200ft. above sea-level), which corresponded to 6 and 24 miles per hour respectively at Greenwich, 200ft. above the sea. Now, since at Greenwich there are 270 days per annum in which the wind is over 7 miles per hour and under 20 miles, it is plain that if the kites were able to lift several thousand feet of wire and four instruments at the former wind velocity, and to fly safely at a wind velocity ten miles over the latter, the kite ought to be a material assistance to the balloon on all these 270 days. Not only so, but if we take the 69 days on which the wind is *below* 7 miles an hour to be a portion of those on which the captive balloon can fly alone during the year, and subtract them from the theoretical 100 which represents its maximum performance, we find it would need the aid of the kite on no less than 239 of these 270 days.

Even if we extend the limit of the balloon alone to days on which the average wind velocity is under ten miles per hour, which is only two miles less than the average for the year, and we also limit the utility of the combination to days on which the wind is less than an average of 15 miles per hour, we still have 120 days on which the kite would be a necessary adjunct to the balloon. In any case, therefore, the addition of the kite would more than double the number of days on which the captive balloon could be flown.

(5) The risk of bursting the fabric of the balloon by its exposure to sudden gusts is a matter on which I do not possess any personal knowledge; but I have been led to infer that it is a fact of some importance owing to the avidity with which captive balloonists seize upon anything which affords what one of them terms a "wind-shield."

About three years ago Mr. C. G. Spencer, the well-known balloon manufacturer, told me he had long been thinking of something to act as wind-shield, and my idea of uniting the kite to the balloon, which originated out of a desire to keep the former up in a light wind, appeared precisely to meet his desire to find a shield as well as support for the balloon in a high wind. Approaching the matter from entirely different standpoints, and with diverse aims, we found our common focus in the word "kite." It is also obvious that if it were not for fear of the destructive action of the wind on the fabric, captive balloonists would long ago have availed themselves of the vertical component of the wind by trying to make the attachment to the balloon on the side instead of below the car. The kite effectively allows this to be done by offering a steady plane instead of a rumpling curved surface, and, with the aid of the top hood, prevents all danger of tearing as long as the balloon is kept well within the area defended by the kite shield.

We may, therefore, consider that the protection afforded by the kite not only lowers the risk of bursting, but allows the balloon to be flown in a wind which would otherwise jerk a good deal of gas out of it and possibly destroy it.

Another point in connection with man-carrying ascents is the expense involved in the constructing and filling the large balloons which are necessary to lift a man. Now, I think I may say with some approximation to truth that the smallest balloon which is used to lift a single man is not less than 22ft. in diameter, with a capacity of 5,500 cubic feet of gas.

A 16ft. diameter balloon, whose capacity equals 2,100c.ft., would lift 136lb. less, assuming the elevating power of 1,000c.ft. of coal gas to equal 40lb.; but a kite attached to match it would, in a wind of a little over 20 miles an hour, lift this 136lb. and its own weight, which need not exceed 14lb. In such a wind, therefore, not only would the balloon be able to fly, protected by the kite, but one of half the capacity would, with a kite to match, easily lift the same weight.

Not only so; but there would be an economy in (1) Balloon fabric; (2) Gas; which in one ascent would more than equal the prime cost of the kite. The lifting powers, exclusive of their own weights, for kites of the following dimensions in different winds are—

	Wind Velocity.		
	14 Miles an hour.	20 Miles an hour.	30 Miles an hour.
18ft. by 14ft. = 126sq.ft.	48lb.	90lb.	220lb.
27ft. by 21ft. = 280sq.ft.	83lb.	208lb.	485lb.

These are calculated by the ordinary formula for pressure. $p = \cdot005\, v^2$ (Smeaton and Rowe's empirical formula). This is believed to be incorrect, and in excess of the real pressure; but since the pressure on large surfaces increases with the periphery as well as the area, I have adopted it as giving a fair maximum on the assumption that the pressure is statical, which for large surfaces is nearer the truth than the dynamical formula.

The angle of the kite to the horizon is taken to be either 30° or 60°. For any angle between these limits the pressure, and therefore lifting power, would be greater, and for 45° would be ⅝ of the above.

Then as to the positive advantages which I have already summarised.

(A) The experiment already referred to at the Tunbridge Wells Gasworks affords additional evidence in favour of this, since the wire at the lower end which made an angle of 35° with the kite balloon instead of 18° with the balloon alone, showed the existence of a great increase of lifting power. For signalling purposes, by means of the electric light, therefore, it is plain that a smaller balloon can be used with a kite to do the same work as a larger one without; and this applies *pari passu* to the case of man-lifting.

(B) The fact that when the kite or kite-balloon is being hauled in, it tends to rise in opposition to what happens in the case of a balloon alone, is very important, since this defect in the latter often endangers, not only its appendages, but itself as well, by driving it into trees or to the ground.

(C) In the event of a kite-balloon being employed for man-lifting purposes with a car attached, it is readily seen that by attaching a pulley to one of the principal kite strings the occupant could vary the angle of the kite to the wind, and thus either adjust it to varying conditions, or else ascend or descend through some considerable space at will. This would be a great advantage for military purposes.

(D) The increased steadiness of the combination has been attested by all who have seen it, and I attribute this in a great measure to the addition of the cup cone tail. For any purposes of scientific observation, signalling, reconnaissance, or otherwise, this could not fail to be a distinct advantage.

(E) For observations on board ship or on coast stations, the kite-balloon, as I have already shown, possesses distinct advantages, since the wind in such places is nearly always high. In fact, by its means I think a system of signalling between ships might be started by using Mr. Eric Bruce's ingenious electric translucent balloon, and thus ships might be able to communicate with each other when by the curvature of the earth or other obstacles they were ordinarily out of sight of each other.

To show the effect of height on the extension of the visible horizon, it may be noticed that while two observers, each elevated 60ft. above the sea, could only see each other's signals up to about 18 miles, a signal hoisted up to 600ft. above the sea could be seen on the *deck* of another vessel 30 miles off, and from a height up the mast for a still greater distance. It seems difficult to conceive any better way of raising signal lights to communicate between ships than either by means of kite-balloons or kite-tandems.

(F) The fact that the velocity of the wind increases with the height above the surface does not seem to be generally known as well as it ought, and within the range of my own experience, I find the vaguest notions afloat regarding its amount and constancy.

The general result of my own observations on this point may be gathered from the following figures, which represent 40 sets of observations, extending over the three years 1883-4-5:—

Group.	No. of Observations.	Mean height of upper instruments above ground.	Mean height of lower instruments above ground.	Mean upper and lower velocities in feet per min.		Mean value of exponent x in the formula— $\frac{V}{v} = \left(\frac{H}{h}\right)^x$
				Upper.	Lower.	
1	7	250	102	1617	1174	0·372
2	3	322	128	2232	1679	·307
3	8	407	179	1705	1385	·275
4	5	549	252	2107	1773	·237
5	9	795	481	2192	1957	·250
6	10	1095	767	2236	2096	·194

The results of which show—(1) That the velocity always increases with the altitude; in fact, a reverse case has never occurred within my experience. (2) That the increase diminishes in a regular manner with the altitude, reaching a nearly constant terminal value which, by comparison with Dr.

Vettin's cloud observations, I find can be best expressed by the formula—

$$\frac{V}{v} = \left(\frac{H}{h}\right)^{\cdot 25}$$

With the exception of the cloud stratum between 1,600ft. and 7,000ft., the formula with this value for the exponent holds for the average up to the cirrus. Thus a velocity of 12 miles an hour at 100ft. would correspond with one of 21 miles an hour at 1,100ft.; and to show that this is practically true from other observations taken at different levels, I will here quote the velocities recorded by Dr. W. Doberck for the wind at the base and top of Victoria Peak, Hong Kong, for 1884-5-6:—

Year.	Mean Velocity of Wind in Miles per hour.	
	Observatory, 150ft. above sea-level.	Victoria Peak, 1,816ft. above sea-level.
1884	14·8	22·4
1885	14·0	25·0
1886	13·5	26·0
General means	14·1	24·4

The velocity at the upper station calculated from that at the lower by my formula would be 26·3 miles per hour, which is only a little in excess of the mean, and nearest what is probably the most correct value in 1886, the observations only having been commenced in 1884.

These observations, which I could easily supplement by others showing the great increase everywhere in the velocity of the wind with the altitude, will suffice perhaps to show not only the futility of inferring the velocity of the wind and its effect on a balloon from observations near the ground, but the utility and power which the addition of the kite would insure at the higher levels.

Dr. Vettin, of Berlin, from observations of the clouds,* gives the following figures for the velocity of the lowest cloud stratum and the wind at the earth's surface:—

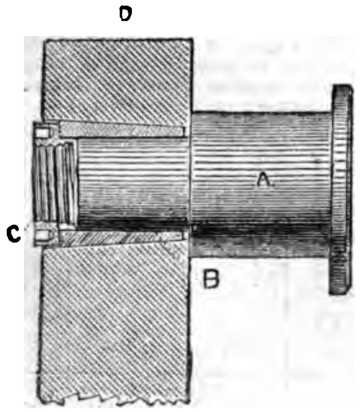
	Altitude in feet.	Mean velocity in miles per hour.	No. of observations.
Under-cloud...	1,600	... 25	... 1,292
Wind............	Sea level	... 13·5	... 4,168

If the lower velocity is taken to be that at 100ft., my formula would make the upper velocity equal 27 miles per hour, and the apparent motion of the clouds is probably lower than that of the wind. I am obliged to defer referring to the subject of kite tandems through lack of time.

E. Douglas Archibald.

METHOD OF INSERTING AND SECURING CRANK PINS.

SOME time since, in making some experimental machinery, it was found desirable to use a crank-shaft in which the crank-pin could be changed, sometimes using 8in. throw, and sometimes using 12in. throw. That is, in a part of the experiment, the piston, which was 14in. diameter, and loaded to 250lb. to the square inch, would have a stroke of 24in.; then it would be changed to 16in., these changes being made a number of times. It will be seen that with this pressure, whatever method of securing the crank-pin might be adopted, it must be one which, when the pin was in place, must be practically unyielding, and not liable to *work loose;* at the same time it should be one *which would allow of easy* removal of the pin without injury to either crank or pin. The plan which was adopted will be readily understood by reference to the accompanying sketch.



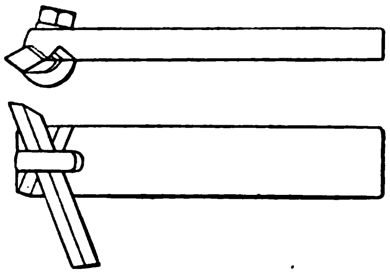


Fig. 1.

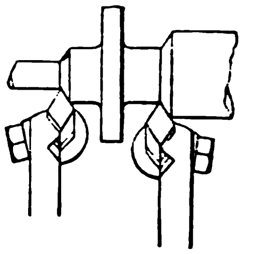


Fig. 4.

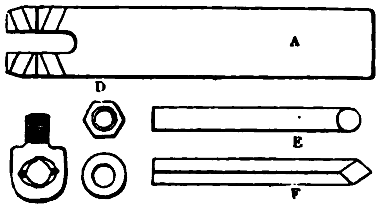


Fig. 2.

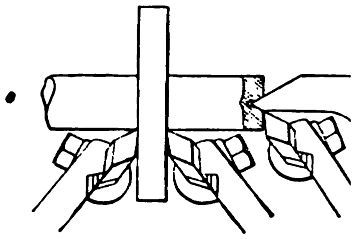


Fig. 5.

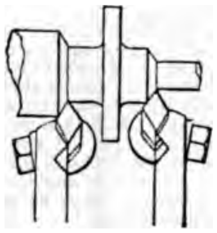


Fig. 3

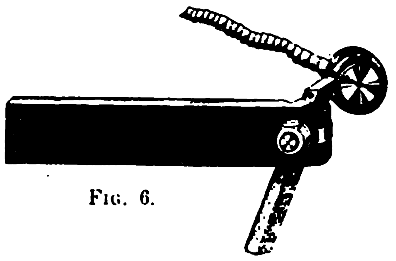


Fig. 6.

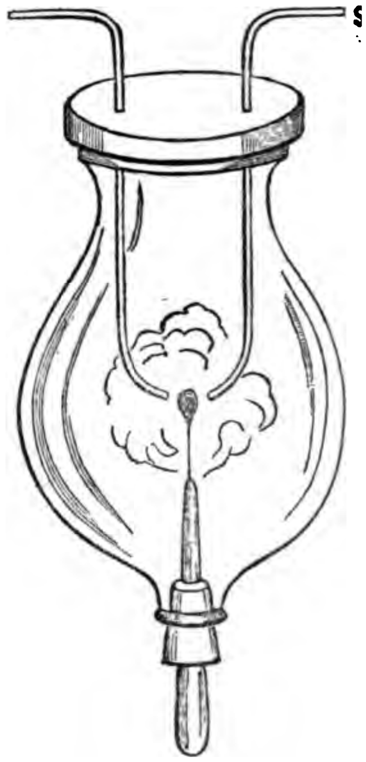
The holes in the crank D were bored taper; largest at the back side. The bush B was also bored taper, and turned on the outside to fit the taper hole in the crank, so as to bring the edge to within about $\frac{3}{32}$in. of the front face of the crank. In fitting this bush, the taper hole in the crank was scraped so as to insure the absolute truth of crank-pin in relation to the shaft. The pin A was then turned and fitted to the bush B, so that the shoulder should be at the same distance from the edge of the bush that the face of the crank was—viz., $\frac{3}{32}$in. The bush was then cut from end to end, so as to give it a chance to expand or contract, and it thus became a circular wedge between the crank and the pin. The end of the crank-pin is fitted into the nut C, care being taken that the thread is a good fit. It is better not to make pitch of the thread too coarse. Now insert the pin A, and place the circular wedge B in at the back between the pin and crank, and force it well home by means of the nut, and you have a pin as rigid as if it had been put in by means of shrinking, or forced in by hydraulic pressure, and yet one easily removed without injury either to pin or crank. This particular pin was never subject to a continuous test in running; but it showed, under a variety of trials, that it would stand up to its work without fault. I believe that this method employed on built-up double crank would be of great utility, especially where for any cause crank-pins have to be renewed.—*Boston Journal of Commerce.*

SEYMOUR'S LATHE AND PLANER TOOL.

THE Capitol Tool Company of Hartford, Connecticut, are introducing the tool-holder shown in the annexed engravings, which explain themselves. Forged tools work satisfactorily enough, but they often require re-forging, and that is expensive and troublesome. One of the especial points claimed for this tool-holder is that it holds ordinary square or round bars of steel, which require no finishing or fitting, and that it therefore requires the minimum expense in keeping up the cutters. A cutter is made by simply breaking or cutting off the length required, and grinding the end to the desired angle, and as heavy and clean a cut can be taken as with a solid tool of the same size. It will be noticed that there are two V-slots crossing each other (Figs. 1 and 2), an arrangement which enables the tool to be used either side up, and with the cutter to the right or left, as Figs. 3, 4, 5. The height of the cutter in the holder can also be varied readily, and the holder thus answers the purpose of an elevating tool-rest. Fig. 2 shows all the parts with the bar A, the securing nut D, and round and square cutters E and F. In Fig. 6 the action of the tool is shown from the face of the work.

NEW LECTURE APPARATUS MAKING SULPHURIC A DRIDE.*

WE have lately designed a piece of app which exhibits in a most striking the oxidation of SO_2, by means of oxy presence of spongy platinum, and which, we will be of interest and use to other lecture consists, as the sketch will show, of an in bell jar having an aperture at each end; th



the lower one is pushed a caoutchouc having passed through its centre a small wood, attached to the upper end of which piece of moderately thick platinum wire, in its position in the centre of the jar a spongy platinum. The upper aperture of the jar is closed with a well-fitting, but not fixed,

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* *Zeitschrift für Meteorologie*, Bd. XVII. July and Sept.

* By Dr. W. R. Hodgkinson and F. E. F.C.S., in *Chemical News.*

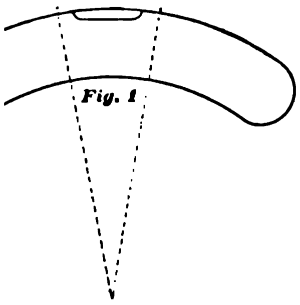


Fig. 1

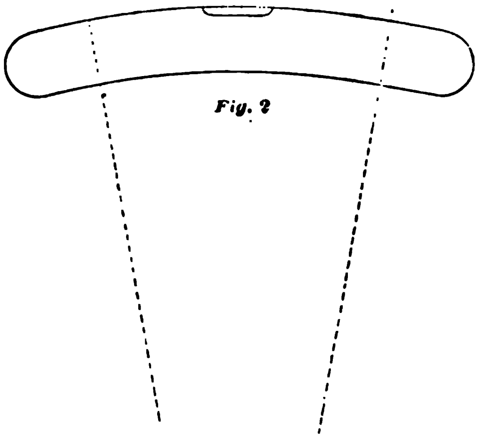


Fig. 2

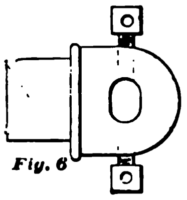


Fig. 6

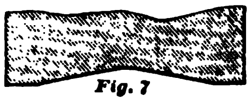


Fig. 7

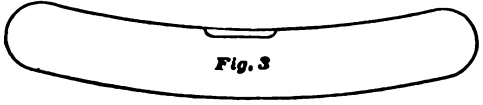


Fig. 3

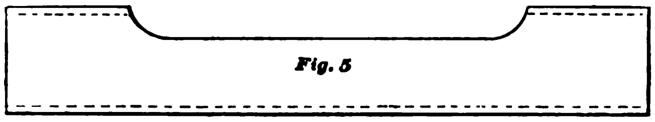


Fig. 5

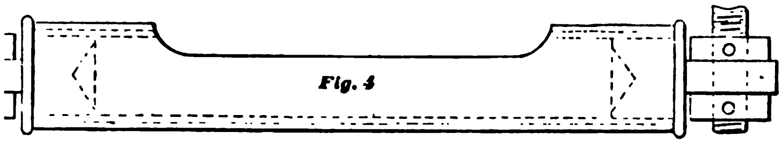


Fig. 4

ough which are pushed two glass tubes
t angles outside, and inside curved so
:e on to the platinum, as shown. The
onge is raised to a moderately high
in a Bunsen flame, and pushed into
streams of oxygen (or even air) and
xide are then passed through their
ibes; instantly the globe becomes filled
of sulphur trioxide, and if the supply
steady, and not too violent, a large
this substance can be made in a very
of time. The experiment is still more
the SO_2 be passed for a short time
ing the oxygen, or *vice versâ.*

POINTS ABOUT LEVELS.*

many seem to think that the sensitive-
and accuracy of a level depend princi-
he fluid with which it is filled, those
an inferior fluid being sluggish and
those which are filled with something
quicker and more sensitive. If a
el glass, such as can be had at the
ores, and is sold to carpenters and
replace their broken ones, be examined,
ound to be, not straight, but curved,
ly by so mounting it as to bring the
upwards that levelling can be done

almost exclusively used as the fluid
common and the better class of levels.
not quite filled, and the air which is
nd constitutes the bubble, finds the
in the bulb or glass, simply because
, and the action of gravitation causes
to take the lowest place. What is
highest place in the bulb is, in fact,
ich is furthest from the centre of the
f the bulb be mounted in the frame
vex side uppermost, and the bubble of
to the middle it simply indicates that
of the bulb have been brought to an
e from the centre of the earth, and if
time the glass is so mounted in the
ts two ends are at an equal distance
e of the frame by which the leveling
the surface or object upon which it
said to be level. As a matter of fact,
evel line is not a straight line, but is
ne which is everywhere equi-distant
tre of the earth.

iveness and accuracy of a spirit level
tly upon the amount of curvature
glass. The reason will be apparent
tion of Figs. 1 and 2, which represent level glasses having different degrees of curvature. Both of these have far more curvature than is ever given to any good level, however. The dotted converging lines, Fig. 1, are at an angle with each other of 20°, and it is plain that to move the bubble from one to the other of these dotted lines the glass would require to be tipped through an angle of 20°; or that, supposing the bubble to be in the centre of the glass, as it is shown, it would be necessary to elevate or depress one end of the glass through an angle of 10°, in order to move the bubble to one or the other of the dotted lines. In Fig. 2 the dotted lines are drawn at the same angle to each other, but, owing to the greater radius of the curve, the distance between them, where they intersect the glass, is greater, and the level is correspondingly more sensitive, since it is evident that if one or the other of the ends of this glass be elevated or depressed 10°, the bubble will move from its present position to one of the lines; which is a greater distance than is the case with Fig. 1.

It is thus made plain that the same amount of elevation or depression in the two cases would cause a much greater movement in Fig. 2 than in Fig. 1, and that the sensitiveness of a level, other things being equal, will be in proportion to the radius of its curvature. If a level glass were made, having a curvature corresponding to that of the surface of the sea, an elevation of 10° in such a glass would cause a movement of bubble of about 700 miles, if it failed to reach the end of the glass within a shorter distance. The curvature is given to the common glasses by bending them in the blowing, but in the case of the finer ones they are ground inside to a certain definite and very slight curve. This is done usually by the use of an arbor of copper or other soft metal, turned to the proper curvature and charged with grinding material and water or oil. The arbor is revolved in a lathe or otherwise, and the glass put over it and manipulated by the hand, until the inside is ground out to a curve conforming to that of the arbor. Finer grinding material is used to finish with, and pains are taken, not only to have only a slight curvature, but a very regular and uniform one from end to end of the glass, and also to have the inside quite smooth. They are then filled with alcohol or ether and closed by the blow-pipe, except in the case of the very finest ones used for certain purposes in connection with astronomical instruments, which are sealed by other means, without the necessity for heating the end of the glass, and the consequent risk of distortion or breakage. Levels of this grade are often provided with an auxiliary chamber connected with the glass, and also filled with the fluid and so arranged that, by turning a milled-head screw, more or less pressure can be put upon the inclosed fluid and air bubble, which latter is thus kept to a uniform length, notwithstanding changes in temperature, from which cause, by contraction and expansion of the fluid, the air bubble is continually being more or less compressed and its length altered.

I do not know to what extent the refinement of curvature has been carried in grinding the glasses, but I have seen them in which a movement of the bubble from one graduation to the other (which were about $\frac{1}{16}$in. apart) indicated an elevation of one second of arc, and, of course, it was easy to read by estimation to half-seconds.

There is a rumour according to which they have been ground to the curvature of the earth's surface, but this is probably not true—one good reason for disbelieving it, if there were no other, being that such a level would be useless, because when placed level it would be everywhere equi-distant from the earth, and there would be no highest place in it; the bubble, consequently, would stay anywhere in the glass with indifference.

It is also evident from this that a glass made straight, or curved the opposite way, as in Fig. 3, would never indicate a level, because, if the bubble were in one end, that end would require to be depressed considerably below the other before the bubble would start to move, but when it did start, it would move to the other end without stopping. Levels are sometimes met with which act in that way, and that is always the cause of the trouble.

At a slight additional expense glasses can be obtained with the graduations made on the glass itself, which I think is preferable to having an independent metallic scale above the glass.

It will be seen from the above that a good level glass must necessarily be somewhat expensive; but when one is obtained and properly mounted it will prove to be a very satisfactory tool, and after using such a one a good mechanic would scarcely be satisfied to use some of the tools which are by courtesy called levels.

In Fig. 4 is shown an arrangement for the mounting, which is probably the best. It is substantially the plan generally pursued in mounting levels upon civil engineers' levelling instruments. It consists of a piece of tubing (Fig. 5) large enough to take the glass in easily, and having a gap cut out of one side for the bubble to show through. In each end is fitted a piece, shown at Fig. 6, except that only one of them has the elongated hole and side-adjusting screws, the other having a round hole to fit the stud.

For use in the shop it would probably be safest to put on an extra tube over the other one, as shown in Fig. 4. This outer tube has an opening cut in it, to correspond with the inner one, on which it fits closely, but so as to allow of being turned round by the fingers. Then, when the level is not in use, the outer tube can be turned half-way round and the glass is completely covered and protected from any accidental injury. The end pieces should fit snugly into the inner tube, and may be secured by small screws.

It often becomes necessary to level a shaft or other cylindrical object in the shop, and for this reason I think it is preferable to make the face of the level frame of the shape shown in Fig. 7.

In levelling a shaft with a level having a plain flat face, it is difficult to know when the level is straight with the centre of the shaft; and if it be held at a very slight angle to it, it is possible, by tipping the level slightly sideways, to make the shaft appear level, whether it is so or not. But by making the face as shown in Fig. 7, it always lines itself perfectly when placed upon a cylindrical surface, and by means of the side-adjusting screws shown in Fig. 6, any error which might arise from tipping the level slightly to one side or the other can be provided against. The error which arises in this way is caused by the fact that it is impossible to so mount a glass in the tube, and the tube in the frame, that the central line, or axis of the glass, will exactly coincide with or be parallel to the centre line of the frame; and after the glass has been put in, and fastened by plaster of Paris at each end, as it should be, it is not easy to change it. To remove the error is the object of the side-adjusting screws, and to make the adjustment, place the level upon a true cylindrical surface, bring it to a level, and then tip it to one side; if the bubble moves towards either end it is in need of lateral adjustment, and by loosening one of the side-adjusting screws, and tightening the other, it can be adjusted so that tipping sidewise will not affect it, and it is then in perfect adjustment, so far as that is concerned. The other adjustment, to bring the glass parallel with the face of the frame, is effected by turning the four nuts which screw on to the studs, as shown, until the level can be reversed end for end, and show true.

In engineers' instruments all these parts are made of brass; but this is chiefly because they cannot use any metal which has an effect upon the magnetic needle, and there is no reason why, if one should prefer it, they could not be made of steel: it would be a better protection to the glass in the shop, and would look better.

J. MILLER, extracted from the *American*

SCIENTIFIC NEWS.

An American distinguished in many ways, and at all events a typical native of the United States, died on July 12. Hiram Sibley was born at North Adams, Mass., in February, 1807, and was at first apprenticed to a shoemaker, but finding the work distasteful, he entered a cotton factory, and subsequently tried his hand at wool carding and machine work. Successful in business, Mr. Sibley became acquainted with Prof. Morse, and quickly realised the importance of the experiments which that inventor of the telegraph was carrying out. With Ezra Cornell, Mr. Sibley went to Washington to assist Morse in obtaining an appropriation to put up the Washington and Baltimore line, and the success which that line achieved led to the establishment of many other telegraph lines, which, mainly by the efforts of Mr. Sibley, were eventually consolidated into the Western Union Telegraph Company of which he was president for sixteen years. When Cornell founded the University which bears his name, Mr. Sibley was named as one of the incorporators, and he has since founded the Sibley College in that University, which has now at its head Prof. R. H. Thurston. We need scarcely say that Mr. Sibley was a self-made man, and that like other Americans who have gained wealth by their own exertions, he used it for the benefit of his fellow-men. For instance, he had a farm of 40,000 acres in Illinois which he divided into tracts, erected a house and barns on each, and let them on the "share" principle to about 150 tenants, and when he started the seed and nursery establishment at Rochester, N.Y., he improved the quality of all his goods by experimental testing and by the offer of premiums. Hiram Sibley was a man of whom any country might be proud.

The untimely death of Prof. H. Carvill Lewis will be regretted by many friends both in this country and America. Cut off in the full vigour of manhood, he died from typhoid fever at Manchester a few days after landing in England preparatory to starting on a journey to investigate the glacial deposits in Europe.

The death is also announced of M. Debray, the well-known French chemist, at the age of 61. He was at one time assistant to Sainte-Claire Deville, and succeeded to his chair.

A continuation of the ephemeris of Comet Sawerthal is given in Dun Echt Circular No. 157, from which we learn that the position on August 6th will be R.A. 1h. 1m. 21s., N. Dec. 54° 12·0′.

An observatory for astronomical purposes is to be erected at the Foreign College, Peking.

Messrs. Wesley and Son's recent issue of their Natural History and Scientific Book Circular (No. 90) contains useful lists of works relating to astronomy and mathematics.

A town's meeting was held recently at Leeds, when it was resolved to repeat the invitation to the British Association to hold their meeting in the town in 1890, and steps were taken to raise a guarantee fund of £5,000 to cover expenses.

The Benchers of the Middle Temple have indicated their desire to advance with the times by instituting courses of lectures on technical subjects for the benefit of law students. As our readers know, some members of the Bar are accomplished scientists; but in too many causes of a technical character the want of technical education in advocates and judges is a hindrance to speedy settlement. The courses are three:—"Electricity," by Mr. Moulton, Q.C.; "Mechanical Physics," by Mr. Aston, Q.C.; "Forensic Medicine," by Dr. Meymott Tidy. Sir Henry James and Lord Bramwell have taken much interest in organising these courses and in making suggestions, especially in respect to "Forensic Medicine." The lectures have been very successful, especially those on the latter subject, which have been attended by upwards of 250 students, the lectures being open to the students of all the Inns of Court. It is noticeable that in only *one* subject, that of Forensic Medicine, have *the Benchers travelled* out of the limits of the *Bar to select* a teacher. In the final lectures *of this course it is* intended to give practical demonstrations on the recovery of certain poisons in the stomach by chemical analysis, and to draw a legal statement of proof in respect thereto, after which the lecturer will submit himself as a witness to examination by Sir Henry James.

The parachute experiment at the Alexandra Palace on Saturday last was successfully performed, Prof. Baldwin descending "gracefully, steadily, and quickly." The parachute he uses is about 18ft. in diameter, made, we understand, of Tusseh silk, and without a hole in the top, as shown in the diagrams of old parachutes in the textbooks. That hole is supposed to be necessary to allow the air to escape, and to steady the machine and prevent it tilting. Baldwin's device is without ribs, and has been made the subject of a patent in this country—or rather, we should say, an application for a patent was lodged, with a complete specification, a few hours before the experiment was made at Hornsey. We presume that Mr. Baldwin's invention consists in some arrangement by which he can insure the opening of the parachute as it descends, and in that case there is little danger of injury to the aëronaut, provided he has a clear space on which to alight. Prof. Baldwin has a belief that aërial navigation is a possibility, and his parachute is an invention to enable passengers to land from the aërial ship. He has made many descents, and has acquired confidence in his invention and his skill.

An exhibition of "fire rescue" appliances was opened on Monday at the Portman Rooms, Baker-street, by the Lord Mayor. Although called the Fire Rescue Exhibition, there are appliances also for extinguishing fires and for preventing fires, and it is hoped that the articles exhibited may form a permanent museum if a home can be found for them.

The acceleration of speed on the railways running north from London is assuming proportions which will give rise to much discussion. The L. and N.W. and Caledonian have already reduced the time between Euston and Edinburgh to 9 hours, and have been running "to time" for some weeks; but now they announce that on and after August 1st the 10 a.m. train will run at an average speed of 47 miles an hour, and reach Edinburgh by 6.30 p.m. The Great Northern and North-Eastern Companies will not, however, allow themselves to be beaten in this race, and they announce that the 10 a.m. from King's Cross will reach Edinburgh in eight hours, running at an average speed of 49 miles an hour. Our readers will be able to comprehend what such an "average" as that means, for many "bits" must be done at 70 miles and more an hour.

The railway which it appears is actually to be built between Jerusalem and the Mediterranean will commence at the port of Jaffa, and run in a south-easterly direction by Yazur, Beit-Dejan, Ludel, Yalo, Soba, and Kusul to Jerusalem. Its length will be 33 miles. The construction will be attended by engineering difficulties, in consequence of the barren and hilly nature of the country through which the line will run. Jerusalem is situated some 2,624ft. above the level of the sea, and the territory in its vicinity will tax the ingenuity of the engineer. Just the opportunity, one would have thought, for the electric-railway engineer.

At a recent meeting of the Paris Academy of Sciences, Prof. Bouchard presented a note by Dr. Boucheron on what is known as paradoxical deafness. The patient in this case is deaf when in a quiet place; but hears tones having the same volume and quality when surrounded by other noises, or, e.g., in a railway carriage. Dr. Boucheron attributes this phenomenon to compression of the labyrinth, and the remedy is an adjustment of the "stirrup." Paradoxical deafness is, he says, sometimes hereditary.

Prof. Graham Bell has been directing his attention to the way in which deaf mutes are cared for in the United States. He finds that the ratio of increase of deaf mutes in America is out of all proportion to the increase in the rest of the population, this being due to the fact that they are taken, in the majority of instances, from their families very young and are placed in asylums, where they become acquainted with each other to the exclusion of the rest of the world. The consequence is that 95 per cent. of the deaf mutes intermarry, and that already 33½ per cent. of their offspring are born deaf and dumb, and the ratio will go on increasing until, Prof. Bell says, an alarming state of things is reached.

A Hungarian Deputy, M. Hlavka, has given a sum of 200,000 florins towards the establishment of a Czeck Academy of Science at Prague.

The heat in Norway this summer is said to be "most intense;" but the highest reading seems to have been 35° C., which is only 95° Fahr. not an extraordinary temperature.

From experiments made by Guareschi he concludes that definite ptomaines pre-exist in the products of putrefaction, and do not result from artificial treatment of the fluids. His experiments were made with fibrin of beef, allowed to putrefy until it became a red, transparent liquid.

Replying to Sir H. Roscoe on Tuesday evening, the Chancellor of the Exchequer stated that the photographic survey telescope had not yet been ordered, but the House would soon be asked to vote the necessary amount.

The Institute of Mechanical Engineers commenced their meeting at Dublin on Tuesday, when Mr. E. H. Carbutt, the president, delivered the inaugural address. The Earl of Rosse then read a paper upon "Balanced or Automatic Sluices for Weirs," and Sir Howard Grubb followed with one on clockwork apparatus for telescopes.

USEFUL AND SCIENTIFIC NOTES.

An examination of the American *Official Guide* for June shows that the fastest trains now on the time-tables are two on the Baltimore and Ohio Railroad, which are timed to run the forty miles from Baltimore to Washington in 45min. without stops, making the rate of speed 53·3 miles an hour. No other train can be found which makes over fifty miles an hour, and the nearest approach to it is a train on the Pennsylvania Railroad, which runs from Jersey City to Philadelphia, making one stop, at an average speed of 48·3 miles an hour. On the opposition—the Bound Brook—line one train makes the distance from Jersey City to Philadelphia at the rate of 45·9 miles an hour, without allowance for the four stops. The quickest train between Philadelphia and Baltimore runs at the rate of 41·6 miles an hour. The fastest long-distance run is that of the Chicago Limited on the New York Central and Hudson River Road, which averages 41·6 miles an hour from New York to Albany, and 40·6 miles from Albany to Buffalo. What is the slowest passenger train in the "Guide" is not easy, the *American Railroad and Engineering Journal* says, to determine, but an "express" on a North Carolina line, which takes nine hours to run 100 miles—an average of 11·6 miles an hour—is a very promising candidate for the honour.

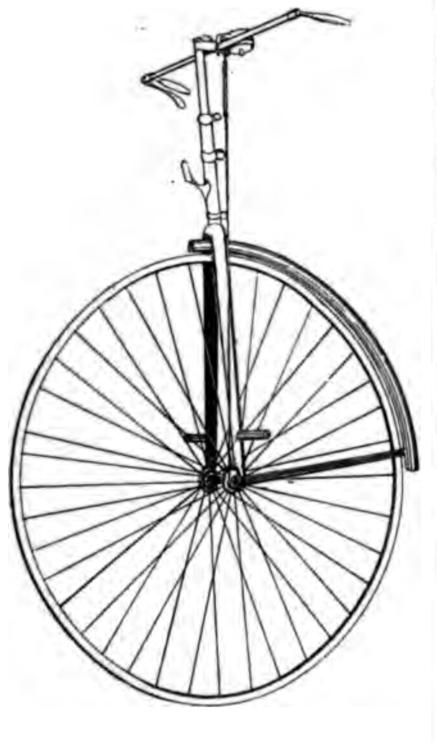
Physiological Effects of Russian Baths.—Dr. Nikolai Makovetski, of Prof. Manassein's clinic in St. Petersburg, has published as a graduation thesis an elaborate investigation made by him on the effect of the so-called Russian bath on nitrogenous metabolism, and on the assimilation of fat and the nitrogenous principles of good. His researches were carried out on four student friends in a condition of perfect health. The baths were given daily for five days; perspiration in a hot chamber was induced, with the usual amount of shampooing, no steam being used. Accurate analyses of the urine, &c., were made for five days before the baths, for the five days during which they lasted, and for two days subsequently. It was found that the assimilation of the nitrogenous parts of the food was diminished, the nitrogenous metabolism being increased. The loss by the lungs and skin was markedly increased, but the urine was diminished; the uric acid, too, was diminished during the days when the baths were given. The baths have the effect of strengthening the muscular and nervous systems, and of increasing secretion when there is much muscular work, especially where the food is deficient in nitrogen, when there is a large amount of nervous and mental activity, and also when there is deficient action of the secretory organs in consequence of preceding hypersecretion, or morbid conditions, such as chronic catarrh of the bronchi, stomach, intestines, or genito-urinary tract, chronic hepatic, renal, or splenic affections. In these cases, together with the baths, fat and hydrocarbons are required in the food. As contra-indications, theory would lead us to include all conditions where the nitrogenous metabolism is diminished, and also those where artificially induced diminution of f appears to act prejudicially.—*Lancet.*

the kinds I have described are two others—manna in sorts, and fatty manna. The first is the produce of Sicily, and occurs in lumps or irregular masses of the same composition and properties as the best kind, but is more liable to adulteration; it generally ferments, and spoils in a year. The fat manna, in soft, adhesive, impure masses, is of little use or value. Besides all the above, the Calabrians specify several other varieties, spontaneous, forced, and manna of leaves or trunk. The juice exudes from the trees in hot weather, during June and July, the discharge commencing in the middle of the day, and continuing till evening. During the night this juice concretes, and in the morning the masses are detached. Towards the end of July the natural discharge ceases, and incisions are then practised. The syrup-like juice now flows with more abundance than ever, concretes as before, and yields the forced manna. The leaf manna is scarce, and much resembles the desert product. An ash tree will live to produce the drug 40 years.

Eos.

CYCLOMETER.

[29056.]—THE inclosed photograph shows my method of actuating cyclometers fixed to the handle-bar; the motive power is obtained from the hub of the wheel, where a little cam-shaped piece is clamped to the spokes close to the hub. A little bracket, carrying a rubber-covered roller on a cranked wire is slipped under the axle nut, and adjusted so that the cam operates it properly. Alterations in length and circular direction are obtained at the tube above. The connecting-rod is jointed so that it can be used with machines having anti-vibration steering, can be fixed in five minutes, and requires no skilled labour.

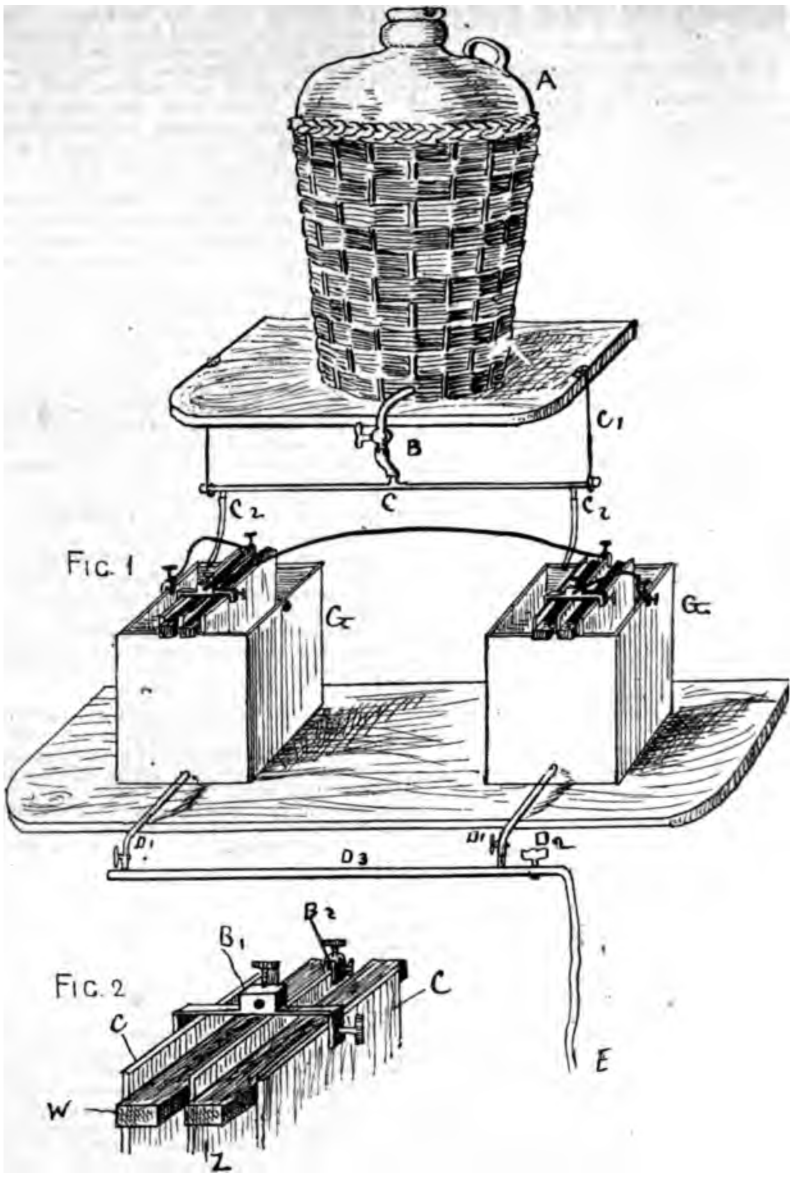


The advantages of a cyclometer fitted in this way are many. It is well in sight of the rider, and out of the way of the oil and dust which obscures the dial and wears away the mechanism which connects them with the axle when they are put inside the wheel. The No. 2 signal cyclometer is adopted, and existing instruments of this make can be altered to work with my arrangement. I may mention that I have had a cyclometer working on the handle-bar of my bicycle for three years now; it is as good as ever, and led me to design an arrangement which could be easily fixed up, and which I had often been asked for, especially by Safety riders. The query (65902) will, perhaps, be answered by the above.

F. L. Striffler.

FOUR DIMENSIONS.

[29057.]—THE valuable and ingenious discussion in the "E. M." on the above recalls to my mind an old riddle, common in my young days; the reply to *which puts this recondite* subject entirely into the *shade—viz.* "*How many sides has a kitchen salt-*



A SIMPLE CHARGING AND DISCHARGING APPARATUS FOR PRIMARY BATTERIES.

[29058.]—THERE being so much trouble attached to charging batteries, &c., I venture to submit the above as a cheap and simple way in which it can be done.

FIG. 1. A, reserve of new solution; B, tap; C, pipe extending the length the cells occupy, the which is held in position by two iron (C_1) hooks from shelf above; C_2 are pipes leading to each cell—each may have a tap if required; G, cells from which a pipe, D_1, leads to D_3, which also extends the length the cells occupy; D_2, a tap to which E, a flexible tube, is carried to any convenient vessel or drain, &c.

FIG. 2.—C, carbon plates; Z, zinc plates; W, wood soaked in wax; B_1, carbon clamp; B_2, zinc binding-screw.

E. Ward Bussell, A.E.E.

SCOTT'S BOILERS.

[29059.]—THE arrangement of boiler furnace proposed by Mr. R. Scott (letter 29034) would, no doubt, increase the production of steam per pound of coal used in the boiler, even after allowing for that used to work the blowing machine; but the full development of his idea of bringing the centres of energy as close to the boiler surface as possible demands the use of gaseous fuel.

The same blowing machine which serves for the one arrangement will also serve for the other. By the use of the fuel in a gaseous condition, the ultimate combustion of the fuel can be made to take place in contact with the metallic surface of the boiler, not only with regard to a small portion of the fuel only, as in Mr. Scott's arrangement, but far the greater part of the fuel can be burnt thus. This is practically carried out in Mr. Fletcher's quick-heating kettles, which have projections from

time, the heat is not absorbed so rapidly
check the combustion.

By modifying his furnace so that the
driven through or over a thick mass of fu
ducing chiefly carbonic oxide, as in S
generator, and then using the gas thus p
in connection with a boiler with projecting
studs, Mr. Scott will obtain much higher
than with the arrangement he proposes.
will be abolished, and the whole apparatus
made almost self-regulating. **A. (**

[29060.]—SOME forty years since, M
an engineer of Bandon, co. Cork, patented
on this principle (see letter 29035), and g
of them into use; but they were found to
very rapidly; and, although economical a
had to be given up. His patent specificati
prior to 1853. A short time since I saw tw
boilers, of a small size, in use in London;
are now stopped. **R. J. I**

BOILER.

[29061.]—THE boiler described by
Monteath (letter 29035) is the Herresc
somewhat crude state. The only differen
the Herreschoff is a double coil, one i
other, and the steam, after passing into
reservoir called a separator, passes throu
involute coil on top of firebox, thus dry
its way to engine. Disadvantage: great v
of steam pressure, as feed-pump varies.
steam could be produced in 6 minutes fro
lighting fires. Has, I believe, very much i
lately.

Southton. **A.**

INDIAN AND CHINA TEA

[29062.] — YOUR correspondent "So
(letter 28594, p. 125, April 6th) has challe

More than one of my difficulties have already been removed—e.g., I know now why 120°, and not 90°, is the better angle. It gives a stronger point, and this, I presume, more than counterbalances the disadvantage of the greater slope of the cut, if this indeed be a disadvantage.

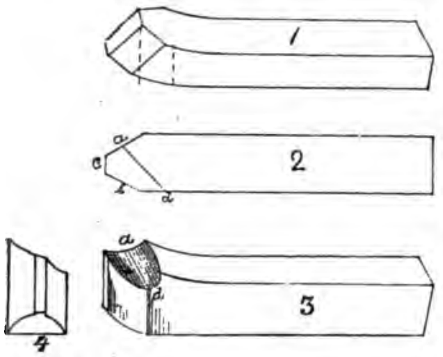
Secondly, through the kindness of Mr. Stevens, I have learned from his models, (models in every sense) how right and left, end tools can be made to fit the bar; also several other forms of tools, which may be the "fancy ones" above referred to, but whose method of application I do not quite take in. I had thought, with his permission, of sending drawings of them to "E. M."

But I do not now think these drawings are needed, as, with the instructions now again given as to how to carry out the grinding, no one need feel any difficulty in making such cutters as he may require.

I have now to thank "J. L."—with whom on other matters I have more than once crossed swords—for his readiness to help me, and for the benefit I have derived from his articles on this bar; and not least, that he has obtained for us all an opinion whose soundness no one will question, and all will value.

Before I conclude the letter, as I have spoken of solid tools as more effective, and, at the same time more convenient, than the Haydon bar and cutter as I then understood them, it may interest some who have not a bar if I give an illustration of the tool I have found work most sweetly for me and take a heavier cut than my cutters would face.

The forging of the tool is the simplest possible, which is a consideration to many an amateur. It may, in fact, be made without any forging at all, if the steel be thick enough to bring the cutting edges up to the height of centres. At the time I made this I had not a piece thick enough; so, with a couple of blows of the hammer over the anvil, I turned up the end of the bar to bring the top somewhat above the level of the centres. This was the whole forging, except a stroke or so on the sides of the bent part, as shown in the plan, Fig. 2. Faces A and B are now ground to an angle of 60°, leaving a part, C, untouched. The tool is now applied to the corner of the stone to form a groove in the direction A B, with its deepest part on the line A D, Fig. 2 and 3. The face is now ground, and the tool, as looked at end on, is given in Fig. 4. The slope of the groove is about 50°, with a face A. This is a most effective tool, and very easily made. Of course the groove A D may be made with a file, and afterwards finished on the stone. It takes very little power, and turns off long shavings—yards long.



July 21. **Fredk. Carre.**

CUTTER BARS.

[29066.]—HAYDON'S, which only carries out with greater facility the principle of cutting tools explained by Prof. Willis, is superior to Tangye's, which does not admit of the adoption of those principles. Neither in Tangye's nor in Smith and Coventry's are the three planes of the cutter capable of being ground, and this is essential to give full scope in the formation of the edges.

It is no doubt more convenient in the workshop to grind but one or two of the aforesaid planes, and therefore, I said, workmen probably prefer either Tangye's or the other; but this does not prove that either is superior to Haydon's. In Smith and Coventry's bar the front or clearance angle is constant; in Tangye's the upper face is so, and this limits in each the range of edges that can be given to the tool. In Haydon's there is no such limit, and it is this which gives it precedence. As to grip of the cutters, I never heard that Haydon's is defective. Indeed, I know that he put it to the severest possible test, and though he smashed the cutter, there was no slip whatever.

O. J. L.

SPAR-WORKING.

[29067.]—A "DISTRESSED BROTHER" has not yet replied to the request made by Dr. Edmunds ("E.M.," June 22, 28884), that he would favour us with "references to, and abstracts of, the information," which, in 65588, he stated that he had found in back vols. of the "E.M." As Dr. Edmunds's further letters appear to be waiting for the reply, we shall be glad to see it without delay.

We are much indebted to Mr. Wenham for his interesting letter on polishing calc-spar ("E.M.," June 29, 28928), and now trust that other contributors will assist in discussing this interesting subject. The making of polarising and spectroscope prisms would be work of extreme interest for the amateur, and hitherto it has been scarcely touched in the "E.M." "Prismatique" has from time to time given us valuable contributions on optical work. Would he now favour us with a contribution upon the working of astronomical flats; also upon the working of double flats—i.e., those truly parallel surfaces, such as are used for the index and horizon glasses of the sextant. **M. O. H.**

PUTTING UP BARBED WIRE FENCING.

[29068.]—I HAVE been at this work of late, and as it is an awkward job, I invented a method which enables me to work single-handed and to strain the wire tightly.

I took an ash stick 2ft. in length and sawed it lengthwise to within 3in. of one end. I put a clout nail at that spot and clenched it to prevent splitting, and then drove in a thin wedge to keep the split part open. This is made to straddle the wire, which must enter it and be pushed down to the angle, or as far as it will go. The short end is made to bear against the post, so as to constitute a straining lever, the spiked part nearest to it keeping it from slipping. Now set your back against the stick and you can hold all steady while nailing, or rather while driving the hooked iron sold for the purpose. I can guarantee the action, and the cost is *nil*.

How is the wire made? The spikes look as if made separately and threaded on during the process of twisting. But how? **O. J. L.**

MINE VENTILATING FANS.

[29069.]—THE ordinary rule for estimating the work done by a fan

$$\text{H.P.} = \frac{Q \times h \times 5{\cdot}2}{33{,}000}$$

in which Q = air volume in cubic feet per minute, as obtained from speed by anemometer multiplied by cross-section of drift; h, measured water-gauge in inches, is objected to as giving incorrect (excessively high) results. It is stated that h is not the true water gauge for exhausting fans in the estimation of work done by the fan, but that a more or less large deduction must be made for the work of the atmosphere acting upon the partial vacuum created by the fan. I am unable to follow the mathematical reasoning upon this subject; but in the case of an experimental exhausting fan of 500 millimèters (19$\frac{11}{16}$in.) diameter and 222mm. (8·74in.) width of disc, diam. of inlet 230mm. (9$\frac{1}{16}$in.), making 856 revolutions per minute, and passing 32 cubic mètres (1120·3c.ft.) of air per minute at a measured water gauge of 19·7mm. ($\frac{3}{4}$in. fall). The work of compression by the above rule, or using metrical gauge (1mm. water gauge = 1klg. per square mètre) =

$$\frac{32 \times 19{\cdot}7}{75 \times 60} = 0{\cdot}140\text{H.P.}$$

No less than 0·071H.P. is deducted for the work of the atmosphere, or called the amount of work conveyed to the fan by the atmosphere, thus reducing the useful effect of the fan under the conditions named with fully open inlet by just one-half. With 1,293 revolutions, measured depression of 42·5mm. (1·673in.) water gauge, and passing 49 cubic mètres of air per minute (1730·8 cubic feet), the work being by rule 0·462H.P., the deduction for effect of atmosphere is 0·252H.P., or 54·5 per cent., whilst, with contracted inlet, 1,776 revolutions, 183mm. (7·2in.) depression, and passing only 13·9 cubic mètres (491 cubic feet) of air, estimated work by rule 0·561 H.P., the deduction for effect of atmosphere is only 0·006H.P., and the useful effect of the fan put down at over three times that of the first and over twice that of the second trial.

I am quite at a loss to explain why these deductions are made, and also why less in proportion in the case of contracted than in fully open inlet, and should feel much obliged if one or other of our talented correspondents would explain it.

Such authorities as Jul. Weisbach, P. von Rittinger, Bernoulli and Margue are cited in support of employing a factor h_a instead of h for the depression, based, as it would seem, upon some normal velocity of the air current, and called the negative and positive depressions. Perhaps some of our friends are in a position to refer to the works of these authorities, and can explain the difficulty. It seems very evident that the useful effect of a ventilating plant calculated by the usual rule—

$$\frac{Q \times h \times 5{\cdot}2}{33{,}000} = \text{H.P.}$$

would suffer a very considerable diminution if h_a be substituted for h. In some cases of contracted draught areas and high velocities the reduction might be as much as 53, or more, per cent. A reduction of equivalent draught area *to some common standard* seems reasonable in comparing fans with *each other*, as otherwise the same fan might, under different conditions of work, show very different percentages of useful effect. With large draught areas and comparatively slow velocities of air currents, the *negative* depression might be perhaps less than 1 per cent., and thus the measured depression h be taken in its entirety; but a fan so working would be no fair comparison with another having to deal with contracted areas and high velocities of air currents. **M.**

JADE IN THE BRITISH ISLES.

[29070.]—SOME years ago a Glasgow lapidary told me he had had several of these so-called jade pebbles, but he considered they were more of a kind of cairngorm and crystal. In regard to the jade found at Wangen, it is quite possible enough that it did come from China, because, besides the corn, cloth, stone axes, glass beads, bronze armillæ, crucibles, and copper beads found at Wangen, Robenhausen, Wanwge, and Meilen, &c., there were also found objects of "nephrite," more especially, as in the cave of Chaleux, in Belgium, and Shussenried, near Lake Constance. Now as nephrite is only found at Lake Baikal, it goes far to show that these early settlers in Europe came from the East, and in all probability kept up commercial intercourse with their relatives of the Turanian tribes of Central Asia, and as there was always a large trade between China and Turkestan, jade would most likely be one of the objects of barter, and so find its way to Europe at that early time. **Dens.**

TWISTED TREES.

[29071.]—AS a rule the creepers (see letter 28572) in our Asam forests grow as ordinary screws, right-handed, and about two per cent. left-handed. In a day's ride through a jungle path one sees often but three or four left-handed, and I have a collection of these latter as curios. The cause of the large percentage of right-handed screws is, so far, out here unknown; but I do not agree with Mr. John Hampden that "it is useless to speculate upon it," inasmuch as it must have some cause, probably a very simple one.

The twist in tree stems is also common, and generally also right-handed. Mr. H. may not be aware that in both wood and bark it is often laid on in left and right-hand spirals alternating (in the same tree) in fine or coarse layers, that hence causes the "cross-grain." It is a great source of strength to a tree, and prevents splitting, which would take place often in high winds with lop-sided branches.

I have seen trees during a bad earthquake not only sway over and back, but the head rotate through an angle of 60°, due to large single branches out of one side.

In some cases (as the *Lagertræmia regina*) the screw in the branchlets is alternately right and then left; it is the only case of the kind I know. Most trees would grow symmetrically, both in branches and branchlets, but for accidents—wind, creepers, animals, or insects; we have many that do so for years. Locality seems to have little to do with the screw or twist. **S. E. P.**

The Phylloxera in Switzerland.—The report of the Federal Government with regard to the progress of the phylloxera in Switzerland is by no means encouraging, as it states that in the course of last year 609 vines were attacked in the canton of Neuchatel, 111 in that of Geneva, 49 in that of Zurich, and 12 in that of Vaud. The report goes on to say that though some of the vineyards attacked had not more than two or three plants affected, there seems to be no doubt that the ravages of the insect are extending very rapidly. The mode of treatment most generally adopted is sulphate of carbon; but in the canton of Neuchatel, which has been attacked for more than 11 years, 182,000 square mètres of vineyard have been destroyed, and the total cost has been £22,000. In the canton of Zurich, 94,000 plants were destroyed in 1886, and 37,000 in 1887. The treatment applied in the canton of Geneva last year necessitated the destruction of 36,000 plants, occupying an area of over 18,000 square mètres, and the cost was about £2,000. The canton of Vaud was not attacked by the phylloxera till 1886, and, so far, it has not extended beyond three communes. Up to the present time the proposal to introduce American vines into Switzerland has not met with much favour, though it has been found very efficacious in France.

EPLIES TO QUERIES.

. their answers, Correspondents are respect- uested to mention, in each instance, the title ber of the query asked.

).]—**Black Beer.**—If by black beer is ıe article usually sold at dram-shops under ne, it is flavoured with spruce, the product 'orway pine. Try the following:—One f water, boil, and pour into a jug or large add 1lb. of treacle or molasses, one table- l (less or more according to strength re- of essence of spruce; when at the right ture, add a table-spoonful of yeast. Keep perate atmosphere, and leave the cork out 'mentation subsides, then cork up or bottle will be ready for drinking in a few days. rovincial town, you may find it difficult to he essence of spruce. ROBERT.

.]—**The Board of Works and Movable ıgs.**—Two courses are open to the querist. ı place his movable galvanised-iron tool- ere he wants it, and leave the Metropolitan f Works to take action if they see fit; or " the officials. Possibly there may be od reason why permission is refused. At , the query cannot be of much interest to J. T.

.]—**Extracting Gold from Quartz.**— " can find all the information he needs in ımbers—even recent ones. The mercury is still the best, I believe, for small quan- crushed ore. OBERHOF.

0.]—**Washing Composition.**—Should Truelove give some more definite idea of ıposition? It is quite certain that liquid a is not used in it, though it is possible ıor ammoniæ may be, and I should have that the querist could have tried various ions for himself. NUN. DOR.

2.]—**Ship Ventilators.**—You do not say ape you want. Get an old one of the sort l, unsolder, and there you have the pattern. HELPLESS.

3.]—**Cooling Oven.**—Why not pump in a ater in spray?—JEHU.

1.]—**Water Motors.**—A turbine is best. ıval formula is $P = \cdot079\ Qh$. Where $Q =$ ı of water in cubic feet per second, and h water in feet. Four to five gallons per is very little. E. H. G.

4.]—**Oil for Gas-Engine.**—Use one of vy petroleum products. NUN. DOR.

3.]—**Waterproofing Paper.**—Saturate 'er with paraffin or coal-oil, or adopt the en process with cupro-ammonium. J. T.

5.]—**Gas-Engine.**—To answer this query he to advertise a gas-engine gratuitously. ot try a hot-air engine? G. M.

9.]—**Reflecting Telescope.**—I should this querist ought to look up his back . See pp. 306, 402, Vol. XXXV. p. 36, XXII. p. 327, Vol. XXXI., and so on. are many illustrations of suitable stands untings in back volumes. DENEB.

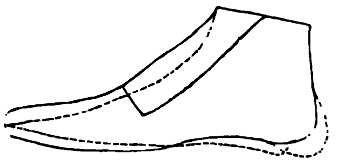
5.]—**Coil.**—This query is incomprehensible. the querist could find the information he s in back numbers. J. P.

8.]—**Railway Gauge.**—On page 76 of . of the "Minutes of the Proceedings of the tion of Civil Engineers" Mr. Longridge With regard to the 4ft. 8½in. gauge he nention a curious historical fact. The first that George Stephenson laid with malleable ils was at the Bedlington iron works in mberland, and was 4ft. 6in. Being rather d for room with his locomotives, he widened ıge 2½in., and that is the way in which the d gauge originated." GRANTON.

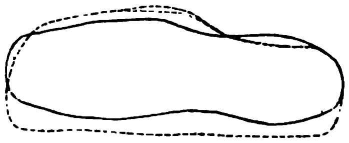
)8.]—**Boots.**—I have been much interested . R. C.'s" query, and also in the replies and erent suggestions made. I have had a sorry nce of both boots and boot-makers. For was annoyed by misfits, and resolved to ısts for myself. This I did by purchasing ıf "ready-mades" about three sizes larger :quired, and worked them down to the ıhape, size, and thickness by using a good sp, calipers for the thickness, and cardboard to the curves of my feet, each last being ı near as possible to suit each foot. As I l them I had both boots and shoes made ese lasts; but not a single pair were satis- I thought, after this experience, further as useless; but was induced to make one ial before giving the matter up for a bad his last pair then did succeed, and I got what I had been long looking for; but, ıy happiness did not last long, for the very ir made were all wrong, and every pair I have had since. I have had about ten pairs made from these same lasts, and only one pair has been right. These ten pairs were made by two different tradesmen only, and they both knew exactly what I wanted; but neither satisfied me. I thought at one time going back to my lasts, and, in fact, having an iron pair cast as A. Smith has suggested; but my difficulty is, How am I to get the makers to make boots properly from my lasts? Lasts are easily got; but how are the boots to be got?—that's my trouble. This question has not been touched by those who have so kindly written in answer to "W. R. C." Will somebody be good enough to suggest on this point?

POOR FEET.

[65808.]—**Boots.**—Your correspondent, "W. R. C.," guessed rightly that bootmakers would condemn his ideas on lasts and boots. For either he is entirely ignorant of the very rudiments of bootmaking, or else it may be a clever attempt to advertise some person's trade whose name will be sent in the "Replies." 1. He insinuates that bootmakers are a most disobliging set of people. 2. He shows figures at the bottom of a last and the side of a last. This last, I cannot help thinking, exists only in "W. R. C.'s" imagination, for since I have been in the trade, twenty years, I have never seen such a one; there is not the least shape to the sole, there is no waist in it, very little heel, and three-quarters of the entire length is the sole from the joint to the toe. In his Fig. 2, the side of boot, he simply makes a slanting line, almost straight, from the instep to the toe of the last, and another one also almost straight from the waist to the toe, which would make it impossible for a person to get his toe any nearer the front of the boot than where he has placed the arrow—the place where he argues the vamp of the boot should begin. And this, he says, is the best fitting "last" he can get boots made on. I submit there is not the least resemblance to a last in his figures at all, and have sent what I consider a fair representation of a last as really made, the dotted lines giving "W. R. C.'s" idea. 3. As regards making a last exactly the shape of the foot, the boot could never be worn made on such a last. First, because a boot always has to be 2¼ or 3 sizes longer than the foot; thus if your foot measured 3½ you would require a 6 or 6½ boot. Second, because you do not require a boot so full round the foot as the foot really measures. If it were made up to the full measure you would say at once it is too large. 4. Regarding the length of vamps, and the making of uppers: If "W. R. C." is prepared to pay the bootmaker a fair price for his trouble, he will have no difficulty in finding plenty of bootmakers who will make the uppers exactly as he wishes them made; with no vamps at all if he prefers them. Hand-closed uppers there is great difficulty in getting, but uppers made to order and closed by machine are to be procured quite easily. If "W. R. C.'s" foot is really the shape he has sketched, it has the appearance of being deformed, in which case he would certainly have to have a last made for his foot. Machine-cut soles are only used in making manufacturer's work, and not in making bespoke work at all.



Fic. 2



Fic. 1

W. M.

[65818.]—**Check Valve.**—Put it on the pipe as near the boiler as possible, and let pipe enter boiler 2in. above the crown of fire-box, so that if the valve leaks at any time, the water cannot get below a safe level from that cause.

Bristol. T. C.

[65831.]—**L. and N.W. Compounds.**—The dimensions and weight of the latest big compounds are similar to the Dreadnought and Titan. I send herewith a few of the chief dimensions as follows:—High-pressure cylinders (two) diameter 1ft. 2in., stroke 2ft., low-pressure cylinder diameter 2ft. 6in., stroke 2ft., driving and trailing wheels 6ft. 8in., leading 3ft. 9in., diameter of boiler outside middle ring 4ft. 3in., length 11ft., length of firebox casing 6ft. 10in., depth of firebox casing below centre line of boiler 6ft. 8½in., number of tubes (brass) 225, diameter outside 1⅞in., length between tube-plates 11ft. 3in., heating surface tubes 1242·4sq.ft. (steam pressure 175lb.), firebox 159·1sq.ft. (total 1401·5), firegrate area 20·5. Weight of engine in working order: on leading wheels 12tons 10cwt., on low-pressure driving wheels 15tons, on high-pressure driving wheels 15tons; total, 42tons 10cwt. I think they are somewhat heavier than is stated in *Engineering* of 1st May, 1885, the paper from which I have taken the above particulars. They seem to be doing better, as they are capable of taking heavy trains. The Scotch express, which is only allowed 3h. 15m., including two stoppages, between London and Crewe (158 miles) is generally drawn by one of these engines. This would, I think, put some of the Midland and other engines to the test, especially when there are 14, 15, 16, and sometimes 17, six-wheeled coaches on. I cannot speak of their coal consumption. There are some new "Precedents" being built. I remember seeing Mabel bring the Scotch express, 17 heavy six-wheeled coaches on, two minutes before time, a performance not to be made light of. Any other particulars I am able to give "Banshee" I shall be pleased to do so. CHILLINGTON.

[65859.]—**A Fallacious Equation.**—Of all the answers to this last week, the only one that hit the real point which causes the fallacy was "J. R. C.'s." It does depend on the fact that a number multiplied by nothing is reduced to nothing. That this is a fact can be proved thus: Let $a = x \therefore a - x = 0$, and $a + x =$ something. Multiplying these together we get $a^2 - x^2 =$ nothing. Perhaps the following two equations may be interesting, and not irrelevant (they are from "Facetiæ Cantabrigienses"):—(1) Let $a = x$, then $ax = x^2$; now take a^2 from each side; then $ax - a^2 = x_2 - a^2$, that is $a(x - a) = (x + a)(x - a)$; divide both sides by $x - a$, then $a = x + a \therefore a = 2a$, or $1 = 2$. (2) Again let $a = x$, then—

$$\frac{a^2 - x^2}{a - x} = a + x.$$

Now, supposing value of a (or x) to be 1, this equation becomes $\frac{0}{0} = 2$. YOUNG ANALYST.

[65859.]—**A Fallacious Equation.**—This query raises an important point lying at the very foundations of algebra. "Nephesh" says the matter is explained in "any good algebra." "Vladimir" says it is an error which "books on algebra fail to warn the student against." Which is right? Prof. Chrystal, in his work, just touches on the subject, but scarcely more. No doubt, to divide both sides of an equation by a factor which in reality is zero is a most dangerous operation, to say the least; but it does not always produce a false result. For instance, let $x = a$, as before.

Then— $$x^2 - a^2 = x^3 - a^3$$

$$\therefore \quad (x - a)(x + a) = (x - a)(x^2 + ax + a^2)$$

Striking out $(x - a)$ the common factor, we get—

$$x + a = x^2 + ax + a^2$$

which is quite true, when we give x and a the numerical value of ⅔. The following test will, I believe, show whether dividing by $x - a$ will lead to a false conclusion or not. Form a vanishing fraction of the two sides of the equation that precedes the operation with $x - a$. Find the value of this fraction when $x = a$, and if the answer is a numerical one there will be a false conclusion; whereas if the value of the vanishing fraction is a function of x, the result will be true. In the example above the vanishing fraction is—

$$\frac{x^2 - a^2}{x^3 - a^3}.$$

The value of this when $x = a$, is $\frac{2}{3x}$, which is a function of x; and the final equation is true. Now, in "Tyro's" example, on the other hand, the vanishing fraction is—

$$\frac{2a^2 - 2x^2}{2a^2 + ax - 3x^2}$$

the value of which is numerical—viz., ⅘.

F. S. S.

[65866.]—**Soldering.**—Aluminium solder is made of 6 parts aluminium, 4½ copper, 89½ zinc, a soft solder, 6 bismuth, 94 tin.

Brandon. A. BIRD.

[65867.]—**Plaster Statuettes.**—Paint your articles in ordinary oil paint (no wax); if old, work two coats; if new, four. Then finish in spirit colour, one coat, which is simply turpentine, and no oil. In finishing be careful not to let edges set before joining, or, in other words, begin a member and finish as you go on.

SHEFFIELD.

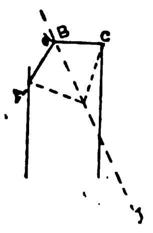
[65870.]—**Cement-Tank and Fishes.**—Perhaps "Rustic" has simply starved his fishes, as he says nothing about having anything eatable in his tank, such as growing weeds. The water, also, may have been too closely filtered.

GAMMA SIGMA.

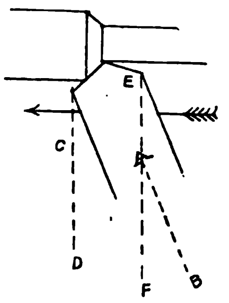
[65878.]—**Medical Coil.**—Your primary and secondary wires should be wound in layers from your reel without any break, according to the strength you intend making your coil, only put a layer of cartridge paper between every two layers of your secondary to keep them from slipping in between. You can make your own paper cylinders by cutting some cartridge paper the width of your coil and glue one side, then wind it tightly round a tube the size of your regulator, ten or eleven times, till about ⅛in. thick.

W. H. EDWARDS.

[65886.]—**Haydon Cutter Bar.**—The first point to consider is the direction of the proposed cut; next, how far you are tied as to the position you can give to the bar. In your case you wish it to lie at right angles to the work in the receptacle of your ornamental rest. In ordinary cases—i.e., with the metal-turning rest—you would have the tool thus, the bar lying in the direction of A B.



You want it to be as C D or E F. Then let D C E F represent the cutter. All you have to do is to turn the bar round so far on the support of the grindstone that the first face will be ground almost true with the side of the bit of steel, as A B of the second figure. Then grind at 120° or thereabouts, and the second edge will fall almost straight across the end. In grinding the top face, *x y* must be in the "run" of the stone, or the two edges will not be equally sharp. A shoulder is cut with a very similar tool. It is a bit of face work, and you can cut it with a tool that will leave the said face quite smooth if the edge that is next to the face is the following and not leading edge,



which is a mere question of position, because with the plain point tool you can work from right to left or vice-versâ; but with your rest you can never fully utilise the Haydon bar. To facilitate side cutting, the bar is also made bent in either direction, the sling part alone being so bent to right or left. Hines has a bar with a hinge at that part; but I should doubt its rigidity. For getting into corners, you have, of course to grind the plan angle at a less degree than 120, or even 90°, and if part of the edge or slip of steel is in the way, it may be all filed out so long as two little bits of the cutting edges remain. This is often a convenience.

O. J. L.

[65889.]—**Vegetarians and Evolution.**—In the elephant, the rat, and some other animals nature meets the wear and tear of the teeth by permitting a more than compensating growth of their teeth. One of the greatest aids to man's comfort that mechanism has now accomplished is that of reducing wheat to flour, in the machinery for which enormous change and advance have taken place during the past few years; grit, the great tooth reducer, being now practically unknown as present in wheaten flour in this kingdom. I conclude that in the age of the Biblical patriarchs the only cultivated form of human food was corn, and its only reducing agent was pounding the grain with a stone held in the hands on a flat stone for an anvil, in the crushed grain of which grit must have been rather untoothsome Having lived to see the time-honoured mill-stones ousted by iron rollers, the question occurs to my mind, On what *food could the patriarchs* have subsisted so as to *have retained the teeth then* so essential for their *very existence? Has* archæological research discovered any record corroborating the said Biblical record as to the enormously-advanced age of its patriarchs?

THE LYDNEY DISPENSER.

[65889.]—**Vegetarians and Evolution.**—I am afraid vegetarians are very illogical. In some lectures lately delivered by Dr. Richardson, that gentleman showed pretty clearly that man's teeth are adapted some for tearing flesh, &c., others for masticating vegetable, and others for crushing nuts, &c., and that the intestines of man took a middle place between exclusively flesh-feeders and exclusively ruminants; but, instead of drawing the obvious conclusion that man's organisation points to his being omnivorous as a rule, he quietly assumes that he should be a fruit-eater par excellence, apparently for the sole purpose of pleasing the vegetarians. Why people who have the power of consuming all kinds of food should wish to restrict themselves and others to certain classes of food only, is a puzzle that seems insoluble. There may be good reasons for anyone restricting himself in consequence of his personal experience of that which he finds most suitable to himself; but it seems scarcely credible that anyone of observation can fail to perceive the wonderful variety of idiosyncrasies and habits in the human race, involving extreme variations in food and other requirements. In short, the "vegetarian" assumes to have greater knowledge than his Creator.

GAMMA SIGMA.

[65894.]—**Green Peas.**—Three pints of clean, hard water to a pint of peas, cleanly shelled, not washed, a teaspoonful of salt and two or three sprigs of mint tops; fresh-gathered garden peas, and an enamel saucepan. Throw in the peas when the water boils; 15 or 20 minutes boiling; then you will get a delicious dish, truly English, never to be had abroad.

THE OLD LADY.

[65896.]—**Pulley.**—It is a pity J. Jewsbury seeks to puff his gear, as his, Moore's, or Pickering's internal gear wears out quite as fast as the nibs of such blocks as Weston's, and requires oiling internally, which the latter do not.

Bristol. T. C.

[65904.]—**A Mermaid.**—Perhaps this ingenious manufacture may be one that was, 30 years ago, in a window in Greek-street, Soho. The upper part was certainly no monkey's skin, but that of a phenomenally long-haired baby. The only hair was on the scalp, and long enough to reach beyond the elbows, which no monkey's, I fancy, does, but some baby's might.

E. L. G.

[65906.]—**Condensing Gases.**—To condense gas or air properly and economically it should be done with a liquid plunger to keep it out of contact of plunger, and to keep things tight for working, and I think the best medium is either glycerine and water or some of the purified bland mineral oils. I herewith forward a sketch of a pump to be worked by hand for the purpose, and likewise a special valve—"adjustable register valve" I call it. The barrel of pump should be enamelled—i.e., vitrified. The barrel is made of iron moulded tube, generally termed "hydraulic tube," or "steam tube," and should be bent in the form of a long U with legs about 1ft. long—short or long bend no matter, as long as it is a curve; a rad inside about 8in. would meet the requirements. There are fittings in the market that will meet other requirements, with very little extra work. A is barrel glazed inside; B glazed and stuffing-box; C clack or valve-box; D E braces or clamps; F plunger; G compensating link; H walking handle or lever to manipulate the pump; I grade for spindle; J valves; K inlet; L outlet; M medium between metal plunger and gas, as glycerine and water or mineral oil; N plug for charging. For adjustable registering valve get a piece of Muntz metal or Delta metal, ¾in. dia., 4in. long, and bore a hole $\frac{3}{16}$in. right through it, and cut in two lengths, and make, as shown in sketch, Fig. 2. A is the barrel; B valve on the seat; C cotter, which answers two or three purposes: keeps the thrust of spring central, and keeps it free when turning; spring-box D around the outside, registers the pressure, and keeps the spring from falling out; E spring; F small grades; G large; at H are two flats for spanner to screw into position where wanted. The hole is $\frac{3}{16}$, the valve outside ⅓, the screw $\frac{7}{16}$, 20 threads per inch, spring bore hole ⅜. I do not think it wants any further explanation. The spring 18 B.W.G. steel, hardened and tempered. If you are going in for very high pressure, you can have larger wire; but 20 or 18 will give you from 20lb. to 2 tons per square inch. Coil it upon a $\frac{3}{16}$ mandrel. The grades C and F are got by fixing a small disc of metal upon a piece of ⅛ brass or steel wire with a centre to it, and turning the affair bottom upwards in a vice. Place your weights upon it, and mark bore where the cotter comes, alternately side for side, and you can mark the sides alternately 1, 2, 3, 4, &c., as you will find that best for reference. Every pound you put on the scale will register 30lb. per square inch if all is right. This valve, by good rights, should be fitted upon an inverted siphon charged with water. By turning the milled edge A
get what pressure you like, or ascertain
have got. The lighter the spring the bett
register, as the graduations will be farth
Do not use glass, as it is very dangerous
or air. It is bad enough when testing by h
I have tested ⅝ and ¾ glass tubes $\frac{1}{16}$in. thi
one ton and more per square inch; but
no dependence to be placed, and when te

FIG. 1

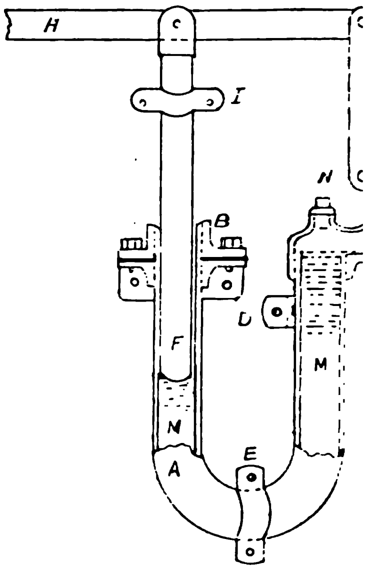
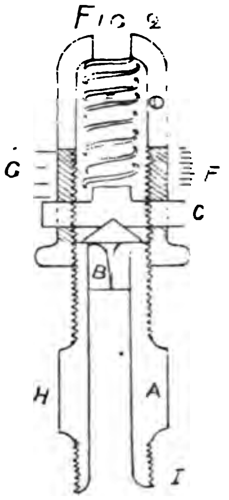


FIG. 2



hydraulic, the glasses break into fine nee
fly all over the place, that you do not kno
you may find them; for when wiping yo
or face, or brushing down, you will fi
enemies in camp that prove very trouble
days afterwards. JACK OF ALL TI

[65909.]—**Perspiring Watchmaker's**
—Try Turkish baths. SHEF

[65909.]—**Perspiring Hands.**—This
probably from peculiarity of constitution,
so if the feet are in the same state. The
tions are certainly capable of modifica
they should have the attention of a med
to whom the general appearance, &c., of t
would suggest the most suitable remed
London or any other homœopathic hospita
your reach, then get a homœopathic chemi
to Bryant's Pocket Manual, or to some o
ing work, from which he will possibly
or more medicines suitable for your
Sulphur, mercurius, calcarea, belladonn
nux vomica: one medicine used for on
the above rotation three times daily,
these six weeks, do much to assist you
tionally; while iodide of potassium—t
dissolved in a teacup of water, a teaspoon
four times daily for a month—may com
cure. THE LYDNEY DISP

[65918.]—**Leclanche Cell.**—I should
easiest way would be for you to dig out t
plate and procure agglomerate plates,
each side the carbon plate, and keep in
with indiarubber bands. Price per pair,
for 3-pint cells, 1s. 8d. quart, and 1s. 2d.
size; zinc as usual; charge same.

E. WARD-BUSSELL,

2nd, $\frac{3}{16}$in.; 1st, $\frac{5}{32}$in. Use this as pattern for cutting the bridge. J. B.

[65940.]—**Height of Violin Bridge**—Depends mainly on the height of finger-board. I would recommend the bridge to be cut so that he or she may be able to finger it easily. That would be, say, the strings 1-16in. clear of finger-board. But some advocate a high bridge and some players a low bridge; but what I have mentioned is about right. Take for instance a high bridge with string $\frac{1}{8}$in. from finger-board; look at the amount of pressure required to bring the strings to it, taking into consideration the amount of pain to the tips of fingers and the thin squeaking tone produced on violin. A high bridge gives neither player nor violin a chance. I therefore advocate a bridge as I have stated. By cutting your bridge in said fashion, you will bring from your violin its full value, and you will play on the shift with the greatest of ease. I have played violins for a number of years, and found by having the bridge cut so as to have the strings 1-16in. from finger-board the right thing.

A. BARNARD.

[65942.]—**Terre Verte.**—I have found this substance in the Island of Cyprus, and a few months ago made an analysis of it, which, roughly, from recollection, showed:—Silica, about 54 per cent.; ferrous oxide, about 20 per cent.; potash, about 15 per cent.; water, about 9 per cent. It occurs as a jointing material of the concretions of the amygdaloidal trap rock of the country, of a deep green colour when massive, but of a pale olive shade when dried and ground. It must have been at one time extensively used locally as a pigment for the frescoes of the innumerable churches (mostly now ruined) which cover the island. The pigment has proved more enduring than the walls. If "Principia" wishes it, and advertises his address, I will, when I have access to my travelling cases, be happy to supply him with a small sample of the earth.

H. B. F.

[65943.]—**Lime Putty** is simply slaked lime or lime tempered with water. In my letter on "Whitewashing" (28995) I was made to say "brick rod" for "birch rod," and I omitted instructions *re* stopping holes and cracks in walls or ceilings. In order to repair the aforesaid, proceed as follows: Remove all unsound plaster with hand trowel, and then with whitewash-brush saturate the cracks or holes well with water; then take two of lime putty to one of plaster of Paris for large holes, but all plaster of Paris for small ones, mixing a little at a time. Leave your repairing clean by taking your wet brush over as soon as you have made good your repair. SHEFFIELD.

[65945.]—**Flexible Steam-pipe.**—Apply to any of the large manufacturers of indiarubber articles, and they will supply all information as to pressure, &c. They are made with wire inside.

Bristol. T. C.

[65947.]—**Emery Wheels.**—Compo. emery wheels are made with about 1oz. of shellac to 1lb. of emery, with $\frac{1}{4}$oz. of rosin added. The shellac and rosin are powdered, and the whole well mixed, when they are melted in an iron pan. This is poured into an iron mould well coated with blacklead moistened with beer, and when poured in is to be well rammed down. When cold it is taken from the mould, put in the lathe, and a hole bored with a hot iron for spindle. It is also turned and dressed up with hot iron. (*Engineer* Almanac, 1882). J. A. HOGG.

[65949.]—**Photographic.**—Long focus instruments are not recommended for portrait work, as in that case rapidity is wanted, and that can only be obtained by double lenses. For landscapes single lenses of long focus give the most brilliant pictures.

Plymouth. B.SC.

[65950.]—**Steam Pump.**—Look in advertisement columns of *Engineer* or *Engineering*, and you will see several ways of doing without an eccentric; but my advice is, Use the ordinary eccentric if you want to keep clear of being in a fix or having the covers knocked off.

Bristol. T. C.

[65953.]—**Battery for Incandescent Lamps.**—TO MR. BOTTONE.—The best thing to separate the plates of graphite from the zinc is a strip of mahogany, beech, or other hard wood which has been boiled for ten minutes or a quarter of an hour in melted paraffin-wax. The best solution for exciting such a battery is certainly—chromic acid 8oz., water 1 pint, sulphuric acid 8oz. Dissolve the chromic acid in the water, add the sulphuric acid in a fine stream, stirring continually with a glass rod or stem of a tobacco-pipe. Make the mixture in a glazed earthen vessel. Do not use it until it has got quite cold. Real graphite is hard carbon, which forms inside the gas-retorts during the preparation of gas. It is technically known by the gas-workers as "scurf." There is a natural graphite, but this is not used for batteries. Artificial graphite plates are also made by making a paste of coke-powder with sugar and molasses, and baking this mixture in cast-iron moulds at a high temperature. S. BOTTONE.

[65956.]—**Lime Precipitate.**—Washing soda added in such quantity that it only just precipitates the lime is about as cheap as anything. On p. 342 of current volume will be found a new process for softening and purifying water. Whoever recommended sulphate of soda evidently did not know much about the subject. PRINCIPIA.

[65956.]—**Lime Precipitate.**—Temporary hardness of water, due to presence of earthy carbonates, may be removed by boiling; permanent hardness, due to earthy sulphates, may not. The addition of lime water removes temporary hardness, and carbonate of soda (washing soda) both temporary and permanent hardness, in the latter case sulphate of soda remaining in solution. Hard-water soap is ordinary lard soap with an excess of caustic soda. J. A. HOGG.

[65956.]—**Lime Precipitate.**—This question is hardly explicit enough to give a direct answer, as lime is usually found in water as bicarbonates and sulphates; the bicarbonates can easily be disposed of by the Clarke process, but the sulphates are much more difficult to deal with. Effectual remedies are dear, or only fit for the laboratory. Soda—say good carbonate of soda—decomposes sulphate of lime slowly in cold water, but more rapidly in boiling water. Sulphate of soda is no good. If Mr. J. W. Sykes likes to send me a bottle, about a quart, of the water he wishes to treat, I may be able to help him. Although the above is so very simple a matter, it requires a few wrinkles to carry it out in a practical manner.

CHAS. E. GITTINS.

100, Fenchurch-street, E.C.

[65956.]—**Lime Precipitate.**—It depends upon the state in which the lime exists in the water. If simply as calcium bicarbonate—that is, calcium carbonate dissolved in carbon dioxide water—then it may be removed by boiling the water, or by adding a quantity of milk of lime just sufficient to combine with the bicarbonate. If the water is boiled, carbon dioxide is given off, and normal carbonate of lime precipitated thus—

$$CaCO_3, H_2CO_3 = CaCO_3 + H_2O + CO_2$$

If milk of lime is added, the reaction is—

$$CaCO_3, H_2CO_3 + CaO_2H_2 = 2CaCO_3 + 2H_2O.$$

The second form in which the lime may occur is as sulphate, chloride, or any other soluble salt of lime. In this case there is one, and only one, method of removing it—by adding a soluble alkaline carbonate as sodium carbonate. The reaction is—

$$Na_2CO_3 + CaSO_4 = Na_2SO_4 + CaCO_3.$$

The presence of lime in the state mentioned is said to produce temporary, and, in the second state, permanent, hardness. In any case, sulphate of soda is useless. The only advice I can give you is to boil your water, which will remove temporary hardness, and add plenty of washing soda for washing clothes; but I cannot recommend the addition of soda for water used to cleanse the body: it causes the skin to become very coarse and rough. CHEMIST.

[65957.]—**Voltage of Gramme Dynamo.**—You can increase the voltage of the dynamo, if shunt wound, by putting a greater resistance in circuit, or by driving at a higher speed; but the most effectual way will be to wind the armature with a finer wire. S. BOTTONE.

[65960.]—**Sleetover.**—I saw the paragraph which "Breech Loader" mentions, reproduced in several papers, and whatever can be said in favour of the explosive (which has probably, like many others, died a natural death before this), the idea of a cardboard barrel, or of the explosive venting its force on the base of the bullet, and nowhere else, is well worthy of the brain of the maddest inmate of Bethlem or any other lunatic asylum. Bellite, securite, and roburite, are mixtures of meta-di-nitro benzole with nitrate of ammonium, and their inventors claim that they are perfectly safe to use in the presence of firedamp, &c. Carbonite consists of the nitrates of potassium and barium, with nitro benzole and cellulose. The inventors claim the same immunity from danger as in the case of the three explosives first mentioned. "Its explosion would not be unattended with flame, and its use, therefore, is not likely to secure immunity from the dangers arising from a blown-out shot."—(Lecture by Sir F. A. Abel, C.B., at Inst.C.E., on "Accidents in Mines.")

MR.GR.R.A.

[65959.]—**Small Organ.**—A small organ I used to play had an open diapason 8ft. front, and the rest of the stops—principal, fifteenth, oboe, &c.—in a swell-box. Of course, all the diapason could not be included in the front; the rest of the stop was inside the case on either side of the swell. The pedal open 16ft. was at the back, not inclosed in the swell-box. There was one manual only, and the organ was very serviceable. If "G. J. J." likes to advertise his address I will write and tell him where he can see a swell organ that might suit him. CHOPIN.

[65959.]—**Small Organ.**—A two-manual organ is decidedly the best, and the specification A may seem somewhat an expensive organ in respect to the specification; but the soundboard can be constructed in one and divided in the bars, and so give the two soundboards as required, and then there is not a lot of metal pipes, which are the most expensive, and with a little scheming the pedal pipes can be utilised in making up the case, which I think would be a compact and useful instrument; but a more complete and useful organ can be got from specification B, which would cost about £150. Stops marked thus * are prepared for.

SPECIFICATION A.

	GREAT ORGAN.	Ft.	Pipes.
1	Open diapason, wood and metal	8	56
2*	Clarinet flute, wood	4 tone	56
	SWELL ORGAN.		
3	Lieblich gedact, wood................	8 tone	56
4	Gemshorn, wood and metal	4	56
5*	Piccolo, wood	2	56
	PEDAL ORGAN.		
6	Bourdon, wood.........................	16 tone	30

COUPLERS.

7 Swell to Great | 8 Great to Pedals

SPECIFICATION B.

		Ft.	Pipes.
1	Open diapason, wood and metal	8	56
2*	Clarinet flute, wood	4 tone	56
	SWELL ORGAN.		
3	Lieblich gedact, wood...............	8 tone	56
4*	Salcional, metal	8	44
5	Gemshorn, metal......................	4	56
	PEDAL ORGAN.		
6	Bourdon, wood	16 tone	30

COUPLERS.

7	Swell to Great	9	Swell to Pedal
8*	Swell octave to Great	10	Great to Pedals

W. G. P.

[65961.]—**Infinite Series.**—I cannot see, more than "Philomath," how to express the nth term of his series; but the value toward which the ratio of any two successive terms will always approach is $\frac{\sqrt{5}-1}{2}$, or that of the two parts of Euclid's line "cut in extreme and mean ratio." E. L. G.

[65961.]—**Infinite Series.**—The general term of a series, every term of which equals the sum of the two preceding terms, is readily found by the Calculus of Finite Differences. For the law of this series can be expressed by an equation of differences, the solution of which gives us the value of the x^{th} term, or T. From such an equation, we find—

$$T = \frac{1}{\sqrt{5}}\left\{\left(\frac{1+\sqrt{5}}{2}\right)^x - \left(\frac{1-\sqrt{5}}{2}\right)^x\right\} \quad \ldots\ldots (1)$$

The equation from which T is derived is (adopting the usual notation)—

$$u_{x+2} = u_{x+1} + u_x$$

where u_x = T. The constants of integration are determined by putting, in the general integral, $x = 0$ when T will = 0; and $x = 1$, when T will = 1. If, however, we put $x = 2$ in (1), we get for the second term of the series—not 2, as "Philomath" supposes—but 1. Correctly written, the series is, therefore, 1 + 1 + 2 + 3 + 5 + &c. If S represent the sum of the first x terms of the series, by integrating (of course, by the inverse method of differences) the expression for T we obtain—

$$= S\,\frac{1}{\sqrt{5}}\left\{\left(\frac{1+\sqrt{5}}{2}\right)^{x+2} - \left(\frac{1-\sqrt{5}}{2}\right)^{x+2}\right\} - 1 \quad (2)$$

Hence, the sum of x terms = the $(x + 2)^{nd}$ term *minus* unity. By substituting in (1) and (2) different numbers, as 2, 3, 5, &c., for x, "Philomath" will be able to verify the above formulæ.

Charing, Kent. J. R. C.

[65962.]—**Signalling.**—Your best way would be to have a bell, battery, and Morse key at both stations, using a single line wire and earth for return. The pipe will do very well for your earth connections if you take care to solder the wire well to it. Six Leclanché pint cells at either end ought to suffice. No. 14 B.W.G. (copper wire), or No. 11 B.W.G. (iron) will do for the line wire. Connect up as shown in my sketch in answer to 65821 (No. 1218), only substitute bells in place of the sounders s.s. You may use either Morse keys or two-way switches, and put both the zinc and bell to earth on the same wire if more convenient. METEOR.

[65964.]—**Skin Disease.**—It is impossible (without inspection and further knowledge of the case than that given by "Nitram") to say what the disease is. It may be some form of eczema; but it would be dangerous to prescribe for it. The patient should consult a specialist at the Hospital for Skin Diseases, 52, Stamford-street, Blackfriars, S.E.

Plymouth. B.SC.

any further information I shall always be pleased to answer anything that lies in my power; or if you care to advertise your address, I will reply by post. PRINCIPIA.

[65980.]—**Legal.**—I am afraid, from the law laid down in the case of Simpson v. Hartopp, Smith's "Leading Cases," 6th ed. 398, that the landlord has power to distrain the plant you lent on the hire system. The law there laid down is that goods sent to another merely for the purpose of having work done upon them are exempt from distraint, while, on the contrary, goods (or plant) sent to remain on the premises are not exempt. I would say that the latter is your case. You should see the landlord; possibly the rent owing is not nearly so much as the plant is worth to you. A case was decided in Scotland where a piano lent on hire for one night was distrained by the landlord for one night's rent of the hall. The landlord succeeded.

Plymouth. B.SC. (AND SOLICITOR).

[65981.]—**Photographic Lenses.**—"J. W." has answered his question himself. The longest-focus lens he can use is 8¾, but I would advise him to use one a little less than this, for the focus will vary according to the distance of the object from the lens, and in some cases, if he is copying and has to enlarge a little, he would need a longer bellows; so on the whole it would be advisable to use a shorter-focus lens. The best lens he can use for instantaneous views is a rapid rectilinear: this is specially suitable for the purposes "J. W." requires, as it will take views, groups, architectural subjects, either instantaneously or with longer exposures, according to the stop used; it is also a capital lens for copying engravings, designs, &c., intended for lantern transparencies. As to price, a firm who advertise on the front page of the "E.M." supply the "Invicta lenses," a quarter plate rapid rectilinear, costing 21s. (subject to a small discount), which is the cheapest and best lens I have ever seen. If "J. W." cares to advertise his address, I shall have pleasure in forwarding specimen of negatives and transparencies taken with one of these 21s. lenses, or giving him any information in my power; or if "J. W." communicates with the firm mentioned, as they make a speciality of lantern and photographic apparatus only, no doubt they would give full particulars. WET PLATE.

[65982.]—**Organ Query.**—The folds of the small bellows or pneumatic motors do not blow outwards, as, under the circumstances named, they are open almost to their fullest capacity, and the leather almost straight. Upon depressing a key, the fold is drawn or forced inwards. J. E. M.

[65983.]—**G. W. R. and M. S. & L. Locos.**—"W. H. P." will find two very good sketches of the M.S. and L. bogie express engines in No. 1097, Vol. XLIII., with a few dimensions attached. The drawings are of No. 438, which belongs, I believe, to the same class as No. 441. The driving wheels are 6ft. 3in., bogie wheels 3ft. 3in., and cylinders 17½in. by 26in. I beg to state that I am not the "Meteor" therein mentioned, as Vol. XLV. was the first I subscribed to. This will account for my taking the same *nom de plume* as the original "Meteor," for which if he still takes in the "E. M." I hope he will pardon me. If I had not bought up some back numbers, I should never have discovered my error. I am sorry I cannot supply fuller details, nor anything concerning the G.W.R. broad-gauge express engines. METEOR.

[65985.]—**Electric-Light Meter.**—"G. R.'s" experience is almost a sufficient answer to his question; but an error of 60 per cent. is very likely, and easy enough for many reasons. Although theoretically it should be a simple and correct form, yet practically it is useless for the purpose. It may be some consolation to know that your next quarter's bill may be half what it rightly should. H. R.

[65985.]—**Electric-Light Meter.**—I think you may take it for granted that the meter registers pretty accurately the amount of current which passes through it; but it does not follow that your club has had the benefit of that amount of current in lighting power, as there may be enormous leakages either in the leads to the lamps or in the return wires and the source of current. Could you not get a practical man to look over the general arrangements and test for leakage? S. BOTTONE.

[65985.]—**Electric-Light Meter.**—After nearly three years' use I can recommend the Ferranti meter (Hatton-garden). It is unfortunately expensive, but I believe it to give indications which must be very near the truth. Each instrument should be calibrated for the extremes and some intermediate points of the currents likely to be registered. If known constant currents are available nothing else but a good ammeter and a *clock will be wanted. In my own test I used the electro-deposition of* copper method. Like Mr. *Preece, I have one of these* meters on the charging circuit, and another on the discharging; one of them when tested gave the same constant for all currents between 3 ampères and 50, the other had more variation, and, for accurate work, corrections would have to be made according to the probable current passing. The meter is read by dial work like an ordinary gas meter, and as the whole current passes through it, and not an infinitesimal portion by a shunt, as is probably the case with "J. R.'s" meter, the record should be less liable to error. ANTARES.

[65989.]—**Port-holes of Cylinder.**—The area of holes equals say $\frac{1}{25}$th area of cylinder. Area of ¾in. diam. = ¾ × ¾ × $\frac{22}{28}$ = nearly ½sq.in., and ports = $\frac{1}{50}$sq.in., or say ¼in. × $\frac{1}{16}$in. full near enough for you. Bars and ports $\frac{1}{16}$in. wide and exhaust ⅜in.

Bristol. T. C.

[65992.]—**Manganese.**—I have made some hundreds of assays of Mn and Cr in iron ores, and never noticed the difficulty mentioned. What do you do before adding the NH_4Cl and the NH_4HO? I always like to get rid of Mn at the earliest possible moment, it being such an insidious substance, contaminating nearly every precipitate produced in its presence. Try dissolving your $Cr_2(HO)_6$ precipitate and reprecipitating with NH_4HO. There is no need to use NH_4Cl if you use HCl and NH_4HO. METALLURGIST.

[65992.]—**Manganese.**—The precipitate with NH_4Cl and NH_4HO (which if green contains Cr) should be washed and fused in a platinum dish with $KNaCO_3$ and KNO_3, boiled with water, and filtered, the insoluble portion tested for Fe and Cr. The solution is mixed with Na_2HPO_4, acidulated with $HC_2H_3O_2$, and boiled, a gelatinous white precipitate is Al. The filtrate is then tested for Cr with $BaCl_2$, giving a yellow. If, however, Mn has been precipitated, both the residue and the solution are bright green and mark the yellow of the Cr. In this case boil the filtrate with HCl and spirit, when the green of the Mn will be removed, while the Cr will be reduced to Cr_2Cl_6, and turn greenish. If, then, the original green sol. be entirely discoloured with HCl and Sp. nothing, but Mn is present, but if a green tint remains, then Cr. was also present. J. A. HOGG.

[65992.]—**Manganese.**—It is practically impossible to prevent some Mn coming down in Group III. by the AmCl and AmHO method; but the amount so precipitated may be reduced by filtering as rapidly as possible to avoid much contact with air, for it is only the —ic oxide which precipitates. If Mn be present in the Group III. ppt., this is indicated by its darker colour, and on subsequently fusing to separate Fe and Cr, the mass turns green owing to the formation of potassium manganate. The green mass usually yields a pink solution due to further oxidation to permanganate, and, unless there be much Mn down, the pink solution runs colourless (or yellow in presence of Cr) through the filter being reduced by the filter paper. Thus the Mn is readily detected, even if it does get down in the wrong group.

WM. JOHN GREY, F.C.S.,
Analytical Chemist, Newcastle-on-Tyne.

[65992.]—**Manganese.**—To test a solution containing Mn and Cr is what I suppose you mean. This being so, you may proceed as follows:—Precipitate the Mn and Cr as $MnCO_3$ and $Cr_2(HO)_6$ by sodium carbonate, wash, redissolve in H_2SO_4, and boil with $BaCO_3$; this will displace the Cr, and leave the Mn in solution. Filter, and test the filtrate for Mn; wash the ppt., dissolve in H_2SO_4, and test for Cr. Perhaps you do not happen to know of Crum's test for manganese:—Boil the salt suspected with HNO_3 and lead peroxide, and if Mn is present, the liquid will develop the characteristic crimson colour of $K_2Mn_2O_8$; this test is very delicate, it being so much so that a trace of magnanese which would escape detection by the ordinary tests is easily discovered by this. $Cr_2(HO)_6$ as precipitated by NH_4HO is a deep bluish-violet; if the solution is very much diluted it is a light pinkish colour, so don't go and mistake it for something else—$CO(HO)_2$, for instance. PRINCIPIA.

[65992.]—**Manganese.**—In separating the hydrates of Cr and Mn in this way, the oxygen of the air is apt to cause manganic hydrate to be formed, which is insoluble in NH_4Cl solution. If "Young Student" will be cautious and not add a very large excess of NH_4OH, and a moderate quantity of NH_4Cl, and immediately boil off the NH_3 until there is no smell thereof, he will probably find sufficient Mn in the filtrate to identify it. I should advise "Young Student" to procure a book which causes the users thereof to think of what they are doing, and which does not set out things in cut-and-dried "tables," &c., as if the reactions and separations of qualitative analysis were sharply defined under all circumstances and in any mixture of salts. "Young Student" would then discover that mixtures of salts are far from behaving to reagents exactly as do the single salts by themselves. It would be invidious to name any particular book; but if "Young Student" wishes, I can recommend one which, if he studies diligently, will make him a better hand at qualitative analysis than any "tables," &c., can ever do. THOMAS.

[65992.]—**Manganese.**—If "Young Student" has the chance, he should consult Clowes's "Practical Chemistry," as it is particularly full and clear on this difficulty. As, however, he may not have access to it, I will give a *précis* of the remarks contained therein. If AmHO and AmCl be added in excess to a solution containing members of Group III.A (Fe, Al, and Cr) only, the whole of them is precipitated on boiling. If AmHO and AmCl be added in excess to a solution containing members of Group III.B (Mn, Zn, Ni, Co), and the solution protected from the air, no precipitation occurs. If, however, the two groups be present together, Mn and Zn will always be precipitated (partly, at least) with Fe, Al, and Cr; and, if they be present in small quantity only, may be entirely precipitated with Group III.A. In the case of Mn this is not of much consequence, as it would be detected by the green colour produced by fusion with KNO_3 and NA_2CO_3 when testing for Cr, but Zn would be entirely overlooked. Therefore, when a precip. is produced by adding AmCl and AmHO, it is best to precipitate Groups III.A and III.B together by adding AmCl, AmHO, and Am_2S, and boiling. YOUNG ANALYST.

[65993.]—**Hydrochloric Acid.**—HCl is added because many of the metals are precipitated by H_2S in an acid solution only. Let "Student in a Fix" try an alkaline or neutral solution: he will soon see the difference. FREDERICK DAVIS.

[65993.]—**Hydrochloric Acid.**—The reason that HCl is added is that some metals of the second group—e.g., Ni, Co—are precipitated by H_2S if the solution is neutral; they are not precipitated if the solution be acid. PRINCIPIA.

[65993.]—**Hydrochloric Acid.**—No book which I have on analysis recommends the course quoted by the querist. I advise him to write to the author of the work asking for an explanation.

WM. JOHN GREY, F.C.S.
Analytical Chemist, Newcastle-on-Tyne.

[65993.]—**Hydrochloric Acid.**—The addition is to insure the expulsion of HNO_3 (if this or nitro-hydrochloric acid has been employed in making the solution), SO_2 and Cl, any of which would cause decomposition of the H_2S. It is evaporated to drive off excess of acid, and diluted in order to lessen the solvent effect which the acids liberated by the H_2S from their original compounds, would have on the resulting precipitate. This is particularly important in the case of cadmium ($CdSO_4 + H_2S = CdS + H_2SO_4$) as CdS is soluble in H_2SO_4. YOUNG ANALYST.

[65993.]—**Hydrochloric Acid.**—See end of answer to No. 65992. Any properly-compiled book would solve this question. The object of evaporating nearly to dryness is to expel any oxidising acids—nitric, chloric, &c.—which would prevent the metals precipitable by H_2S from coming down. Test the filtrate from the first group with a drop of indigo solution, and, if it is not decolorised, go ahead; but if it is, evaporate nearly to dryness, and again take up with HCl. Please "Young Student" try the following experiment:—Take some lead nitrate and make a nitric acid solution of it; dilute, and add some HCl, keeping the solution hot, and pass H_2S gas. There will be little or no precipitate of PbS—only sulphur. Now, please, "Young Student," think for yourself—What is the action of H_2S on dilute nitric acid? THOMAS.

[65994.]—**Vacuum.**—The mercury falls [illegible], so that the air really gives a pressure of [illegible] of the outside pressure. As the air admitted was same as outside its volume must have been increased [illegible] times, so that the original space was ¼ × ¼ × [illegible] = $\frac{1}{32}$c.in.

Bristol. T. C.

[65994.]—**Vacuum.**—When the air is admitted to the tube of the barometer its pressure is reduced from 30in. (that being the atmospheric pressure at the time) to 4in., and its volume is increased from ¼c.in. to $\frac{30}{4}$ × ¼ = 1·875c.in. Therefore, this is the volume of the space above mercury after admitting air, and this corresponds to a length of tube of 7·5in. But since the mercury fell 4in. on admitting air, the original vacuum must have been 7·5 − 4 = 3·5in. long = to a volume of ·875c.in. ELAS.

[65995.]—**Deflection.**—The beam has $\frac{2}{12}$ × 5 × 2,240 = $\frac{22,400}{12}$ft.-lb. of work done on it, and the weight has therefore to fall $\frac{22,400}{12}$ ÷ 200 = 9⅓ft. to deflect the beam to the same extent.

Bristol. T. C.

[65995.]—**Deflection.**—The energy expended in deflecting the beam is 5 tons × 2in. = 5 × 2240 × $\frac{1}{6}$ = 1866ft.-lb. The 200lb. weight must

therefore possess this energy when it strikes the beam, and this would be due to a fall of $\frac{1966}{200}$ = 9·83ft.
ELAG.

[65997.] — **Shock.** — The usual form of these machines is that of a magneto-electric generator (a small high-tension dynamo), which, on standing on the platform, dropping in a penny, and seizing the handles, is driven by the weight of the person and a shock so obtained. The penny is put in for two reasons—one to pay for the shock, and the other to release the mechanism of the generator. The platform afterwards rises, catches the mechanism, and is then ready again.
PRINCIPIA.

[65997.]—**Shock.**—The penny releases a detent, which thus allows the handle or handles to be drawn out. This drawing out the handle sets the battery in action, which actuates the coil, and at the same time lets the penny fall into its proper receptacle. When the shockee lets go the handle, a spring pulls its back into its place, puts the battery out of action, and lets the detent fall again into the locking point of the handle bar.
S. BOTTONE.

[65998.]—**Preserving Leaves.**—Dry the specimens between absorbent botanical paper under pressure, changing the paper about every four hours, and finally dry between layers of hot sand, still under pressure between botanical paper. The colours cannot be fully retained, as with the evaporation of water the chlorophyl is chemically changed, the phylloxanthein predominating over the phyllocyanin. However, this is a debatable point, and cannot be fully explained.
FREDERICK DAVIS.

[65999.]—**Filtering Paper.**—"Young Analyst" ought to know that the best filtering paper is that which leaves the least residue after burning. Working in Germany, I have been altogether accustomed to Swedish and Rhenish; but no doubt English makers are quite as good. After weighing it, burn a square foot of each; weigh again, and you will know which is best.
Plymouth. B.Sc.

[66002.]—**High Ground.**—In the Geological Museum, Jermyn-street, London, W., there is a geological model of London which will perhaps answer your requirements.
PRINCIPIA.

[66002.]—**High Ground.**—If "N. A. L." examines a Government Survey Map, he will find the various prominent parts marked in feet above the sea-level. At all events this is the case in our town, and I have no doubt it will be the same with London.
ECNAL.

[66004.]—**Test for Platinum.**—If it is a white metal, and is unaffected by boiling HNO_3 (nitric acid, aquafortis), it is either platinum or some rare metal which he would not have much chance of getting at anything like the price of platinum. It is important that the nitric acid should be pure —at least, free from chlorine.
YOUNG ANALYST.

[66004.] — **Test for Platinum.** — There are several simple tests for this metal, as—Rub the metal on a touchstone (or piece of old black Wedgewood) and touch with nitric acid (aquafortis); if the white stain disappears, it is silver or baser metal; if it stays unaltered, it is platinum. Platinum is very hea[illegible], more so than gold; it is not so white as silve[illegible] It will not melt in any furnace.
PRINCIPIA.

[66004.] — **Test [illegible] Platinum.** — Metallic platinum is insoluble [illegible]l acids except a mixture of nitric and hydrochloric. This solution evaporated to a low bulk and diluted with water gives, with H_2S, a slowly-forming brown precipitate, readily soluble in AmHS. To another portion of the solution add KCl and a little spirit, a yellow crystalline precipitate of potassium platinic chloride PtK_2Cl_6 forms. Platinum is not affected by great heat.
J. A. HOGG.

[66005.]—**Preserving Flowers.**—See my reply to "Preserving Leaves." FREDERICK DAVIS.

[66006.]—**Mitis Metal.**—It is claimed for this metal, which is stated to contain from 0·08 to 0·10 per cent. of aluminium, that it will produce castings which are perfectly sound and entirely free from blow-holes. Other properties equally wonderful are also ascribed to it; in fact, were it to fulfil all that is claimed for it, it would be an ideal steel. It may be a good metal, and do well for small castings; but there are plenty of other metals in the market that will do so, and which are less expensive. Mitis steel, I think you will find, will soon be a thing of the past; it is gradually dying a natural death, like a great many other wonderful inventions of a similar nature which were going to revolutionise the steel trade. It is very interesting to know that it really contains no aluminium, or, to put it more mildly, so small a quantity that it cannot be detected by chemical means. I know of several chemists who have analysed it, and they have every one of them failed to find the least trace of aluminium. I have also anlalysed it myself with similar results. On one occasion I made an analysis, together with a gentleman connected with the firm who manufactures it here, but we could not find any of the metal which is stated to be present, and which imparts to the steel its wonderful properties, but which properties remind one of those which are claimed for so many of the patent medicines now before the public. With regard to the soundness of the castings, I know of a firm who had one made the other week, but which was so full of blow-holes that it had to be rejected. Being daily brought in contact with many connected with the iron and steel industries, I hear a good deal, but I think further comment is needless.
HENRY J. HARDING, F.C.S.
84, Bank-street, Sheffield.

[66009.]—**Arsenic in Muslins, &c.**—The colouring matter may, perchance, be arsenite of copper, but most things are now dyed with aniline colours. The chemical detection of arsenic requires some little manipulative skill; however, try "Marshe's" or "Reinsch's" tests, for which see any chemical work, or try the following:—Take a test tube, three parts fill it with a mixture of equal parts of hydrochloric acid and water, to this add a small piece of zinc, then insert a small piece of the substance to be tested, in a rolled-up state, place a loose plug of cotton wool, saturated in solution of acetate of lead, and lastly, lightly cover the mouth of the test tube with bibulous paper saturated with solution of nitrate of silver, when, if the bibulous paper becomes black or dark coloured just over the orifice of the test tube, the substance tested contains arsenic. Of course, all the reagents must be absolutely pure.
FREDERICK DAVIS.

[66009.] — **Arsenic in Imitation Indian Muslins and Cretonnes.**—In reply to "E. A. A.," the tests for arsenic are difficult to be made, except by one having a knowledge of chemistry. But the following facts are nearly as useful as an analysis: —Purchase none but fast colours, or such as will stand soap-and-water at 160° for ten minutes without much colour coming off. The colours most liable to contain arsenic are mauves, blues, and greens; but only those that are bright or pale. An arsenic colour after hot soap would contain only a trace, and not sufficient to cause any harm, so persons who desire to be entirely safe should wash all such goods with soap and hot water after they are made up. Arsenic colours are now used only in the lowest class of furnitures or cretonnes, as such colours will not stand soap or light well. There are other colours as well as arsenic which, if not soaped by the printer, are quite as poisonous as arsenic; but in fast goods this is always done, to my certain knowledge, if the goods are for home trade, or on a fairly good cloth. VULCANITE.

[66009.]—**Arsenic in Indian Muslins and Cretonnes.** — Upon consideration, I think Reinsch's test might be used in an ordinary household; but if there are children about, better lock up or throw away the chemicals after use. Procure some "hydrochloric acid (pure) for analysis" from a dealer in chemicals, and some clean, bright pieces of pure copper foil. Two or three pieces a square inch or two in area will do. Now take, say, three or four square inches of your muslin and boil it for about twenty minutes with some of the pure hydrochloric acid diluted with an equal bulk of distilled water. If there is any arsenic in the muslin it will be dissolved by the acid, and on removal of muslin and substitution of a piece of the bright copper foil a steel-grey deposit will form an the copper. Try a blank experiment first with the copper and acid alone, and only when you are sure there is no arsenic either in the acid or in the copper can you be certain of the presence of arsenic in the fabric.
THOMAS.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

65392. Sunshade for Woodenette Perambulator, p. 290.
65398. Hook Tools Again, 290.
65420. Optical Lantern, 290.
65422. Chuck for Pointing and Drilling Wire, 290.
65437. Valve of Gas-Engine, 291.

65645. Herschel, p. 381.
65650. Determination of Copper by Electricity, 381.
65669. Oscillating Slide-valve Steam-engine, 382.
65670. Joining Lead Pipe, 382.
65673. Optical, 382.
65680. L.B. and S.C. Locomotive, 382.
65681. Smocking Machine, 382.
65887. Cremona Varnish, 382.

IRELAND has 76 collieries—nine in Ulster, seven in Connaught, 31 in Leinster, and 29 in Munster. Very few of these are being worked.

QUERIES.

[66010.]—**Hydroxylamine Chloride.** — Is this salt manufactured in England, or can it only be obtained abroad?—H. C. M.

[66011.]—**Incandescent Light.**—Will any reader tell me what power incandescent lamp would it take to light up a shop 14ft. by 17ft., and how to make a cheap battery for the same?—LAMP.

[66012.]—**Turbine and Electricity.**—My dynamo will light 200 lamps of 20c.p., 45 volts each, a distance of 400yds. away. How many H.P. should I get from a good electro-motor at that distance?—BOB RIDLEY.

[66013.]—**E. and M. Locos, 32 Class.**—Wanted full particulars of new 4-c. bogie engines, working Peterboro and Cromer traffic this year. A sketch also will oblige.—X. Y. Z.

[66014.]—**Bicycle Spokes.**—The hubs of my bicycle are gunmetal and the spokes squeak very much. Will some one kindly tell me how to remedy the defect? The spokes appear to be quite tight in the hub.—BICYCLIST.

[66015.]—**Water Motor.**—Can any of "ours" kindly give instructions to construct a water motor to drive small dynamo? Have good pressure of water.—WATER MOTOR.

[66016.]—**Blowing Cylinder.**—I wish to know what H.P. it would take to drive a blowing piston, 100in. bore, 8ft. 7in. stroke, at 5lb. per square inch.—AMATEUR.

[66017.]—**Dynamo.**—I have a dynamo the F[illegible] of which are 12in. long and 3in. diam. Armature is [illegible] is 28 sections, 8in. diam. by 4in. wide. I want to [illegible] how many pounds of wire I am to put on the F.M.'s, and what H.P. it will take to drive. Also how many 16c.p. lamps it ought to light up.—GRATEGOSH.

[66018.]—**Violin Making.**—Being desirous of making a violin, I would be very much indebted to anyone who would take the trouble to explain how to start about the job. I have plenty of tools, and can use them a little, so I think with a little explanation as to timber, shapes, &c., would be able to stumble over it.—AMBITIOUS.

[66019.]—**Burnt Steel Tools.**—How is it that overheated steel tools are burnt? What chemical change takes place? Dr. Ure states in his "Dictionary of Arts" that in the best works no slag or flux is used and the steel is melted in unluted (unclosed) crucibles?—J. FIELD.

[66020.]—**Pianoforte Repairing.**—I have a piano with the usual check action where tapes are used. When I strike a note, I notice that the hammer does not fall back on to the check, and in consequence it produces a harsh tone. How could I remedy this? Have the turning of the screws at the end of the keys anything to do with it, or is the fault in the action itself, or is it from damp?—MUSICUS.

[66021.]—**Electrical Magnets.**—Will some one kindly tell me if the power of electrical magnets depends on the quantity of wire wound on them or the current of electricity passing through them? Also if it would be possible to make a magnet, using the electricity generated with a dynamo made on the same principle, and the same size as the electric gas-lighter, and what would be the power of the magnet?—AMATEUR.

[66022.]—**Iron Floor Plates.**—Would Frank Caws or "M.I.C.E." kindly say if the formula given on pp. 127 and 170, Vol. XLVII., is applicable to ascertaining the strength of a perforated floor plate? In other words, if by using this formula I find the strength of a solid plate of cast iron, say ⅜in. thick, of a definite size, how am I to proceed to find the strength of a similar plate, but in which there are perforations, which take away ⅜ths of the weight of the metal? If this formula is not applicable can they give me another?—J. R. G.

[66023.]—**Boiler Priming.**—I have a 4H.P. vertical boiler which I work at 40lb. (one of A. Chaplin's boiler and engine combined). Will "T. C., Bristol," or other friend say why it primes so badly, and the cure? Is putting soda in the boiler to soften fur a proper thing to do? Is there any way of preventing fur? If not, the best thing to minimise its accumulation. Please do not refer to back numbers, as I am a new subscriber.—SALIS INCEV.

[66024.]—**Organs**.—"J. E. M." mentions (29016, 20 July, 1888), having supplied electric blowing apparatus for a large church organ, and I have no doubt many of our readers have organs of different sizes to which they would apply the same kind of blowing apparatus if the motors are not difficult to make and the battery power not too expensive. If not troubling "J. E. M." too much I should esteem it a favour if he would kindly describe the motor and state power required (battery) to blow an organ of eleven speaking stops. I have some knowledge of electricity and should endeavour to make motor myself, as I could not afford to purchase an expensive appliance? —A FOUR YEARS' SUBSCRIBER.

[66025.]—**Portable Railways.**—Can anyone who has experience of these say if they would be of use and economical in a small ironworks, employing about 70 men, which is about half a mile from the railway station, to and from which about 15 tons a week are carted by road? A straight track could be got through level fields to the station. It is proposed to have a line of 16in. guage, the waggons of suitable form drawn by a horse. Will it be necessary to excavate the soil, say, for 1ft., and fill up with ballast on which to bed the sleepers, and serve as a track for the horse as well? Will wood sleepers suit, or is it needful to use iron ones? What would be the cost of such, say, ½ mile long, sidings, points, &c., extra?— J. R. G.

[66026.]—**Mine Ventilation—Work of Steam.** —In a table of mine ventilation I find the work of 1klg. (2·2055lb.) of steam used through the fan engine expressed in kilogrammètres (1 kilogrammètre = 7·233ft.lb.) of work in lifted air from the mine, in some cases as much as 6,993 kilogrammètres being done by 1klg. of steam, and in others only 2946. The work of 1klg. of steam in the case of steam nozzle ventilation being stated at 3,833 kilogrammètres. Would someone kindly explain how this is arrived at, and how it compares with other known instances? In the case of the highest duty above mentioned the volume of air passed per second is stated at 24·25 cubic mètres, and the weight of each cubic mètre of air at 1·18klg. The useful effect of the ventilator in H.P. = 17·46, and in per cent. of the indicated power of engine = 40·9. There is also another item given—viz., the equivalent area of air sluice = 1·257 square mètres, being, I presume, a measure of comparison for and with other fans based upon the rule, $a = 0·38 \frac{V}{\sqrt{h}}$ square mètres, in which a = equivalent area of air sluice opening, V = air volume in cubic mètres per second, h = measured water gauge depression in the drift in millimètres.—M.

[66027.]—**Rotation Dynamometer.**—I want to ascertain the power communicated to a fan shaft when in full work. I believe there exists apparatus called rotation dynamometers for this purpose, applied either immediately to the shaft or intermediately between the driving and the driven machine, and should be glad of an explanation of action and method of estimating the power from the data thus obtained. Machines of this kind are, I believe, expensive, and require considerable mathematical proficiency and extensive practice to operate. Is there any other way or any more simple apparatus, for ascertaining the power used by the fan? Of course, if driven by an engine solely employed for the fan, the engine would be indicated; but this would, after all, not give the nett power used by the fan, as there is the friction of the engine itself, and of the belting and intermediate shafting, which would not thus be shown. In the case under observation the fan is driven from a line of shafting doing at same time other work.—M.

[66028.]—**Meat Larder.**—Is a current of air desirable or the reverse? I have been told that a draught is objectionable for keeping meat, and, on the other hand, I have heard of a leg of mutton being hung up in a tree in [illegible] preservation. Our larder is a cellar looking [illegible], with large window filled with fine gauze, not glass, [illegible] gauze in the door panels. Stone floor and no drain opening, lest sewer gas should enter. It is hardly as good a keeping place as was expected. Would any more ventilation be an improvement? There is spare power available for part of the day, and a light fan could be worked without much difficulty.—X. Q. Z.

[66029.]—**Electric Wiring.**—What is the interpretation of the following sentence from the address lately given by Mr. Crompton on central station lighting? "A modified three-wire system for batteries is less complicated than a three-wire system from dynamos. By the use of accumulators you may reduce the cost of your feeders very largely on either the direct three-wire or five-wire system if you put your batteries at the distant point." What is a three-wire system, two flows and one return, or one flow and two returns, or what?—X. Q. Z.

[66030.]—**Silver Solder.**—Would some reader kindly help me with a recipe for cheap, but good and white silver solder for soldering best German silver (termed by some rolled nickel)? I have been using the following (1oz. of refined silver to 1oz. of brass wire), but find it shows too much of a brass appearance. Would not a portion of pure tin do mixed with it? Also should sterling or refined silver be used. I do not want it to exceed 3s. per ounce in cost (cheaper, if possible), include 10d. for flatting as I require it at paper thickness for my use.—WARWICKSHIRE LONGSHANKS.

[66031.]—**Sailing Boat.**—Will some reader kindly give me full particulars of a 14½ft. boat, *Dark Secret*, manned by one man, Capt. Andrews, which sailed about a month ago from United States bound for Europe? I want materials, dimensions, and table of offsets to enable me to build a similar boat. If not known, a table of dimensions, offsets, &c., to build a 14½ft. sailing boat, suitable for an ocean voyage for one or two persons. Also some idea of cost, materials, and length of time likely to take an amateur to build.—ATLAS.

[66032.]—**Common House-Flies.**—Generally these insects fly about quite noiselessly, now and then they buzz in a provoking manner. Is this buzzing a voluntary act on their part, or are the quiet flies a distinct species from their buzzing brethren? If the latter is the case, what is the difference in the anatomy or otherwise between the two that causes such a difference in their behaviour?—X. Y. Z.

[66033.]—**New Algebraical Symbols.**—Can anyone tell me the meaning of three horizontal parallel lines with two dots over them? If there be none such used, will those of my readers who possess Chrystal's "Algebra," kindly turn to p. 244 and tell me whether there is such a symbol in the sixth line? It is in my copy, but the two dots are not quite so black as the rest of the line. I have examined them through a strong magnifying glass, but cannot tell for certain whether they were intended to be printed.—F. S. S.

[66034.]—**Dynamos.**—TO S. BOTTONE.—I have a dynamo which I want to use for charging small accumulators, fields 6in. high, 2in. diam., cores 4 by 4, armature 4in. diam. Siemens H fields stand on top of cores, cast-iron bed. What wire to use for same and what may I expect to get? Also a dynamo, F.M. 2in. wide, ¼ thick, cores 3½ long, armature 3¼ by 1½. F.M. form half-circle on top of cores of 8in.—READER.

[66035.]—**Peroxide of Hydrogen.**—The article in your last issue on Peroxide of Hydrogen as a disinfectant contains such remarkable statements that I should be glad if some chemical reader will say how it is to be used for such purposes as preserving meat and other domestic uses? Is it to be diluted with water or used as purchased? A liquid having such valuable properties, and at same time being quite harmless if taken internally ought to be widely known.—W. P.

[66036.]—**Glass Drilling.**—Can any of your readers inform me of any means by which I can drill 1in. holes in glass ⅜in. thick, in less than 45 to 50 minutes, which it takes me now by a treadle drilling machine? I want several holes of the same size through small pieces of glass for electrical experiments. They must have clean edges.—AT SEA.

[66037.]—**Violin Playing.**—For the last 20 years I have played the violin more or less, and am sorry to say (although a lover of the instrument) with poor results, owing chiefly, I believe, through not holding it correctly. In my time I have seen not a few cheap instruction books; but the instructions they give are very vague and contradictory. I am sorry to say my fingers have poor command of the strings, and near the third joint of the fore finger, left hand, I have quite a corn, and after I have been playing a short time it becomes so tender I know not what to do to keep on playing. My method of holding my violin is for my left hand to be level with my nose, the neck of the violin resting above first joint of the thumb, and the palm of the hand to be nearly at right angles to the under part of the neck of the instrument, and I am able to look straight up between the strings. I should also be glad to know how far from the nut the thumb ought to be. In fact, any hint that will get me out of my bad habit will be thankfully received. What ought I to pay for good instruction book? FIDDLER DICK.

[66038.]—**To "M.I.C.E., Bath."**—Will you please tell me whether you think very advanced mathematics of great use to a civil engineer—that is to say, are they worth the trouble of studying for a man in that profession? Prof. Rankine's books are crowded with intricate mathematical reasoning. I have just bought the latter's "Civil Engineering," and would thank you very much to tell me what books to study in order to understand his text. I am very fond of mathematics for its own sake, although I know very little. I have done four books of Euclid, algebra to the end of quadratics, rudiments of mechanics and hydrostatics, and have just commenced differential calculus, but can make very little out of it.—STUD.INST.C.E.

[66039.]—**Magneto-Induction Machine.**—I have a 12in. compound horseshoe magnet of 14 plates, each 1⅜in. wide, ¼in. thick. On suspending the armature the magnet will attach itself and also support a weight of 15lb. This, with its own weight, 40lb., is 55lb. in all. Now I wish to construct an induction machine for intensity currents. Will some correspondent kindly give me particulars as to length and gauge of wire, size and shape of bobbins, and power I may expect to obtain? I may add that the ends of poles are clamped together by plates that are only ⅜in. apart, so the bobbins must revolve in front of poles, which form a square surface 4in. each way. There is no mark to distinguish the poles. How can they be determined?—THOS. AGER.

[66040.]—**Hydraulic B Pumping Ram, Spring Water.**—Would any of "ours" kindly give their experience with B pumping spring water rams? Height of lift about 170ft., with falls average about 3ft., with plenty of bad water for driving power. My object is to know and secure a good machine which will deliver pure water without gathering any of the bad driving water, and the whole thing to work the longest time without contamination of the spring water—spring water required for 40 persons daily. Small lifts would be of no practical use against very high lifts as here stated. Firms all state their successes, but not their failures—my reason for asking this through your much-valued paper.—YORKS.

[66041.]—**Dressing for Timber.**—We have a very valuable carved tree here, erected out-doors, in Surrey. It is called American Pole, which is the work of the Hydar Indians, North America. Height 40ft., mean diam. 4ft. We are very anxious to preserve this from decay. The wood is a cedar. Two years since we dressed it with solution enamel, but I observe this damp season the face is getting green. Should be much obliged for any advice best to preserve this pole with some invisible solution.—SURREY.

[66042.]—**Gas-Lighter.**—Will some of our electrical friends advise me as to the best battery to render white hot a very short length of platinum wire for the purpose of lighting gas? As the arrangement will be used but once a day, I want a form which will endure for some months without replenishing, if any such can be suggested; or I must have one (a bichromate, I suppose) so arranged as to immerse the zincs at the moment of using. This I can accomplish myself. If a Leclanché would do, how many cells should I require? Should they be joined in parallel or series? If a bichromate, would one cell be sufficient? If so, what should be the dimension of plates? What size and length of fine platinum wire should I use?—H. H.

[66043.]—**Physics.**—Would some scientific friends assist me in producing a lecture on heat suitable for a public audience? I want some suitable and telling experiments to illustrate such phenomena as expansion, contraction, ebullition, freezing, conduction, convection, sources of heat, &c. Good experimenss or works of reference will oblige.—H. H.

[66044.]—**Painting Tapes.**—A little time ago I got an answer to a query on this. Will some one now give me further information? I want to paint a flax tape for outdoor use. The paint should not contain turps, as it rots fibre, nor much pigment, as white lead, as it cracks off and tends to start tape cracking. It must be hard to rivet tags on, and elastic not to crack, and the sooner it dries the better. I think an oil such as is used for oiling canvas would do if it could be made hard. It must be uninfluenced by wet.—D. P.

[66045.]—**To Mr. Bottone or Mr. Eaves.**—May I trouble you for the exact dimensions for compound dynamo, capable of giving out 80 ampères at 100 volts? Armature to be of the toothed pattern, laminated and wound with one layer of wire. Frame to be of S. P. Thompson's idea—i.e., with two poles and one field magnet. I have plenty of time and good tools to make a serviceable dynamo, and would like to make one to light my premises up with. I have made a small machine from Mr. S. Bottone's book, the "Dynamo," and it gives every satisfaction as a small one.—SAVORY.

[66046.]—**Sleep in Daytime.**—Can any of our readers kindly help me with something to put in the ears (without injury) to prevent any ordinary noises from waking me in the daytime? My occupation calling me out half my time on night duty, it is a sore trouble for me to get proper rest, being extremely liable to be woke up on any noise occurring, and not being able then to get to sleep again, sometimes only getting two hours' sleep. I can sleep well at night.—E. H.

[66047.]—**Metal Dishes.**—How strong a fly press shall I want to draw an upright edge on a brass blank ½in. high, 7in. diam., No. 20 B.W.G.? Shall I want a pressure plate? What pressure shall I want to rough 1sq.in. No. 20 brass sheets with parallel grooves, 40 to an inch, right-angled and well up to a point? I shall be thankful for any hints on the dishes.—D. P.

[66048.]—**Rouge.**—I have been grinding pebbles, petrifactions, &c., and polishing them with rouge, chiefly for view under the microscope; but I find the stones are much disfigured by the red oxide filling up the minute pores and crevices in them. How may I get rid of it? I have tried scrubbing the stones in water, and boiling them in a solution of washing soda without much effect.—NO SIG.

[66049.]—**Fumigating Machine.**—Can any of our chemical friends suggest anything that will drive out rabbits from holes or burrows? I have a machine (patented) that is worked by a blower similar to a winnowing machine, which forces the vapour off from a dished iron plate heated underneath, if desired, by a lamp, the fumes or vapour being driven through an indiarubber tube, which can be turned into any hole desired.—F. WHADDON.

[66050.]—**Trombone.**—Will some one kindly inform me of the best lubricant for the slide of trombone? I have tried all kinds of oils, black-lead, and a host of other things, but without success. I have seen professionals take something from their vest pocket, dissolve it in their mouth, and then spit on slide. Can anyone tell me what it is? Ordinary saliva will not do—at least not mine.—A. L.

[66051.]—**Violin.**—I have a violin, the label of which bears the inscription—"Martin ——— geigenmacher in Mittenwald, 1773." It is in German handwriting. The surname I cannot decipher. It may possibly begin with a small d. I cannot find the name in Hart's work on the violin. Can any correspondent versed in fiddle lore tell me the name?—E. E. M.

[66052.]—**Telescope.**—Would any reader kindly say if I could make use of an o.g. 36in. focus, 4in. diam., in making an astronomical telescope, and what lenses I would use in conjunction? Say if it would be servicable.—PEEP.

[66053.]—**Seraine's Gas-Engine.**—Can anyone kindly explain the action of the valve gear in Seraine's gas-engine, illustrated in the *Engineer*, Vol. LVII. p. 344? The description given there is very meagre.—V. J. B.

[66054.]—**Power of Compound Engines.**—The power of compound engines is said to vary with the size of the low-pressure cylinder. I should be very much obliged for an algebraical proof of this statement. The data are the sizes of the cylinders, the initial pressure in the high-pressure cylinder, and the rate of expansion in each cylinder.—V. J. B.

[66055.]—**Spring Motor.**—Will some one kindly give me a little information of how to construct one of three springs or more, or one to work with weights and that does not take up much room, as it is to work some clockwork gear and does not require winding up?—F. LOVETT.

[66056.]—**Gas-Engine.**—TO "ENGINEER, ST. MARY CHURCH, TORQUAY."—Will you please to give me the size of air and gas ports for a gas-engine (compression principle), cylinder diam. 4in., and 5in. stroke? Charge fired by spark from coil. Slide works on cylinder end. Diam. of latter 5¾in.—C.

[66057.]—**Silver Soldering.**—Will some technical reader tell me how to solder on the loop handle of a first-class pair of scissors? I am up to doing large work, but fail in this.—D. P.

[66058.]—**Air-Gun.**—I want to supply a new valve to an air-gun, as the present one, made of horn, is not air-tight, although I have returned the horn, and afterwards ground it in with crocus powder. Will anyone be good enough to inform me if horn is the best substance for this purpose, or would ivory or "woodite" be better?—W. J. B.

[66059.]—**Chloride of Sodium.**—I shall be obliged if any of our correspondents who employ chloride of sodium for a flux in the melting of metals to name the best description of crucible for that purpose, or a lining to employ on an ordinary clay crucible to protect it.—F. W. FINCH.

[66060.]—**Fumigating Pastilles.**—I beg to thank "Eos" and others for their reply to queries (Spermaceti and Resins) and wish to know if he has during his long residence in the East learnt the composition of the above. I have hunted through a great many books, but have failed to find what I require.—PRINCIPIA.

[66061.]—**Stained Glass.**—Can any reader give me any idea how to obtain a transparent stain that will adhere to glass without firing? Any colour will suit.—J. J. W.

[66062.]—**Antipyrine.**—Will some one kindly give me some information as to the nature, composition (formula), and pathological effects of antipyrine, and, if possible, some method of detecting its presence in analysis?—YOUNG ANALYSIS.

[66063.]—**Breaking Weight of Rope.**—If the breaking weight of a rope, 100ft. long, hanging perpendicularly, is one ton, what weight would break a similar rope stretched between two poles hung from the middle of it?—SPON.

[66064.]—**Enamel Signs.**—Can you give me any information regarding enamel signs now so much in use, their manufacture, glazes used, where principal manufactories are situated, and if there is any book published giving particulars?—A. DOR.

[66065.]—**Iron Mattress.**—Can any reader give any information about mattresses made throughout of iron? I do not mean spring mattresses with cotton ticking tops.—F. K. H.

[66066.]—**Bank Token, 1812.**—What is the value of a bank token for 3s., date 1812? I have heard that there are only six in existence. Is this true?—GRANTON.

[66067.]—**Accumulators.**—Are the lead plates rendered porous merely in the casting, or is any further process used to increase the surface exposed to the electrolyte?—F. H.

[66068.]—**Green Peas at Christmas.**—How are green peas kept so that they can be cooked at Christmas and served up fresh and fragrant as I have had them?—CAROL.

[66069.]—**Spanners.**—Will some of your readers give their experience of the merits and failings of the many spanners now in use?—HEXAGON.

[66070.]—**Navy-Cut Tobacco.**—Can any of "ours" say how Navy-Cut tobacco is made?—SMOKER.

[36071.]—Loco. Motion.—How is the proper throw of eccentric sheaves determined for slide-valves of any given travel, and fitted with link-reversing gear, the quadrant link having its concave side towards crank shaft?—X. Y. Z.

ANSWERS TO CORRESPONDENTS.

_ *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

_ Attention is especially drawn to Hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

BACK NUMBERS.

WE receive so many queries asking for directions how to make many instruments and appliances which have been fully described in back volumes, that we have compiled a list, which we shall insert in this column at intervals, of those most frequently sent, and as the numbers are still in stock, new subscribers should consult the list before sending their questions.

Pattern Making: Nos. 938, 941, 943, 945, 948, 950, 952, 954, 955, 956, 958, 959, 962, 963, 969, 974, 978, 986, 989, 993, 995, 998, 1,000, 1,001, 1,003, 1,004, 1,008, 1,009, 1,010.
Silver-plating: Nos. 1,009, 1,010.
Varnishes: Nos. 478, 619, 675, 723, 775.

The following are the initials, &c., of letters to hand up to Wednesday evening, Aug. 1, and unacknowledged elsewhere:—

W. H. HARLING.—J. M. P.—Hanover.—J. Fowler.—Magnet-Electro.—M. O. H.—Fireman.—Electrical.—Rob Roy.—C. E. Wilde.—E. M. Richards.—W. Hill.—M. K. S.—H. Urquhart.—John J. Cam.—Jack.—Elag. Sussex.—John Williams.—Strains.—H. E. Bickerton.—S. Bottone.

LUMSIE. (Your question was answered as soon as possible after its receipt—viz, on p. 467.)—RUTTER. (Official information is now supplied from the Emigrant's Information Office, 31, Broadway, Westminster. There is also some description in *Whitaker's Almanack.*)—MARINER. (Have we not given enough about blue prints? See p. 483, Vol. XLV.; p. 432, Vol. XLIV., and the indices generally.)—H. T. (It is not easy to remove printer's ink. Try turpentine and soak up with blotting-paper.)—B. LONDON. (Books of the kind are not plentiful; but you will find information in such works as Ure's "Dictionary of Arts, Manufactures, and Sciences," Payen's "Industrial Chemistry," "Chemical Technology," by Richardson and Watts. Look in at the Patent Office Library and see if you cannot find works to suit you. It is open until 10 p.m.)—AMATURE. (Crystallise what articles? If you will make the question definite, we will answer it or insert.)—SPELTER. (The easiest and best way of brazing band-saws has been given many times. Scarph the ends, anoint with a paste of borax and spelter, tie with wire, and grasp with a pair of brazing tongs the beaks of which are nearly white hot.)—F. CASSILIS. (Patents are to be obtained at the Patent Office, Southampton-buildings, Chancery-lane—on payment of the money for the stamps on the necessary documents. See any of the guide-books issued by our advertisers who transact business at the Patent Office.)—BETA. (Coat the groove with gold size, and when that is "tacky" (nearly dry), place the leaf in the groove, bending it so that the bottom is reached first.)—HENRY MCDERMOT. (Procure a catalogue from J. and A. Churchill, New Burlington-street, W. They publish a number of medical, physiological, and anatomical works.)—JOHN BROWN. (Paraffin oil has been recommended for promoting the growth of hair; but see indices.)—ENCADREUR. (A broken knife ground to a sharp corner is as good as anything; but perhaps the most convenient tool is a blade resembling the knife used in a bookbinder's old-fashioned plough—that is, flat on one side, with the edges bevelled off.)—D. B. (Meerschaum is a silicate of magnesia. It is found in pits or mines in Greece, Turkey, and Syria.)—A. C. G. (We have had notes from time to time about the Keely motor, for which see indices.)—IN THE DARK. (One of the electric gas-lighters is fitted with a battery, but the improved form contains a little influence machine—see p. 403, No. 1033; also No. 1154, p. 212, and pp. 205, 419, this volume.)—J. T. LEIGHTON. (We do not see what useful opinion can be expressed. Your apparatus may give better results than the American devices do; but we have published all available details, and now await something more definite.)—HARRY. (There are water velocipedes, as you know; but the only way to get yours adopted is to enter it for a patent (which costs one sovereign) and then seek the aid of manufacturers.)—ASPIRANT. (You might do as you say by study, and the classes would be of use, but not for a Board of Trade certificate, because at least a year must have been passed at sea in the engine room.)—SIRIUS. (Loomis's "Practical Astronomy" (Sampson Low and Co.), 10s. 6d., or start with Main's "Astronomy" (Lockwood and Son), 2s.)—H. R. MURPHY. (The *Cabinetmaker*, 42, City-road, price 6d., monthly; but you should also see the *Building News*, weekly.)—J. W. D. (How to make a phonograph was given so long ago as No. 683; but you will have seen the more recent inventions illustrated in this volume (p. 452) and p. 528, last volume.)—PRINTER. (If you mean how is the printing transferred to glass, that is done by coating the glass with pale copal or Canada balsam, laying the print on that when tacky, and then when dry rubbing the paper off with a wet finger.)—NOVICE. (No room for a discussion of the kind just now. Psychology is a long way in front of phrenology.)—NOVICE. (See the tables in the textbooks. Formulæ are also given in them. It depends on the resistance to its passage.)—BOOT POLISH. (Recipes for making blacking have been given many times. You appear to want the varnish, a recipe for which was given in No. 749, p. 520 It is a solution of shellac in spirit, coloured with lampblack and Prussian blue.)—DISS. (Yes, see advertisement columns. 2. It can be bound round with calico and varnished.)—X Y. Z. (Westinghouse air-pump illustrated in No. 752.)—N. Y. W. (You will probably find the recipes in Crookes's "Handbook of Dyeing and Calico Printing," published by Longmans. The query is not of sufficient general interest for insertion.)—E. C. M. (The various pigments are ground up in the same way as the lampblack—common ones for cheap inks, and mixing is a matter of taste.)—ANXIOUS ENQUIRER. (Presumably the correspondents applied to thought sufficient had been said about the slide-rule, several low-priced and useful treatises on which can be obtained of almost any bookseller.)—W. H. B. (You ask, "Is the carpenter's slide-rule of any practical use?" The answer is, Yes. If you cannot refer to back volumes, you can procure from any bookseller a treatise on the subject.)—H. C. (There will always be differences of opinion on the subject; but the majority of shorthand writers use Pitman's system, modified to suit tastes, perhaps, but still his system. See indices.)—F. I. C. (Much obliged for the trouble you have taken; but the question was as to a "degree," and fellowship of a society is not exactly that. If you refer to some comparatively recent back numbers, or communicate with the secretary, you will find that the rules have been suspended lately for a time, and there is no reason why the correspondent should not go through the required forms and add the letters to his others. What he wanted was a degree which should serve in some way as a sort of diploma.)—SPINNER. (Why not attend some of the science classes in your town? Procure Goodeve's work on the "Steam-Engine," Lockwood and Son, and Bourne's "Catechism of the Steam Engine," Longmans.)—J. STANLEY. (You could have found it explained many times in the last forty volumes, which represent twenty years of scientific progress. See an article in No. 1162 on modern compound engines. The economy is due to higher pressures and to a better distribution of the steam. You are quite mistaken about the *Great Eastern*, because she is strong enough to be fitted with modern engines if it were worth while.)—C. S. (Type metal will be the handiest, and you can cast that in well-baked plaster moulds.)—A. SIDWELL. (Nitric acid is used for etching steel.)—W. H. J. (We believe they are out of print. Try Wesley and Son, Essex-street, Strand. Diaphragms are not absolutely necessary.)—H. C. D. (It is not far better than electro-plating. The cleaned metal is covered with an amalgam of gold made by mixing one part of gold with 8 parts of mercury. The latter is driven off by heat and the gold is left as gilding. Explained in all the Recipe books.)—WOODPECKER. (Have you looked through the indices? You will find several methods of photographing on wood described. The process is of little interest nowadays.)—W. P. (Recipe for pickling tomatoes in last volume, p. 91; for preserving in Vol. XLV. pp. 568, 615. 2. As to the fresh fruit, the method has been frequently described—and that recently.)

New Rupture Appliances.—Sufferers may save themselves a lifetime of discomfort and suffering by being properly fitted with a perfect appliance. Examination free by a most experienced and skilful surgeon at Harness' Electropathic Establishment, 52, Oxford-street, London, W. (corner of Rathbone-place). Note only address, and call to-day if possible. Pamphlet free.

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Messrs. JAMES W. QUEEN and Co., of 924, Chestnut-street, Philadelphia, are authorised to receive subscriptions for the United States for the ENGLISH MECHANIC, at the rate of 3 dols. 25c. gold, or Thirteen Shillings per annum, post free. The copies will be forwarded direct by mail from the publishing office in London. All subscriptions will commence with the number first issued after the receipt of the subscription. If back numbers are required to complete volumes, they must be paid for at the rate of 3d. each copy, to cover extra postage.

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All the other bound volumes are out of print. Subscribers would do well to order volumes as soon as possible after the conclusion of each half-yearly volume in February and August, as only a limited number are bound up, and these soon run out of print. Most of our back numbers can be had singly, price 2d. each, through any bookseller or newsagent, or 2½d. each, post free from the office (except index numbers, which are 3d. each, or post free, 3½d.)

Indexes for Vols. VI., VII., and IX., 2d. each. Post free 2½d. each. Indexes to Vol. XL., and to subsequent vols., 3d. each, or post free, 3½d. Cases for binding, 1s. 6d. each.

NOTICE TO SUBSCRIBERS.

Subscribers receiving their copies direct from the office are requested to observe that the last number of the term for which their subscription is paid will be forwarded to them in a PINK Wrapper, as an intimation that a fresh remittance is necessary, if it is desired to continue the Subscription.

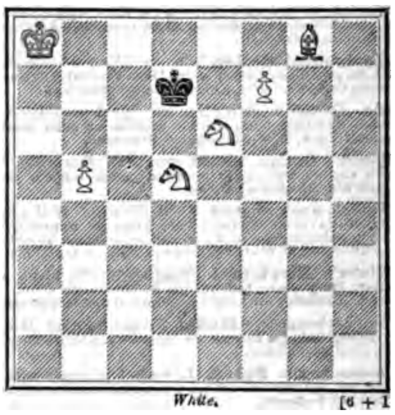
Holloway's Pills purify the blood, remove all obstacles to its free circulation through the lungs, relieve the overgorged air tubes, and render respiration free, without reducing the strength, irritating the nerves, or depressing the spirits; such are the ready means of saving suffering when anyone is afflicted with colds, coughs, bronchitis, and other chest complaints.

CHESS.

ALL communications for this department must be addressed "CHESS EDITOR, ENGLISH MECHANIC, 332, Strand."

PROBLEM MCVIII.

Black.



White to play and mate in two moves.

SOLUTION TO 1,106.

White.	*Black*
1. Q-R 4.	1. Anything.
2. Mates.	

(Five variations.)

NOTICES TO CORRESPONDENTS.

CORRECT solutions to 1,106 by A. Wheeler, A Dean, E. W. Barnett, Sorrel, J. Palmer, Link, R. G. Briscoe, H. Fellows, and G. W. Middleton; to 1,105 by G. W. Middleton (2), H. Fellows (2), R. G. Briscoe (3), S. Bazley, W. Jay (3), E. W. Barnett (2), Link (2), J. Palmer (2), and Sorrel; to 1,104 by A. Dean and Link (2); to 1,103 by Link and G. W. Middleton.

LINK.—You sent your letter to the wrong address; see notice at the top of this column. We have rectified omission.

W. JAY AND G. W. MIDDLETON.—Pleased to hear that you like the work. In Problem 15, there should be a W R at K B sq, and in problem 13, the W B at K R 2 should be at K Kt 3.

J. G. HANKIN, S. BAZLEY, AND J. KISTRUCK.—You have overlooked in 1,106 that after 1. Kt takes Kt (ch), B takes Kt checking.

F. J. HOWITT.—Thanks for problem. We shall be pleased to avail ourselves of it as soon as this Tourney is concluded.

A PROBLEM and Solution Tourney, confined to two-movers, is announced to commence in the Wilkes-Barre *Record*, valuable prizes being offered. The Solution Tourney will commence August 16th. Composers may send one to three problems up to October 1. Address Fred. Wendel, S. Canal-street, Wilkes-Barre, Pa. U.S. America.

A NEW book of problems is announced, which will be anticipated with an exceptional amount of interest. Mr. G. J. Slater, who has probably won more prizes in chess Tourneys than any living composer, intends to publish about five hundred of his problems. A special feature will be the offering of prizes for the discovery of second solutions.

THE British Chess Club Handicap Tourney has concluded, Messrs. Blackburne and Gunsberg dividing the first and second prizes with a score of eleven won games each. Messrs. Bird, Wainwright, and the late Dr. Zukertort share the third, fourth, and fifth prizes with ten games each; while Messrs. Gattie and Pollock divide the sixth prize with 8½ games each.

THE Zukertort Chess Club has been opened at 217, City-road, London, with a view to popularise the game of chess among the working classes. On the opening night, Mr. Bird, who has taken a leading part in the movement, was supported by Mr. Hoffer and other distinguished chessists.

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The address is included as part of the advertisement, and charged for.

Advertisements must reach the office by 1 p.m. on Wednesday to insure insertion in the following Friday's number.

OUR EXCHANGE COLUMN.

The charge for Exchange Notices is 3d. for the first 24 words, and 3d. for every succeeding 8 words.

Good Value Offered (cash or instruments) for all kinds of Scientific Appliances.—CAPLATZI, Science Depot, Chenies-street, near British Museum. Estab. 1862.

Wanted, old Colonial **Postage Stamps** used before 1860, also Collections of Stamps. Good exchange.—E. W. DRURY, 125, Coltman-street, Hull.

Horizontal Boiler, 30in. by 15in., double riveted; with fire tube, dome, safety valve, also Vertical Engine. Wa. Tricycle or Facile.—HOY, Kingsley-street, Sunderland.

54in. Coventry **Bicycle**, in good condition, suit learner. Exchange small drilling machine or other mechanical tools.—CYCLIST, 20, Windmill-street, Gravesend.

7½-centre **Lathe**, planed iron bed, face-plate, rests, treadle, and all underworks complete. Great bargain. Offers.—HARDWICK, Siddals-road, Derby.

Wanted, a pair of good Field Glasses. Will give box of MATHEMATICAL INSTRUMENTS, Electrical Apparatus, Microscope, in mahogany box, and part cash, or exchange anything useful.—HERBERT SUTCLIFFE, Holywell-green, near Halifax.

Winter's **Electrical Machine**, 2ft. plate, ebony Sextant, Ivory Scale, best quality Pedometer, 50 miles. Offers wanted. Exchange Scientific Apparatus.—HUDDY, Liskeard.

Will exchange two **Model Engines and Boilers**, cost £8, and cash, for Tricycle or Safety.—A. RIDER, Thornycroft Hall, Chelford, Cheshire.

Exchange 9in. **Spirit Level**, 2 glasses, with brass plates top and bottom. What offers, mechanical or electrical, to value 4s. 6d.?—Below.

Exchange, 10in. rosewood **Spirit Level**, 1 glass, with brass plates; 1 by 4in. Pocket do. What offers, mechanical or electrical, to value 5s. 6d.?—Below.

Exchange, treadle **Sewing Machine**, in good condition, by Wright and Man, suitable for boot and shoemaker. Offers to value £6 10s.—Below.

Send **Stamped Envelope** for particulars of machine to C. H. HARCOURT, Ford's Water, Zeals, Wilts.

Exchange, 3in. **Electric Bell**, new; also 2-draw Telescope, for Geneva Watch or pair Leg Vice value £10s.—J. HARCOURT, Ford's Water, Zeals, Wilts.

Exchange, full-sized **Violin and Bow**, splendid tone, for gent's Geneva Silver Watch to value 20s.—JOSEPH HARCOURT, Ford's Water, Zeals, Wilts.

4 new 2½in. **Safety Valves**, with spring balances, and one Excelsior Steam Pump. Exchange Tube Expander or offers.—W. BOSS, Measham, Atherstone.

English Silver **Lever Hunter**. Exchange Electrical Instruments.—F. W., 16, Crescent-road, Plumstead, S.E.

Field Glass, in case, Microscope, Violin, and 3½in. Electric Bell, for lathe tools or parts of Models Engines.—SMITH, 12, Barkerend-road, Bradford, Yorks.

Perambulator Fittings, Wheels, Springs, Bodies, China Handles, Rubbers, Brass Handle Bearers, Hoods, Laces, Straps, Bolts, &c. Exchange Smith's Tools.—LOWE, Orange-street, Nottingham.

New powerful **Microscope**, case, tongues, object-glass. Exchange for 3in. Electric Bell, new, or offers.—JOHN COLLINGE, John-street, off Cross-street, Middleton, near Manchester.

54in. **Bicycle**, wants new tyre; and Telescope, on tripod, all brass. Exchange 3in. or larger Lathe complete.—F. DALTON, Dean, Kimbolton.

Steamer, screw, 4ft. 9in., fast, pair engines, 2 propellers, riveted copper boiler, steam and water guage, perfect, value £10. Exchange English Lever and cash, or Lathe.—R. WEBB, 29, Regent's-row, Queen's-road, Dalston.

Bombardon, by Distin, 4 rotary valves, capital order; euphonium, by Courtois, 4 valves, [illegible] horn, by Butler—lot [illegible] Will exchange for a good [illegible], no rubbish.—C., 37, Tyneham-road, Lavender-hill, London.

Grand pair of coupled high-class model **Beam Engines**, bright and complete, fitted with pumps, governors, throttle valve, made regardless of cost by Lord Scarsdale's engineer, and made for work as well as show. Bargain. Half cash, half exchange.—295, St. Philip's-road, Sheffield.

Bicycle, 54in., ball bearings, hollow forks, splendid machine, all complete, guitar in case, machine head nearly new. Exchange for rear-driving safety.—C. PENNY, North Cadbury, Bath.

Calculating Machine, Boucher's patent calculating circle, electro-plated, same size as silver watch, for vest pocket, for all rapid arithmetical calculations, with book of directions. What offers in books or other useful exchange?—FORREST, jun., Boortree Cottage, Gourock, Greenock.

Half-plate Camera wanted, with accessories. Will exchange good CHEMICAL APPARATUS, large number books, good stamp album.—Write at once to H. OAKSHOTT, Falmount.

Dynamo Machine, lights 20 45-volt lamps, or two Arc Lamps, 2,000c.p. Exchange Electrical, Wires, or offers.—GEORGE TOLMAN, Electrical Engineer, Wolverhampton.

Lathe Wheels speeded for gut and band, heavy ones, cranks complete; 12in. Circular Saw complete. Offers. Approval.—W. SMITH, Bilston-road, Wolverhampton.

53in. **Bicycle**, all bright, cranked handles, brass hubs, direct spokes, Palmer's ball bearings to both wheels, new rubbers, bag, &c. Exchange for gentleman's Gold Albert to value of £4 10s. or offers.—J. GREEN, Barley Groves, Frodsham Bridge, Cheshire.

Gent's Silver Geneva **Watch**, nearly new, cost £2 15s. Canadian Gold Double Albert, fetter link, recently cost 15s. What offers?—9A, New-road, Spalding.

Patent Sewing Machine **Lamp**, cost 12s.; Banjo, six-stringed, nearly new, worth 15s. What offers?—9A, New-road, Spalding.

Model **Horizontal Engine**, ⅝in. bore, parallel guide bars, link motion reversing gear, governors, force pumps, &c., vertical firebox, boiler riveted, water space round firebox, tank, water gauge and taps, fittings, &c. Exchange.—EDWIN, Roebuck Hotel, Stoke, Staffordshire.

Lathe, 2½in. centres, planed iron bed, face-plate, nearly new, 5in. heads and T (headstock damaged). Exchange.—Below.

Valuable **Eccentric Chuck**. Exchange.—7, Belmont-grove, Birkenhead.

Will exchange Moldacot Pocket Lockstitch **Sewing Machine**, almost new, for a modern Book on Electro-plating.—J. LEY, 27, George-street, Hanover-square, W.

Wanted, Lathe Flywheel, 2ft., for strap, also crank. Exchange BICHROMATE BATTERIES or COILS, good condition.—FRED, 3, Melford-road, Buxton-road, Walthamstow.

Gallon **Copper Still**, solid tin worm, pair wrought iron pulley blocks, pair 4-cone pulleys, several steam taps. Wanted 5in. slide-rest.—TIMMS, Towcester.

"**Planetary and Stellar Worlds.**" "Ganot's Natural Philosophy." "Æsop's Fables," "Hygiene for Schools," "Abbot's Latin Prose," "Latin Verse," &c. Offers wanted.—ROBERT SMITH, Eas. Wall, Londonderry.

¼in. Rhumkorff **Spark Coil** in exchange for Coil Winder with contrivance for winding wire even.—WILLIAM TAYLOR, 37, Bishop-street, Dublin.

What offers for a job lot of **Morse Sounders**, Duplex keys, Varley relays, switches, indicator drops, &c.—PERCY HUDDLESTON, High-street, Woolwich.

30c.p. **Dynamo**, 2 lamps, 2 lamp-holders, switch, 12 yards cable, only used a few times. Offers.—ED. FRANCIS, St. Austell.

Grove Cells, ten in case, with lifting arrangement, perfect, cost 100s. Exchange for insulated wires or electric bell, indicator, sundries.—GEORGE TOLMAN, Wolverhampton.

Galvanic Belts.—Pulvermacher's improved Galvanic Belt, cost 50s. Exchange anything useful.—P. MUCKLE, Gimber Cottage, St. John's-green, Colchester.

Powerful 5-cell **Battery**, complete in polished teak case; also large Electro-Magnet. What offers? Resistance Box wanted.—E. H., 25, Percy-road, Starch-green, Shepherd's Bush, W.

Working model **Marine** (screw) **Engine**, drive 5ft. boat, with reversing gear, nearly new, for smaller Engine or offers.—LINCOLN, George-street, Croydon.

Bicycle, 54in., balls and hollow throughout, cradle spring, lace saddle, combination bell, King of Road lamp, good as new. Exchange Drawing Instruments and cash to £5.—POTTER, 90, Bishop's-road, Cambridge Heath, E.

Pair **Mechanical Telephones**, 2 electric back contact pushes, side door push, quantity of "Electrical Reviews," "The Steam Engine," by Evers. Exchange offers as below.

Wanted, Bottone's "Electrical Instrument-Making for Amateurs," small Bench Vice, Tenon Saw, small Drill and Horseshoe Magnet.—FOSTER, 39A, Stannary-street, Kennington, S.E.

THE SIXPENNY SALE COLUMN.

Advertisements are inserted in this column at the rate of 6d. for the first 16 words, and 6d. for every succeeding 8 words.

Fretwork.—Catalogue of every requisite, with 600 illustrations, free for 6 stamps.—HARGER BROS., Settle, Yorks.

New Illustrated Price List of **Screws, Bolts, and Nuts** for Model Work, drawn to actual size, sent on receipt of stamp.—MORRIS COHEN, 132, Kirkgate, Leeds.

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The English Mechanic
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FRIDAY, AUGUST 10, 1888.

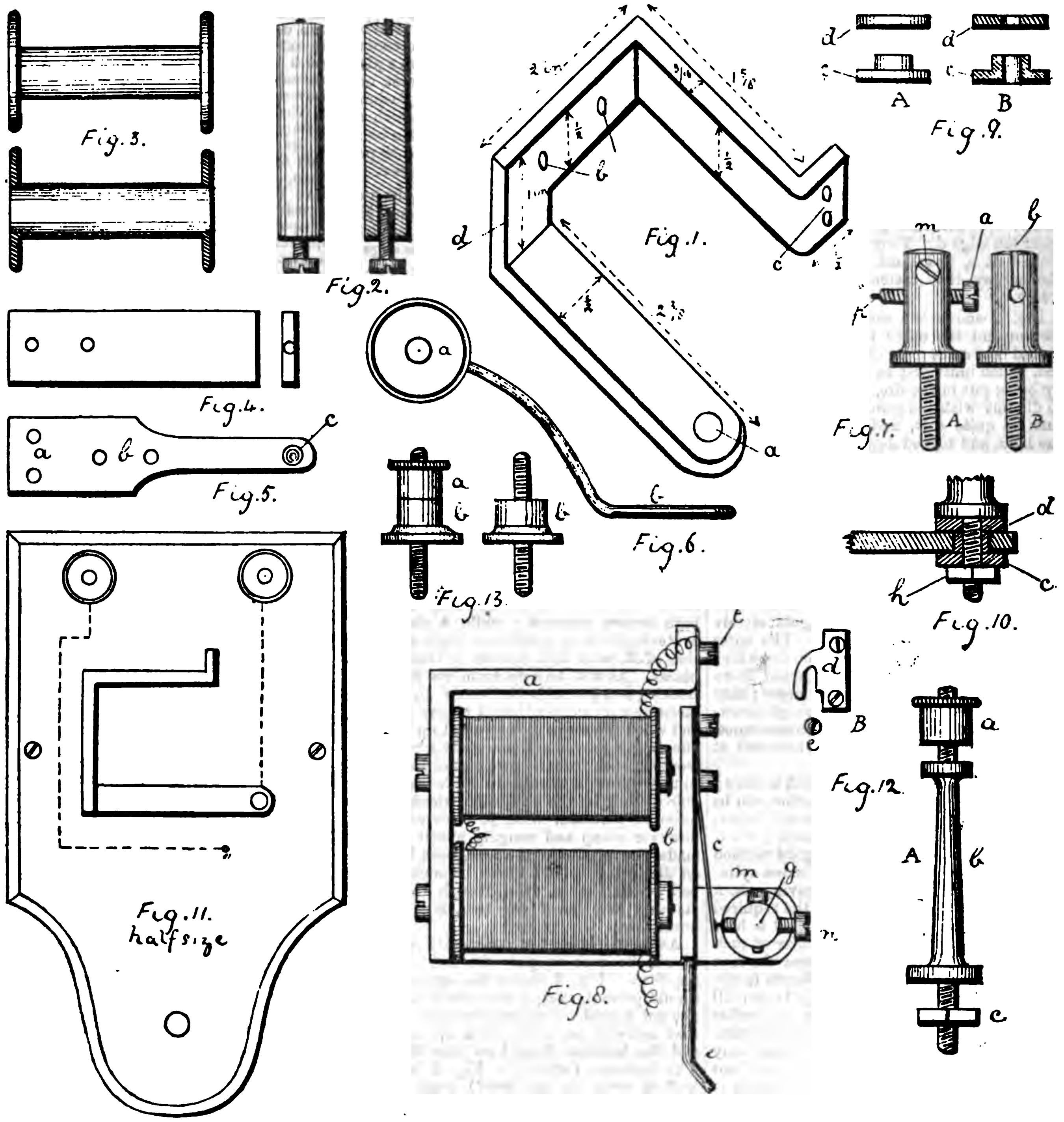
ELECTRIC-BELL CONSTRUCTION.—I.

By F. C. Allsop.

ALTHOUGH, owing to improved methods of production and a brisk competition, electric bells and all their necessary appliances can be bought so cheap nowadays that it is, perhaps, hardly worth while making one's own; yet there are hundreds of people who, if merely from the satisfaction it affords them, prefer to, and do, manufacture their own apparatus. They have, perhaps, first purchased some bell set, and finding the ease with which it could be fixed, they have been induced to fit up a more extensive system, until at last the thought has occurred that they should construct their own apparatus. And really, the construction of electric bells, indicators, &c., presents but little difficulty; neither does it necessitate the employment of any heavy or expensive machinery, and the amateur with plenty of time at his disposal, a determination to do his work thoroughly, and a fair knowledge of his tools, can readily, and at no great expense, construct apparatus that will serve his purpose quite as well as any that he might have purchased, though it may not have the degree of show or finish possessed by its professionally-made brethren, which, after all, adds nothing to their efficiency. A few woodworking tools, a vice, a small lathe (about 3in. centres), with a set of drills and tools, are all that is required, and should the lathe be without a slide-rest it does not matter, as there will be so little occasion to use it that it can well be dispensed with; but if the amateur is the happy possessor of a three-jaw self-centring American chuck (preferably one that is geared to work with a key at the side) he will save an immense amount of time and trouble, as this chuck is really the chuck, *par excellence*, for the manufacturing electrician. The most usual form of the instruments will be shown; but there are various ways of fixing certain parts, and many more will, no doubt, occur to the amateur, who will, of course, select such methods as are best suited to his means. The drawings being either full or half-size, will greatly facilitate the description, and this is, perhaps, the best method of describing the construction of any apparatus, as it allows one to see at a glance what is required, and which would otherwise necessitate a column or so of explanation. In cases where the figures are shown in perspective, the dimensions will be marked. The different uses and methods of connecting up the various apparatus were fully described in "Practical Electric Bell Fitting," and thus will not, of course, be treated of here; so for any information on that subject the reader is referred to those articles.

Bells.

These are generally nominated by the diameter of the gongs, and are made as a rule from 2½in. to 12in., advancing in sizes by ½in. up to about a 4in., and by inches from the 4in. gong to the 12in. The drawings



and method of constructing a 2½in. bell will be given, and also the size of cores, bobbins, and amount of wire for two or three of the larger sizes; the other parts of the bell must then be increased in proportion.

As the trembling or vibrating bell is the one more frequently employed, we will commence with it, and the accompanying drawing represent the different parts in detail of a 2½in. trembling bell, a size that is most generally in demand.

Fig. 1 is a perspective view of the iron frame, to which is screwed the magnet cores, spring, and contact post, and which, in fact, forms the base of the movement. A pattern must be made for this in wood, and a casting obtained from it in iron, great care being taken to have it well annealed so as to be free from residual magnetism. The casting must then be smoothed over with a file, and if a more finished appearance is desired, the top edge may be filed bright, and subsequently polished and lacquered. A ¼in. hole, *a*, is next drilled in the iron frame, the centre of the hole being 2in. from the edge *d*, and a ⅛in. hole is drilled at each of the points *b*, which are ⅜ and 1¼ respectively from the edge *d*. Two small holes are also drilled at *c*, and must be tapped to receive the screws that fasten the spring to the frame.

Fig. 2 shows the iron cores, the one in section and the other in elevation. These should be made out of a piece of ⅜ iron rod, which must first be thoroughly annealed by being put in the fire, and the fire allowed to die out with the iron still in. They will then be quite soft, and must be placed in the lathe and turned down to the right size, being drilled and tapped at one end to receive the screws by which they are fastened to the frame. The other end is slightly rounded off, and has a small hole drilled in it, into which is driven a brass plug, that prevents the armature sticking to the poles; which would be the case if the iron was not as soft as it should be. If it is not desired to turn the cores, a piece of iron can be obtained the right diameter and the lengths merely cut off and drilled and tapped. The cores can also be riveted into the frame, for which purpose the ends are slightly turned down and the holes in the frame made larger; they can then be easily riveted in; though screwing has the advantage as regards appearance, besides allowing the cores to be removed at any time.

The bobbins, Fig. 3, one of which is shown in section and the other in elevation, can be obtained for a few pence, so that it is perhaps not worth while making them; but if this is desired, the following is a good method of procedure:—First turn two wooden cylinders out of a piece of box, leaving them slightly larger than the size of the required bobbins. Now with a drill, drill a hole through the centre of each cylinder of such a size that it will just slide over the iron cores. Then place a piece of beech in the lathe, and turn it down (slightly taper) till the wooden cylinder will slide on rather hard, so as to give it sufficient grip for turning. With a sharp chisel the cylinder may now be trued up to size, and the inside cut away, leaving the flanges, and the bobbin is complete.

Fig. 4 shows the armature (the one a side and the other an end elevation), which should be constructed out of a piece of bar iron, care being taken to see, as was the case with the cores, that it is left quite soft. If it can be procured, it will be found best to use that kind of iron known as "French iron," as it is peculiarly suited for armatures, being finished on both sides. Thus, it needs only to be cut off the right length, drilled, and it is ready for fixing. Two holes must be drilled in the side of the armature, being tapped to receive the screws which serve to fasten it to the spring. A small hole is also drilled in the lower end of the armature, into which one end of the hammer is afterwards screwed.

The spring, of which Fig. 5 is a side view, next demands our attention, and should preferably be made in steel, though it is frequently made in bass, and as this is the easier metal to work, it will perhaps be our best method to use it. It should be cut out of thin sheet brass, taking care to get the greatest length in the direction of the grain of the metal, and then slightly hammered to impart to it the necessary elasticity. Four holes must then be drilled in it, two at *a*, through which pass the screws that fasten it to the frame, and two at *b*, through which the screws by means of which it is attached to the armature pass. The platinum contact *c* can be fixed either by soldering on a piece of sheet platinum at the required spot, or a hole may be drilled and a piece of platinum wire passed through, the ends of which are afterwards riveted over, the one side being hammered more than the other so as to present a large surface to the contact screw.

Fig. 6 shows the hammer complete, the head (*a*) of which consists of a brass disc about ⅝in. diam. and 3-16 thick, with the edges slightly rounded off. A hole is drilled in the edge to receive the handle *b*, made out of a piece of steel wire bent to the shape shown, both ends of which are threaded, the one to screw into the hammer head, and the other into the lower end of the armature. The hammer heads of bells take a variety of forms, a brass ball being very frequently used; but perhaps the cheapest form is made by cutting off for this size bell, say, ⅝in. of ¼ brass rod, and drilling a hole half-way along, by means of which it is fastened to the handle.

The contact-post (Fig. 7) A and B should be turned up to the form shown out of a piece of ½ brass rod. Two holes are next drilled for the screws, the one for the contact-screw *a* being at right angles to that for the tightening-screw *m*. With a metal saw the contact-post is then sawn at *b* right down to, and parallel with, the adjusting-screw *a*. B shows the contact-post finished, but with both screws removed; while A shows the contact-post in a position at right angles to that of B, with both screws in their proper places. As will be seen from the figure, by slacking out the adjusting screw *m*, the contact-screw *a* can be adjusted to any position, and when the screw *m* is screwed up again, it effectually prevents the contact-screw from working back from its proper position. The contact-screw *a* should be of brass with a hole drilled in the end, into which a small piece of platinum wire, *p*, is driven; and however cheap and roughly a bell is being made, the platinum contacts, both here and on the spring, should never be omitted, as a bell without these, even though the workmanship may be of the best, is altogether unreliable.

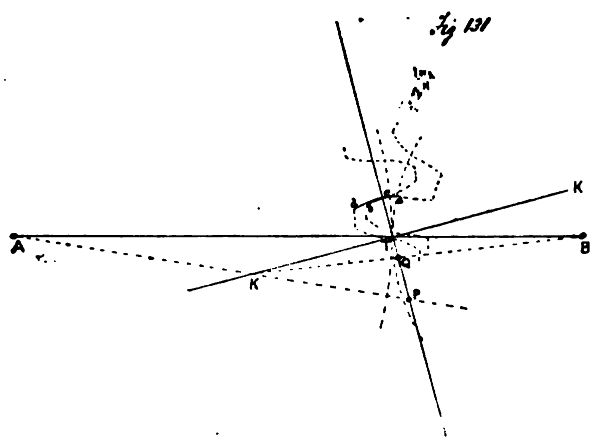
As the movement is now nearly complete, it will be best to put the finished parts together. Fig. 8 shows the appearance it should present, except that the bobbins are not yet wound. The iron cores (Fig. 2) are first screwed on to the back of the frame and the bobbins slipped on over the cores. The hammer (which in Fig. 8 is shown broken away at the bend) must then be screwed into the end of the armature, and the armature screwed on to the spring, which in turn is screwed on to the frame *a* by means of the screws *t*. Before fixing the contact post, two washers *d* and *c*, Fig. 9, must be turned out of a piece of ebonite rod or boxwood, and these serve to insulate the post from the frame. A shows the washers in elevation, and B in section. The method of fixing the contact post is shown in detail in Fig. 10, which is section of the iron frame and washers, the top part of the contact post being broken away, and the rest shown in elevation. The washer *d* is first slipped over the threaded part of the contact post, which is then passed through the hole *a* (Fig. 1) in the frame. The washer *c* is next slipped over the boss on the top, passing into the frame which it insulates from the post. A nut, *h*, is then run up, and the whole screwed firmly together.

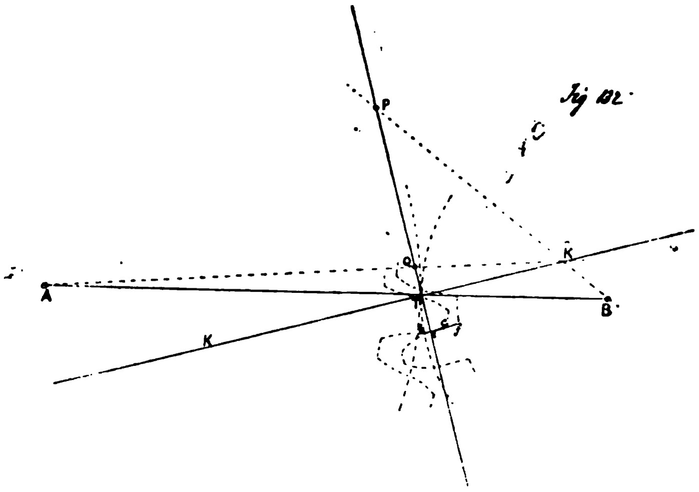
(*To be continued.*)

PROF. S. P. THOMPSON'S METHOD OF DEPOSITING THE HEAVY METALS.

THAT what are known to metallurgists as the heavy metals might be of considerable use in the arts, if a cheap method of depositing them by the electrolytic process could be devised, has been well known to students, and it is possible that the improvements recently patented by Prof. S. P. Thompson may be of commercial importance. His improvements relate mainly to the electro-deposition of the heavy metals such as platinum, iridium, palladium, ruthenium, and the like, and of their alloys, and have for their object the obtaining of the deposits in a bright metallic form, also of cheapening the preparation of the solution for producing such deposits. The metal or alloy is first brought to the state of chloride by known chemical processes. The chloride, after having been dried at a moderate temperature, preferably that of steam, is dissolved in distilled water or other soft water of adequate purity. To this solution is added a solution of a certain medium, also previously similarly dissolved, the weight of the medium taken being from 10 to 40 or 50 times as great as that of the metallic chloride. As mediums are employed phosphate of soda, or phosphate of soda mixed with borate of soda or carbonate of soda, or with tungstate of soda, or with any of these materials, or the corresponding salt of ammonia mixed with the soda salt. The mixed solutions of metallic salt and medium are then heated together, preferably to the boiling point; and to the liquor so produced is added one of the following brightening substances—namely, salammoniac, bromide of soda, carbonate of soda, bicarbonate of soda, carbonate of ammonia, hyposulphite of soda, hypochlorite of soda, chlorate of soda, or a mixture of two or more of them, for example, a mixture of salammoniac and carbonate of soda. Preferably such brightening substances are also similarly dissolved in a little water previously to being added to the solution. The mixture having then been preferably once more heated, it must be neutralised. If it is found alkaline, a few drops of hydrochloric acid or a solution of chlorine in water or other suitable substance are cautiously added. If it is found acid, carbonate or bicarbonate of soda is added.

The bath so prepared should be warmed to a temperature of from 60° to 90° C. (140° to 194° Fahr.), and is used in the ordinary well-known way, with a fairly strong electric current. The anode may be of carbon, or of platinum; but in every case it will be found requisite in the daily use of the bath to add (preferably hot) further quantities of strong neutral metallic solution as the metal is withdrawn by deposition from the bath, and also from day to day to add small quantities of borate of soda or other medium, and also of carbonate of soda or of hydrochloric acid or chlorine water to correct the acidity or alkalinity of the bath. As a typical example of the improved process, the following quantities may be taken for the deposition of bright metallic platinum—viz., chloride of platinum 2oz., borate of soda 1lb., carbonate of soda 1lb., salammoniac 2oz., the solution being finally made up with water to 1 gallon. Owing to the costly nature of the separated chlorides of the single metals, such as chloride of iridium and chloride of platinum, the patentee prefers to employ a mixed metallic chloride containing platinum with a certain admixture of iridium, ruthenium, or the like, just as it occurs in or is derived from the natural ore. Grains of the natural ore are treated with hot aqua regia to obtain the chlorides in solution, these being subsequently boiled down to expel nitric acid. Or the mixed solution may be prepared wholly or in part by





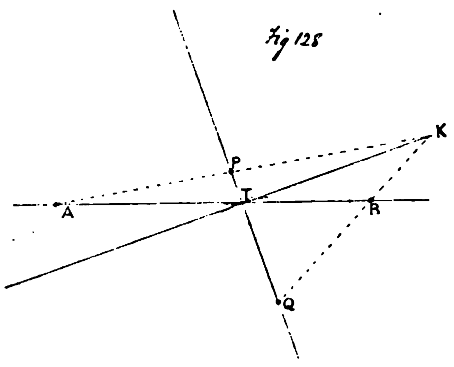
electrolysis, the grains being placed on a plate of carbon or other suitable anode, and subjected in a chloride bath to the action of a current which slowly dissolves out the more soluble part of the ore. The residue may be afterwards further digested in aqua regia. Prof. Thompson is aware that phosphate of soda and phosphate of ammonia, and also chloride of sodium, in conjunction with chloride of platinum, have already been suggested for use in baths for the electro-deposition of the heavy metals, and he therefore lays no claim to the use of such substances in themselves, but only their use in combination with the other substances and in the manner described.

GEARING.—XX.

The Odontograph.

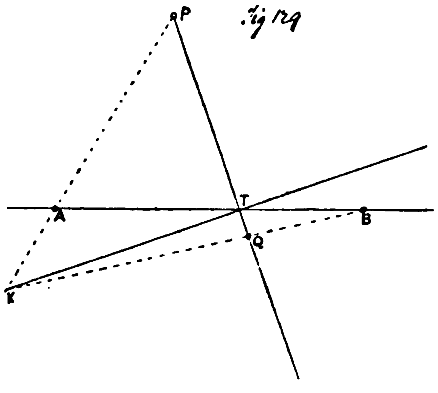
To understand the principles on which the odontograph scale is constructed, it is necessary to revert to the diagrams on p. 129 of Vol. XLVI. We saw that certain points C and D, Figs. 4 and 6—the centres of tooth arcs—might be considered as the terminations of a link C D dividing the line of centres A B of two wheels A and B. These points C and D are, in Willis's odontograph scale, taken as the centres for the curved tooth faces and flanks of the system, a constant angle being given to the link or line connecting those centres.

Thus, in Fig. 128, A and B are the respective centres of motion for a wheel A and pinion B, whose line of centres is divided in T; A T, B T being therefore their respective radii. Draw P T Q making any angle with A B, raise a perpendicular T K upon it; upon P T Q assume a centre P for the arc of the tooth belonging to wheel A. To find the centre for the arc of the pinion tooth, join A P, produce the line to K, join K B, and produce to Q, Q then will be the required centre for the arc of the pinion tooth.



By comparing this diagram with that on p. 129 of Vol. XLVI., we see that we have constructions precisely similar, P and Q in this Fig. 128 being the terminations of an imaginary link dividing the line of centres A B in T.

It is obvious that the angle A T P can be varied without affecting the principle, but in practice that angle is restricted within moderate limits. For instance, supposing, as an extreme case, it were a right angle, then there could be no tooth forms struck, because A B would be tangential to the arcs struck. If, on the other hand, the angle A T P were very acute, the tooth flanks would slope so much that their line of action would be too oblique. Prof. Willis adopted the angle of 75° as the most suitable mean, and that is the angle given to the odontograph, which is equivalent to saying that all the centres of tooth arcs struck with that instrument *are located on a line making an angle of 75° with the line of centres.*



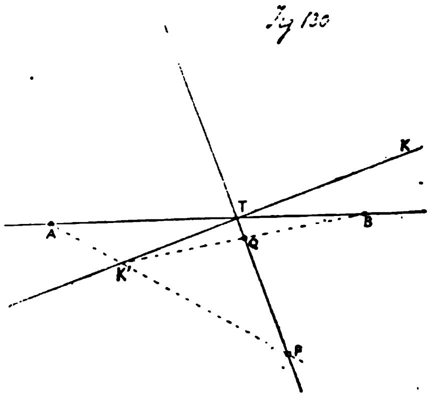
It will be observed at once that the form of tooth which we obtain is one having a single curve only, very much resembling the involute. If we want to obtain double-curve teeth, certain modifications must be adopted. In Fig. 128 the precise point of contact of the curves is *upon* the line of centres. For double-curve teeth we must obtain our points of absolute precision shortly *before*, and shortly *after* the line of centres.

It is clear, referring to our link diagram, that it is not even necessary that the ends of the link shall be on opposite sides of the point T. They may both be upon one and the same side of T, without affecting the principle of the system.

Comparing Figs. 128, 129, 130, we have three possible positions of centres shown. Fig. 128 has been already explained; Fig. 129 illustrates the effect of variations in positions of centres, still on opposite sides of T; while Fig. 130 shows both centres placed to one side of T. In Fig. 129 the point P being assumed as the centre of curves for wheel A, and A P T being *less* than a right angle, the point K becomes the instantaneous centre, and this being connected with B gives us Q as the centre of arc for wheel B.

But now in Fig. 130 assume the centre of arc for wheel A at P; this produced to A would by its intersection K′ with T K produced, give us Q as the centre of arc for wheel B. Then the arc struck from P would be *concave*, and that from Q *convex*. Therefore, by means of this construction we can not only obtain single curve teeth, as already explained, but double curve teeth also.

If reference be again made to Fig. 4 in Vol. XLVI. p. 129, it will be seen, as noted also in the text, that though the velocity ratios of the arms and links are only strictly constant for one position, yet that they are very nearly so for other positions a little to right and left of that. As far as practical considerations go, they are accurate, and though circle arcs struck from single centres, as in Figs. 129, 130, can only be absolutely correct for a single point, they will also be practically correct for a little distance to each side of that point. In wheel teeth struck by the odontograph scale two such positions are found—one for the concave, one for the convex, face, situated within and without the pitch circle, corresponding respectively with the middle of the arc of approach and the arc of recess.



In Figs. 131, 132 are shown the connection between the constructions in Fig. 129, 130, and the application of the same to the odontograph scale. Both sets of figures being similarly lettered, the identity of the construction is apparent. In the figures A and B are the centres of the wheel and pinion respectively, whose line of centres is divided in T. P T Q is the line upon which the centres of the tooth arcs are taken, making an angle of 75° with the line of centres. K K is the perpendicular to this line at T, prolonged.

The centres P Q are found as follows:—In Fig. 131 the centre of the wheel B is joined with that point K which lies on the side opposite to P Q T, and thus Q becomes the centre of the arc *a b* forming the tooth-face of wheel B. For the tooth-face of wheel A, in Fig. 132, join the centre A with the K on the side opposite to P Q T; Q then is the centre of the arc *b c* forming the tooth-face. For the tooth-flanks of A join A (Fig. 131) with the K, which lies between it and P Q T, and produce the line to P; P is then the centre for the flank *c d*. For the flank of B in Fig. 132, join B to the K between it and P Q T, produce to P, and P will be the centre of the flank *e f*.

The distances T *c* and T *e* are in each case always struck at a definite distance beyond T, being equal to *half the pitch*, as illustrated in the figures, in order to bring the points of absolutely correct action during approach and recess at equal distances from the pitch-point T.

Since the angle A T P is constant, and also the distances T K, and T *c* and T *e* are comm to all the wheels of the same pith, it follo that they will all fulfil the primary conditions required, and therefore work together smoothly.

The construction shown in Figs. 131, 132 might be repeated independently for each wheel or wheels required. But the odontograph saves the trouble by supplying in a direct manner the line P Q T in the figures, and also centres for a large number of wheels. This I will illustrate in the next article. **J. H.**

THE PROGRESS OF STEAMSHIPS.

IF finality has not yet been written in connection with the increasing speed of steamships, it is evident that the limit has been nearly reached. It is not so many years ago as to be beyond reckoning when Brunel had great difficulty in persuading capitalists to let him build large steamships to cross the Atlantic, and now, added to the race between the railway companies, we have a struggle for supremacy amongst the Transatlantic steamships which Brunel, when he built the *Great Eastern*, could scarcely have dreamt of. Lately there has been a tendency to secure high speed for passenger vessels regardless of cost, and the latest specimen of marine express machinery is the Inman and International Co.'s liner the *City of New York*, which is the largest passenger steamer afloat, and is in many respects a most remarkable achievement of the naval achitect. When the *Etruria* and the *Umbria* of the Cunard line were built, it was thought that at last the limit had been reached, for they possessed an amount of engine-power compared to tonnage altogether beyond the early ideas of builders of steamships who are still living. Now it seems that two indicated horse-power per ton of displacement is not considered too much, and the performances of the *City of New York* and her sister vessel, the *City of Paris*, will be watched with much interest by naval architects and marine engineers. Those vessels must cost about £300,000 each, and their engines will probably indicate as much as 20,000 horse-power; but such is the rivalry between the Atlantic passenger companies that it is not at all unlikely even the *City of New York* will be eclipsed in a few years, for it is stated that Messrs. Harland and Wolff, of Belfast, have in hand for the White Star Line a vessel which it is hoped will be more rapid and more magnificent. The *City of New York* is the largest passenger carrying vessel now afloat. She is 2,500 tons larger than the *Serria*, 2,723 tons larger than the *Etruria*, and 2,340 larger than the *City of Rome*. She is 565ft. long over all, 63¼ft. broad, 42ft. deep—moulded—and 10,500 gross tons, with accommodation for fully 2,000 passengers. She is fitted with five decks, and the space between four of them is 8ft., but between the upper and main decks is 9ft. 4in., while the depth of the hold is 39½ft. To give an adequate idea of the height of the *City of New York*, it may be mentioned that from the keel to the captain's bridge is 76ft. She has twin screw propellers, and each set of engines will indicate 9,500 horse-power. In order to avert rolling, the ship has been fitted with a steadying tank chamber containing water, placed athwartships, and intended to arrest or check rolling by the transfer of the water from one side of the ship to the other, at such velocities as will modify her own periodic or rolling time. The hull of the vessel is divided by transverse bulkheads into fifteen water-tight compartments, including three for boilers and two for machinery, the latter being separated by a longitudinal bulkhead. The doors in the bulkheads are on the upper deck far above the load water line, it being determined not to trust to the doors being promptly shut in cases of danger. None of the compartments exceed 35ft. long, and the quantity of water they hold to load water line is 1,250 tons, or to upper deck 2,250 tons. Even were two or three filled the flotation of the vessel would not be placed in danger, and her buoyancy could easily be trimmed. As an additional precaution the vessel has two bottoms, the space between them being 4ft. They serve a double purpose, for not only will the existence of an inner bottom insure that no part of the ship will be flooded by a fracture of the external bottom, but the space can be utilised for carrying water ballast to the extent of 1,600 tons for adding to the stability or altering the trim of the ship. The machinery consists of two sets of engines of the three-crank triple-expansion type, having piston valves throughout, the diameter of the low-pressure cylinders being 113in. Each set of the engines is capable of exerting sufficient power to propel the vessel at four-fifths of her maximum speed, so that should one set break down no serious delay will take place, for the vessel will go at a speed, say, of 16 knots instead of 19 knots per hour. The cylinders and their covers are cast-iron, but the pistons are of cast-steel of the dished type. The crankshafts are built of steel; the thrust, tunnel, and propeller shafts are also of steel. The crankshaft is 20¼in. in diameter at the journal, and 21in. at the pin; the tunnel shafting is 19¼in., and the propeller shafting 20¼in. The piston-rods and all the principal moving parts are of ingot steel. The piston-rods have tail-rods, and are attached to the pistons by flanged connections. The high, intermediate, and low-pressure cylinders are 45in., 71in., and 113in. in diameter respectively, the stroke being 60in. All the valves are piston valves, being one on the high, two on the intermediate, and four on the low-pressure cylinders. The adoption of the four sets of piston valves for the low-pressure cylinder is unique, and is necessitated by the large port area in this cylinder, and to avoid the strains due to the great overhang which would be caused by the adoption of two sets only. The valve-gear is of the ordinary eccentric type, the eccentric straps being of cast steel lined with white metal.

PRACTICAL APPLICATIONS OF ELECTRIC WELDING.*

By O. K. STEWART.

THE history of electric welding extends over a much longer period of time than is generally supposed. Some eleven years ago, Prof. Elihu Thomson, who then held the chair of Chemistry and Mechanics at the Philadelphia Central High School, was delivering a course of lectures before the Franklin Institute of that city, and among other experiments by which he intended to prove the substantially identical nature of electrical energy under any and all circumstances, he reversed an ordinary Ruhmkorf induction coil, showing thereby the difference of potential between the current in the primary and that in the secondary of the coil. In performing this experiment he brought the terminals of the coarse secondary winding of the coil into contact, and was surprised to notice that a high degree of temperature was reached instantaneously at the point of contact—in fact, such a high degree of heat that the ends were stuck quite firmly together, the copper wire being actually melted, so that it required considerable force to separate them. Instantly the thought flashed through his brain—electric welding. Prof. Thomson was, however, very busily engaged in teaching and lecturing, and in developing the Thomson-Houston system of electric lighting for the next five or six years, and it was not until, in the regular course of manufacturing electric-lighting apparatus, it became an imperative necessity to discover some means of having more perfect joint in copper wire than could then be obtained, that his mind reverted again to the old experiment at the Franklin Institute, and electric welding became an assured art.

I should like further to call your attention to the fact that the discovery was made several years prior to the building of a welding machine. Several years ago (I do not remember the exact date) the necessity for welding the ends of copper wires became so imperative that Prof. Thomson designed and built a small machine with which to weld fine wires. The experiment with this apparatus were so very successful that the inventor decided to build larger and better apparatus and experiment further with a view to welding, if possible, much larger pieces of metal. These experiments were also successful, and the invention has been much further developed in the past year or two than the general public can have any possible idea of.

The theory underlying or the principle involved in the Thomson process of electric welding is very simple, as indeed is most of the apparatus also. The Thomson process of electric welding consists simply in forcing through the pieces of metal to be welded currents of such large volume that these pieces can carry them without heating. Now, when the pieces are placed in abutment, the point of greatest resistance, as you all know, is where they contact with each other, and it is of course at this point that the heat is first generated. The instant heat is generated at the point of contact, the resistance at that place enormously increases, and a consequent more rapid development of heat is the immediate result. The metals are consequently raised to a high welding temperature in a very remarkably short space of time, and upon a slight pressure being applied to force the pieces together, a perfect welding is effected.

The field that is open for the process of electric welding is surprisingly vast, and of course no one can tell where it will lead to. I think the most important reason why electric welding is taking its place so rapidly—no, I will not say most important, but one of the most important reasons why electric welding is taking an important place so rapidly—is that the heat generated by the current is the only absolutely pure heat known in the world. The blacksmith, when welding with either a gas furnace or a coal fire, is constantly running the risk not only of burning his metal, but of introducing into it foreign matter in the form of gases which are very deleterious to the substances of either iron or steel, which are the principal metals worked by blacksmiths.

Now, the heat generated by the electric current is absolutely free from all foreign and harmful substances, and it is this fact, I think, which very largely accounts for the rapid advance of electric welding, so far as practical work is concerned. Of course, this is not the only reason. One very important reason is the fact that the heat effected by the current is under absolutely perfect control. Now, I do not mean to say that this regulation is nearly perfect, or that it is very perfect; but I state that it is absolutely perfect for the reason that it can be made entirely and perfectly automatic. The heat can be begun, and a stop put on the apparatus which will control the heat perfectly.

Then, again, welding by the Thomson process is a much neater and quicker operation than welding by the ordinary method of forge or furnace. I might also say in this connection that no skilled labour is necessary to operate an electric welding apparatus. I have in my mind now one young man who came to us not knowing anything of the conditions under which different metals should be welded, and who in a very short time has become so expert in handling these machines that he can now, on the first trial, make perfect welds in any of the ordinary metals and in almost all varieties of steel, including, although I say it with some reservation, even Mushet steel and manganese steel.

As I have already stated, the field for electric welding is so very broad that I have been really much embarrassed in endeavouring to present the most interesting portions of it to you this evening. There are hundreds of applications of the process, and, under the circumstances, I do not think I can do better than simply cite one or two instances or examples of very small work, and then some of larger work. We are not limited, of course, in our work by the size of the pieces to be welded. We can weld the finest wires and the heaviest pieces. As an example of quite small, though not the smallest, work, I might mention the welding of gold rings. We have succeeded in welding gold rings. I want to call your attention to the fact—that I say we *have* succeeded. It is no longer a matter of experiment, but the welding of gold rings by our process is an assured success. Now, what does this mean? It means, first, that we can make a better joint than is now made, doing away entirely with soldering, and in its place making a continuous gold ring; secondly, it means that the work is accomplished in about one-fifth of the time that it now takes to make a decent joint; and it means, lastly, that soldering material is saved, that an enormous wasting of heat is done away with, and that the dangers of burning gas are entirely obviated.

As an example of somewhat larger work, I might mention the welding of axes. There is, not very far from Boston, a manufacturing establishment which turns out about three thousand axes a day. Their axe is made of a body of ordinary wrought iron, to which is welded an edge or face of fine tool steel, tempered and toughened. Their pieces of metal, before welding, have to be prepared somewhat in this manner. That is, a groove is cut in the body of the axe while a taper is cut on the face or blade, the latter being set into the former and the pieces welded in this position.

Now, in electric welding we do away entirely with this preparation, and I am very glad to say that without very much experimenting we have been able to entirely convert the engineer of this company to electric welding. He is now a firm believer that electric welding is the thing as far as the axe business is concerned.

As an example of much larger work, I might mention the welding of pedestals and locomotive frames. This is an entirely different class of work. The pieces have to be carefully prepared, a raised portion being left on the base or edge of the frame, and a taper groove being cut in the pedestal so that it may fit down over the raised portion referred to.

Some months ago I had the pleasure of being in

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* By O. K. STEWART, an address recently delivered before the Boston Electric Club.

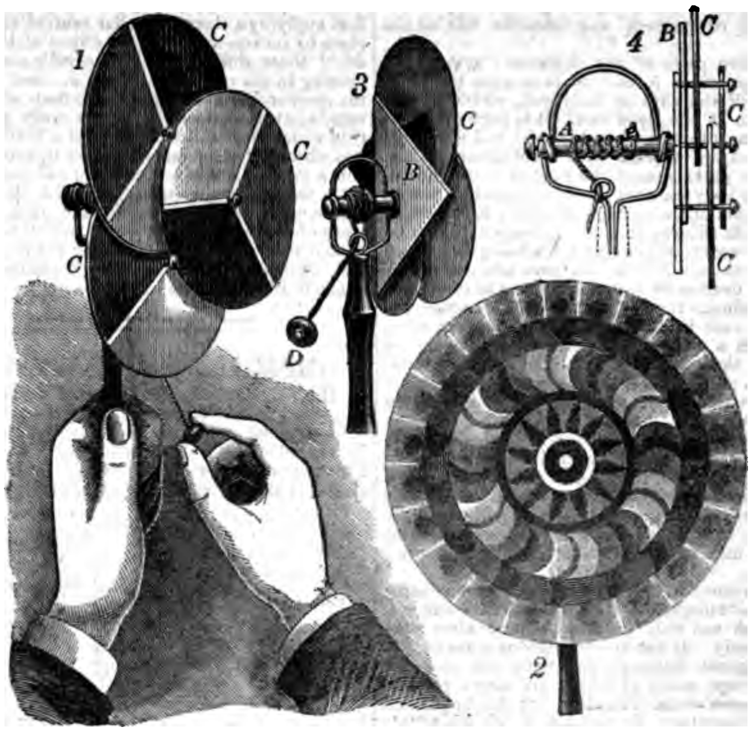
Philadelphia, and while there of walking through the Baldwin Locomotive Works. This establishment is turning out fourteen locomotives a week. Now, what does this mean for electric welding? In the first place, on these engines there are some five or six copper rings, the wire composing which is of small diameter. The joints in these rings are at present made with a blowpipe flame, and it takes an expert some four or five minutes to make a single one. We can make them in as many seconds. There are also on each one of these locomotives at least one hundred and fifty joints in iron, from a half inch area of section to several inches area. Now, it takes anywhere from four to fifteen minutes to make these joints by the ordinary process, and welding, you must remember, has been reduced to a very economical and accurate art in this establishment; but nevertheless we can do the work in at least one-fifth of the time which they now occupy. There are on each one of these locomotives four frames, each frame having on it at least two—sometimes three, four, and five pedestals. We will suppose that the average is three pedestals per frame. That makes twelve pedestals to the locomotive. To prepare the ends of the pedestals and the taper on the base of the frame takes some forty minutes. They have to be heated and hammered into shape while hot. After they are prepared in this manner (blackboard illustrations), they have to be reheated to a welding temperature, placed under a steam hammer and welded, this last operation requiring some thirty or forty minutes. You can easily see what this means. We allow twelve joints to each locomotive, and this makes one hundred and sixty-eight pedestal welds a week—one hundred and sixty-eight welds, understand me, which require at least one hour's time each.

In talking the matter over with Mr. Converse, who is the general manager of the company, I think we came to the conclusion that we could "beat this all hollow," the only question in the mind of Mr. Converse being whether the weld would be as perfect as at present. You will see that we would do away entirely with the preparation of these pieces, making a butt weld of the pedestal to the bit or expansion on the base. There are, of course, a large number of other applications, but I think that these three should be sufficient to indicate at least what the possibilities of electric welding are. There is one thing that I should like to mention finally—that we are able to make very durable, strong joints between metals of different kinds. For instance, these specimens which I hold in my hand consist of brass and copper welded together, and then twisted around twice. The joint held through this twisting, showing the strength. You will see that it is not even cracked.

What do we expect in the future for electric welding? We expect to be able to weld boiler plates. We do not say that we are able to do it now, but we have been thinking over the matter and experimenting, and we believe that this welding of boiler plates together is a thing of the not distant future. The same may be said of any metal plates. We expect also to be able to weld tubes in the length. I do not wish to be misunderstood. I do not say that we are now able to do this, but I do say that we believe it can be done. We are at present working upon apparatus of a light, movable character, which, without mechanical power, we believe will be powerful enough to weld line wire, such as telephone, telegraph, and electric light and power wires on the line. The apparatus can be put into a waggon and carried to any desirable point. The current obtained from storage batteries forms a portion of the apparatus, and the welding is effected on the line. We expect also to weld lead pipe in the same manner, so that any plumber can have a welding apparatus with which he can make one continuous lead pipe in mending and in building, doing away entirely with "wipe joints," and the expense attendant thereon. With an absolutely pure heat, with absolutely perfect means of regulation, with the heating constantly before the eyes of the operator, with a neatness to which ordinary methods cannot at all be compared, with an increased economy of, in all ordinary cases, at least 300 per cent., with absolute safety of handling apparatus—with all these advantages, I do not see why electric welding should not rapidly rise to the dignity of a most important and valuable art.

NEW CHROMATROPE.

WE give an engraving of a novel toy which illustrates some of the phenomena of colour. Upon the spindle A is secured a star B formed of two triangular pieces of pasteboard arranged so that their points alternate. One triangle is red, the other green—complementary colours—which produce white when they are blended by the rotation of the star. In the angles of one of the stars are secured wire nails, which serve as pivots for the three discs C, as shown in Figs. 1 and 4. Each disc is divided into three equal parts, which are coloured respectively red, blue, and yellow. The discs overlap at the centre of the star B.



Around the spindle A is wound a cord which passes through the loop formed in the star frame in which the spindle is journalled, and is provided at its end with a button D. By pulling the cord, the star B is whirled first in one direction and then in the other. As the series of discs C turn, the colours are blended in different ways according to the relative arrangement of the different sections. All the phenomena of the blending of surface colours are illustrated by this simple toy. At times the centre will be a beautiful purple, while the outer part is green. At other times some portions of the colour disc presented by the rotating dics are white, showing that a proper mixture of the three primary colours yields white light.

At the instant of the change of rotation from one direction to the other, the arrangement of the discs is such as to present beautiful symmetrical figures. All the changes of colour in the toy in its normal condition are, of course, accidental. When it is desired to try the blending of any of the colours, when arranged in a particular way, the discs may be prevented from turning on their pivots by stretching over each disc a small rubber band. The maker of this simple toy has succeeded in securing colours which produce remarkably good effects.—*Scientific American.*

THE VINEGAR EEL.*

THE owner of a microscope, desirous of using it, can find material for study and observation everywhere. The old oaken bucket that hangs in the well, or the filth in the kitchen sink, a bit of the deal wood of the kitchen table, or the scraping from a surface of the skin will furnish, any one of them, abundant material for an hour of work, and would busy an expert for many months. There is also an interesting object in the bottom of your vinegar cruet.

Go about the work thus: First, be sure you have within easy reach the following utensils:—

1. Microscope with high ($\frac{1}{2}$) or low powers ($\frac{1}{8}$). 2. A number of clean slides and covers. 3. Half a dozen watch-glasses. 4. A supply of bibulous paper. 5. Two dropping tubes and a couple of glass stirring-rods. 6. A glass of water. 7. Some vinegar. 8. Reagents as follows:—1. Glycerine or glycerine jelly. 2. Alcohol. 3. Acetic acid. 4. Eosine.

The first step is the acquisition of skill in catching the material for study. To acquire this proceed as follows:—With one of the dropping tubes lift a drop from the sediment in the bottom of the supply. Catch this on the centre of one of the slides. Place the slide on the stage of the microscope and examine the uncovered drop with the low power, moving the slide about backward and forward with the sediment in sharp focus. If involved in the sediment is a long and narrow thread-shaped translucent body in quick motion, it is almost certainly the object of search. If one or more are not seen after the first lot has been searched through, try it over again until one of the wriggling bodies has been found. Having found one with the low power, hold the slide over a dark background. A piece of black cloth, or a black tile, is good for the purpose. Try to see the worm with the naked eye. One will soon succeed in doing this after having learned the sinuous motion which is habitual to the worm. Having acquired the necessary practice in detecting the specimen with the naked eye, collect an abundant supply for future use.

To do this, examine closely the vessel of vinegar. On the surface and on the side toward the window or source of light probably a great many of the eels are swimming actively about. With the pipette suck up a few of these and drop them into a watch-glass of pure water. When there have been removed to the pure water a dozen or so of the largest of the eels, there is then sufficient supply of material for study. This process could not occupy the expert more than five minutes. It has a value in teaching carefulness and skill in delicate manipulation as well as in securing material for study.

Next, with the pipette, lift out of his watch-glass prison one of the eels and deposit it with the least possible fraction of a drop of water on a fresh dry slide. If the slide be moist the water will spread out over it in every direction, but if dry, then it will remain in a small spot. Pour out a little alcohol into a watch-glass and add to it several drops of strong acetic acid. This is a killing fluid. Alcohol alone would be deadly, but of slower action. Place a drop of the killing fluid on the eel upon the slide. It would be useless to attempt to see it under the high power during its time of active movement, but it will soon become quiet enough for easy study. Do this with the high power first, covering the object with a cover-glass, and then running enough of the alcohol under the cover to entirely fill the space between it and the slide. The eel can now be examined at leisure.

Examination will convince one quite soon that the creature is not one of such simplicity as is implied by the popular expression, "there is nothing in him," but that he is very complex. First observe his shape—very long and narrow, blunt at one end, and sharply pointed at the other. Referring from him to a live one under a low power, you can readily see that the creature always moves about pushing the blunt end forward, and this as well as other facts prove that his body has a head end, though it exhibits nothing which suggests a head separated by a neck from the body, and bearing eyes or other sense organs. If now, the high power study be resumed, the various parts of this body can be distinguished, after very careful study, for the parts are transparent, and hence difficult to see. At the blunt front end of the body a notch marks the entrance to the digestive tube. The mouth can be seen leading into a straight thick-walled *gullet*, and this in turn into a globular *gizzard*. From the gizzard a tube runs straight through the body, which terminates slightly behind the very acute tip in an opening (the anus). There is no distinction of stomach and intestine behind the gizzard.

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* By H. L. OSBORN, in the *American Monthly Microscopical Journal.*

When the parts of the alimentary system are thus made out, it is best to determine the exact situation of the skin or body wall, which may be best begun at the head end. It is partly of muscular tissue, overlaid with skin cells, and the whole covered on the outside with a chitinous cuticle, but these parts cannot be readily distingushed. When the body wall has been distinguished, search in the region of the stomach intestine for an organ besides it in this region. A difference will here be found among the specimens, some being males and others females. The organs here are the rather extensive ovaries or testes according to the sex of the individual. If a female, one will see numerous oblong or oval bodies separate from one another, many with a clear round central spot. These are eggs with their nuclei or germinal vesicles. Careful search of a number of specimens will further prove that an opening exists in the middle of the body. This may, perhaps, be traceable into the generative organ, into which it really leads. It is the reproductive orifice. The males have a different looking generative organ—the testes made up of numerous small round bodies, the ultimate cells which give rise to the spermatozoa, and which are "peculiar in that they retain the character of cells, and may even exhibit amœboid movements" (Huxley).

Besides muscles, digestive organs, and generative organs, the vinegar eel has a general nervous system which can only be demonstrated after very special study. It has no conspicuous sense organs. Its zoological relations are with the so-called round worms, many of which are man's greatest enemies, such as the Trichina; but the Anguillula aceti is harmless. Other forms of Anguillula thrive in sour paste, and still others are instrumental in producing a disease in wheat. Gordius, the "horse-hair worm," belongs to this group.

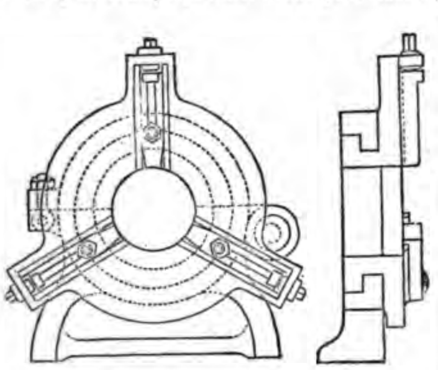
It is scarcely possible to preserve the vinegar eel so as to show the facts pointed out as easily seen, and they can so readily be obtained at any time that it is scarcely worth while to attempt it. However, it may be done in one way, as follows:—As for staining, the cuticle prevents the entrance of most stains, but eosine can be made to penetrate with difficulty.

In mounting the best method is as follows: First get the specimen in alcohol in the centre of the slide; then with the bibulous paper remove all alcohol from the slide, except just about the specimen; then quickly, before the evaporation of the alcohol, drop on it a small amount of warm fluid glycerine jelly. Balsam should not be used (though it could be well enough), because of the similar density with the specimen, making the latter almost invisible. Cover the jelly with a cover and run in enough warm jelly to fill out the space between the slide and cover. After the jelly is hard wipe carefully away the excess at the point where the jelly was run under, and ring with Bell's cement or with shellac cement. Slides made in this way will show the points above mentioned, or some of them, and will "keep" indefinitely.

The student must be cautioned against expecting to find all the structures shown in any one specimen, because the position in which the body lies may hide some of them.

A NEW CENTRE REST.

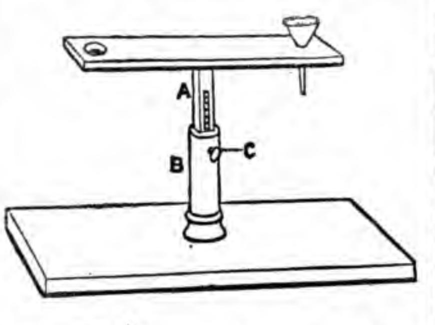
THE accompanying cut shows the construction of a lathe centre or steady rest, the invention of Henry B. Gould, 42, Prairie-avenue, Providence,

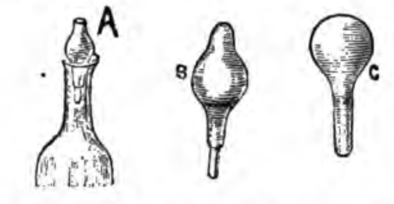


R.I. Every lathesman is familiar with the objectionable features of the ordinary rest—viz., the necessity for first turning a place on the work to which the rest jaws can be applied, which place must be turned as true, and must afterwards wear as true, as the finished work can be, because the truth of the work depends upon the truth of the part to which the rest jaws are applied at the time of finishing. It is also impossible to use the ordinary rest upon shapes other than round without first applying a sleeve or collar centred and held in place by set screws. It is the object of this rest to avoid these difficulties by providing a working bearing in the rest itself, in the manner shown by the cross-section. The jaws have their seats in the usual slotted recesses, which are made parts of a ring which is turned true, and has a bearing in the rest which is turned out to receive it, and of which it is a part. In this way the ring and jaws revolve with the work, the truth of which depends, of course, upon the centring of the ring, and the truth of its bearing in this rest, which is so large as to prevent serious wear during the progress of a job. This provides for the work coming out true at the finish.—*American Machinist.*

IMPROVED FILTER STAND.*

I HAVE devised an improved form of filter stand, in which the inconvenience arising from the projecting end of the rod, on which the support for funnel slides, is done away with. In this form I make use of the rod and socket arrangement. A glance at the accompanying sketch fully illustrates





my meaning without further explanation. A is the rod having funnel support affixed on its upper end; B is the hollow pillar into which A slides, being held firmly at any height by means of the screw at C. Any ordinary joiner can make a filter stand after this pattern.

Having often been annoyed by the frequency with which the valve made of indiarubber tubing—generally used when performing analyses by reduction, &c.—gets out of order and will not act, I was led to make use of a modification, the nature of which is explained in a few words: instead of the piece of tubing with a slit in it, I make a glass bulb, the size of which varies with that of the flask in use, and over this bulb I slip a small piece of indiarubber tubing sufficient to cover the bulb completely. The shank of the bulb should be about 3cm. long, and should be dropped into the neck of the flask, so that the globular portion rests on the top. When ebullition has entirely ceased, and the flame is removed from under the flask, the partial vacuum caused by the rapidly-cooled gases inside draws the bulb tightly down on the flask neck, thus making a perfectly air-tight stopper, which requires considerable force to remove.

In the smaller figures A is the neck of the flask; B is the bulb with its covering of indiarubber; and C is the bulb without its covering. The principal merit of the contrivance is its simplicity and certainty of action.

HOW TO CONSTRUCT A TABLE SPECTROSCOPE.†

A GOOD spectroscope is an instrument of great value to the student of physics or chemistry. Indeed, it is not too much to say that for many purposes it is absolutely indispensable. Unfortunately, the cost of such an appliance is very considerable, and it is on this account, perhaps, that but a small proportion of those having a theoretical acquaintance with its revelations and capabilities are familiar with its practical use. While spectroscopes are now found among the apparatus of all large colleges and schools, there are numerous workers, even among the students in these, who would find it of great advantage personally to have the uncontrolled use of such an appliance. There are many other workers, too, outside scholastic walls who, while toiling at their ordinary avocations, are devoting their perhaps scanty leisure to experimental science in various directions. To such often it is unknown that a really efficient and valuable instrument capable of use, not merely for *showing*, but for *measuring or mapping*, spectra may be constructed by anyone of ordinary intelligence at a very small cost. But, apart from economical considerations, the intimate acquaintance with the theory of the instrument gained by the *constructor* during the process of making is of no little value; as in this way he learns lessons and solves for himself problems never perhaps attempted by the simple user of the optician's highly-finished "brass and glass."

In giving some account of a method which has in practice been found very efficient for arranging the component parts of a table spectroscope, it is not proposed to deal at all with the making of prisms and lenses. It is premised that these will be procured at once from a reliable optician, their cost being, after all, very little when compared with the price asked by dealers for a complete spectroscope of really no greater efficiency than the one now to be described.

The *soul* of the instrument, so to speak, resides in the prism. This should be of the densest optical flint glass procurable, with refracting angle of 60°, and should measure not less than 1in. on the side. Three achromatic telescope objectives of 1⅛in. diameter and 8in. to 10in. focal length will also be required. The small unmounted combinations kept at most large optical establishments to replace breakages in pocket telescopes will answer perfectly. Very little advantage is gained by procuring them ready fitted in brass cells, while the cost is a good deal increased. Only a simple method of fitting up the unmounted lenses will therefore be given; but should convenience point to the use of those already in cells, it will be easy to modify the instructions accordingly. The only other materials necessary are some brass tubing, sheet brass, and well-seasoned wood—except, indeed, the ocular for the view telescope, which will be treated of in its place.

At this point we are to decide of what material the plate or *table*, to which all the other parts are attached, shall be made. Brass is very efficient—indeed, the best; but its use will necessitate two or more patterns, castings from them, and metal-work in the lathe, for which everyone may not be prepared. For convenience, joined to simplicity and cheapness, however, nothing can surpass a wooden plate, and we will suppose these advantages as deciding the selection in its favour. For this purpose a disc of well-seasoned cherry or mahogany, A A, Fig. 1, is to be turned up 4in. in diameter and $\frac{7}{16}$in. thick. A slightly ornamental beading round its periphery, as indicated, relieves the appearance of undue thickness. When made it should forthwith receive two or three coats of thin shellac varnish.

The three objectives, two of which are shown at O O′, Fig. 1, are next to be mounted in small "telescopes." To do this, the solar foci of the lenses being noted (by holding them in sunlight before a card and measuring the distance at which the image formed is smallest and sharpest), some brass tube is selected of external diameter slightly larger than the glasses, while the interior diameter should be a little less, and three pieces cut off, each being about 1½in. shorter than the focus of the lens it is to contain, B B, B′ B′, Fig. 1. If the tubing has been well chosen, it will then only be necessary to ream out a space at one end of each of these bodies to a depth slightly exceeding the thickness of the objective, and giving an internal diameter just sufficient to readily admit the same (as at B B′, Fig. 1). These recesses, when truly made with a square internal shoulder, form convenient cells for the reception of the lenses, O O′, which, when introduced (the concave member first), are retained in place by brass rings, D D′, fitting tightly to the front of the cells. Such rings are cut from a short length of tubing similar to that used for the telescope bodies, the diameter of which has been reduced by slitting it longitudinally with a fine hack saw, bringing the edges of the slit together by a wrap of tightly-twisted wire, soldering up the slit, and then cutting off three narrow bands for the rings, which, after a little fitting, will readily enter the front of the lens cells and hold the objectives fast. By this arrangement the lenses are quite well collimated, and very little of their effective aperture is cut off. A *draw tube*, I I, I′ I′, for each body will now be necessary. Each may be 3½in. long. Sometimes mandrel-drawn brass tubes can be had in sizes which conveniently slide within one another, and only need a little polishing to make them work with freedom. But should such not be readily procurable, an actually better sliding joint can be made from a strip of woollen cloth selected of proper thickness to just enter the larger tube when wrapped around the smaller. Such a cloth band, K K, K′ K′, fixed in the end of each body tube remote from the objective cell by means of a few drops of warm glue to which a little acetic acid has been added

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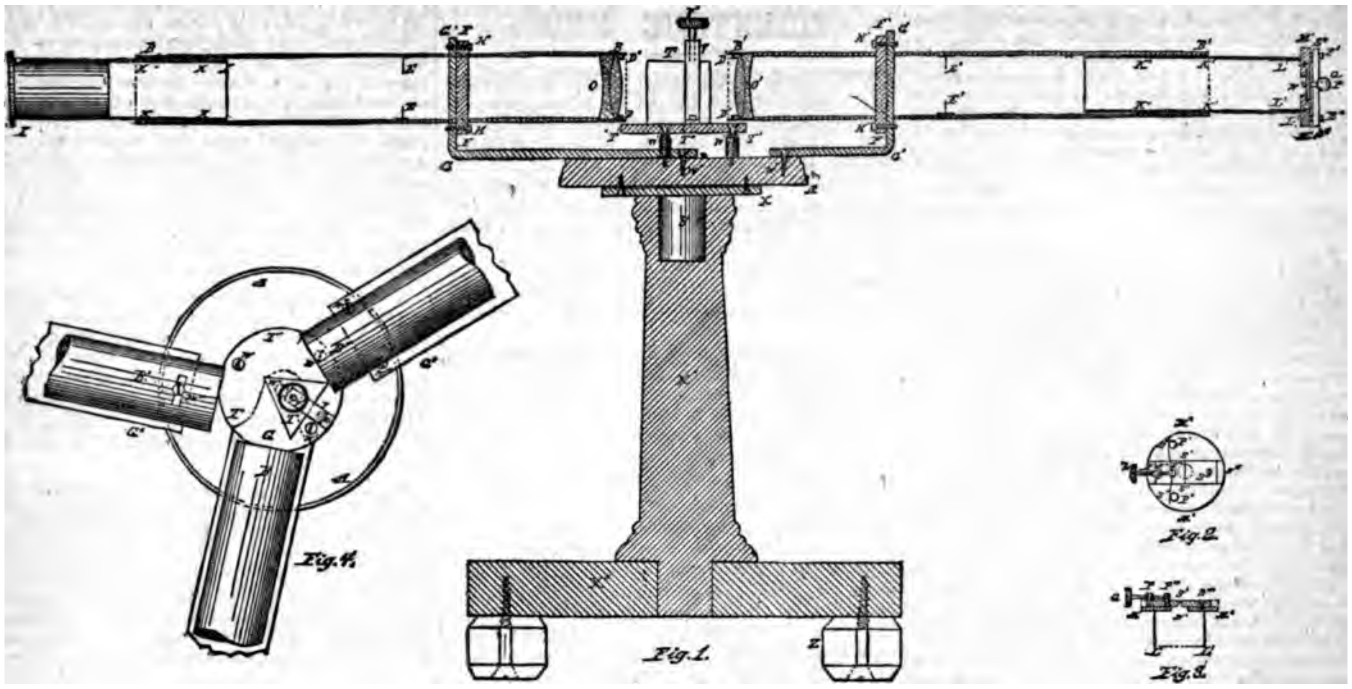
* By G. H. BOSTOCK, F.C.S., in the *Chemical News.*

† By A. F. MILLER, in the *Scientific American Supplement.*



makes a slide for the focussing tube at once smooth and firm in working and perfectly light-tight. At this juncture the interiors of all the tubes are to receive a coat of dead-black made by rubbing a little lamp-black with a few drops of gold size and thinning with turpentine till suitable for application. At a later stage the exteriors may be polished and lacquered according to taste. Each body should also be provided with an internal diaphragm, E E, E' E', of blackened cardboard, having a central aperture large enough to admit the whole cone of rays from the objective while yet cutting off scattered light. The diaphragms are most conveniently placed by gluing each into a cardboard ring just capable of sliding tightly into the tube.

The telescopes are prepared for mounting by fitting each into a disc-like ring of $\frac{3}{16}$ sheet brass, F F, F' F', 1⅜in. in external diameter, and provided with a central aperture just admitting the body tube, to which it is soldered 2¼in. from the objective end. Two small holes are drilled through each of these discs at H H, H' H', on opposite sides of the central aperture and midway upon the flat surface. These are tapped and fitted with small screws of any convenient thickness and about ⅛in. long, which serve to attach the completed telescopes to their supports by entering corresponding holes drilled and tapped therein, and also to adjust them in the same visual plane.

The attachments of the telescopes to the table are next to be considered. At this point select one of them definitely as the "view telescope," B B, and if there be any difference in their focal length, the longest should be preferred for this office, while the shortest is reserved for the "scale," Fig. 4, B'' B''; the other becoming the "collimator," Fig. 1 or 4, B' B'. For the support of the view telescope, take a strip of ⅛in. sheet brass, G G, 6in. long and ¼in. wider than the diameter of the body tube. This is bent at right angles so that one arm measures 4in. and the other 2in. An aperture is made through the shorter arm a little longer than the body tube, and so placed that its circumference shall fall exactly ⅛in. from the exterior of the rectangular bend (at the lower G, Fig. 1) At $\frac{3}{16}$in. from the other extremity a ⅛in. hole is drilled through the middle line of its surface and countersunk for the head of a small wood screw, W'', thus providing for its final attachment to the centre of the table. 1¼in. of the longer arm on each side of W'' should now be reduced to ¾in. in width, and rounded at the extremity as appears at G, Fig. 4, so as to admit of free angular motion between the stage pillars, W'. The collimator support, G' G', differs from the one just described only in having both arms of equal length, 2in. The end by which it is attached to the table, A A, is drilled and countersunk at each corner for the wood screws, W''', Fig. 1 or 4, which hold it in place. The scale support, G'', Fig. 4, is the same as the last described, but the aperture for its attaching screw takes the form of a slot, W'''', Fig. 4, ⅛in. by ⅛in., the object of this arrangement being to permit of certain adjustments which will be found necessary in use.

An adjustable "slit" must next be provided. For the slit-plate a piece of carefully flattened ⅛in. sheet brass, M' M', Figs. 1, 2, 3, is cut into a circle 1¼in. in diameter and perforated with a central round ¼in. aperture, N'. Concentrically about this orifice a ⅛in. length of brass tube, L' L', is soldered, of such diameter as just to slip into the draw tube of the collimator. The opposite face of the brass disc is to have a slot or groove, N'', ⅜in. wide and $\frac{1}{16}$in. deep, cut diametrically across its surface, traversing the central hole. The sides of this slot must slant inward, so that its width shall be greatest at the inner surface, as shown, with the object of retaining in place the two sliding "jaws" of the slit, S', Figs. 2, 3, which are to be capable of horizontal motion within the groove. For these latter a piece of $\frac{1}{16}$in. hard brass 1in. long is carefully fitted to work as smoothly as possible to and fro in the slot, in which it is retained by its edges, which are made to slant in coincidence with the slides of the slot. When this piece has been fitted so as to work with perfect freedom, yet without shake, it is to be withdrawn and its back (*i.e.*, the surface coming in contact with the bottom of the slot) marked in the middle with a perfectly vertical line. With a fine triangular file it is then cut through upon this line so as to produce two movable portions or jaws with chisel-shaped "knife edges." The knife edges must be worked as truly straight and smooth as possible, since any little irregularities upon their surface will be magnified by the refractive power of the prism into broad dark bands traversing the spectrum horizontally, to the great detriment of the instrumental definition.

It is not easy to suggest the best method of arriving at this result. A piece of very fine, smooth slate with water will remove the roughness left by the file, after which a very fine "slip" with oil, and lastly perhaps a piece of plate glass with rouge will, with proper skill, give a passable degree of clearness. A good result here will, however, most likely come only as the reward of patience after several trials. The finished jaws are to be replaced in their slot with the bevels of the chisel edges inward, and caused to meet just over the centre of the slit-plate aperture, S' (Fig. 3). Hereafter it will suffice that one of them shall be capable of motion, so the other may now be secured in place by a small screw, S'', Figs. 2, 3, passing through it into the slit-plate. The movable jaw must have screwed into it a small upright brass pillar, P''', about ⅛in. in diameter and ¼in. high. Two similar pillars are also screwed into the slit-plate at P' P'', their office being to sustain a small piece of watch spring, S', which by its pressure upon the pillar of the movable jaw tends to draw this back and open the slit. This action is opposed by the delicate mill-headed screw, Q, which works in a direction parallel to the plane of the slit-plate, passing at right angles through a fourth pillar, P, screwed down into the slot of the slit-plate behind the movable jaw, in which a rounded notch, N'' (Fig. 2), is filed to avoid catching on the pillar, P. By turning the milled-headed screw, Q, the slit can be closed to any extent, while the spring, S', reopens it as the pressure of the screw is relaxed. The pillars, P' P'', should each have a small slot filed at the point where the spring, S'', presses, while a slot cut down into the head of the pillar, P''', receives the middle of the spring and holds it steadily in place. The finished slit is attached to the collimator by slipping the ⅛in. projecting tube, L', into the draw of the latter.

The scale is employed for the measurement or mapping of spectra, and consists simply in a photographic reduction of any selected scale of equal parts. It may be mm. or inches and parts. Whatever one be adopted, a portion of it, say 10in. long, should be drawn with the divisions and numbers very clearly shown in ink upon a strip of paper 1in. wide. From this latter a negative on glass is to be made, the reduction being just sufficient to bring the length of the photographed image within the internal diameter of the scale telescope draw-tube. The end of this latter is fitted with a brass disc of the same size as that employed for the slit-plate, and furnished like that with a central aperture, which in this case, however, may be as large as the draw tube, which, passing into it, may be fixed in position by soldering. A small square portion is to be cut from the negative plate in such a manner that the scale shall occupy the middle, while a sufficient margin is left round it to permit of its attachment by means of a little acetic glue to the brass disc just described. The scale is so placed that its centre coincides with the axis of its supporting telescope. All that portion of the glass plate not occupied by the scale is to be covered with tinfoil carefully pasted on so as to leave the latter only visible in the midst of a narrow slit, the object being to exclude all light except that which enters through the divisions of the scale.

The stage, T' T', for the prism, T, consists of a circular plate of $\frac{3}{16}$in. brass, 1⅜in. in diameter. It should be as flat and true as possible. It is well to accurately mark its centre, and drill there a very small hole, T'. A diametral line should also be inscribed across its surface with a graver and straight edge. At one of the points where this diameter meets the circumference the prism support, V, is to be screwed down to the stage, or it may be even soldered on. This support is of ⅛in. sheet brass bent twice at right angles. Its free arm is drilled through and tapped to carry the milled-headed screw, V', used to retain the prism, T, in position. The height of the support, V, should be sufficient to leave ¼in. clear space between its upper arm and the top of the prism. The stage, T' T', is secured to the table, A A, by three brass wood-screws, W', the holes for which are drilled in the positions indicated in Fig. 4, W', so as to leave room for the angular motion of the view telescope support, which, when the instrument is put together, passes between the screws in the largest free space. A very simple and most efficient arrangement for levelling the prism stage is thus contrived. Three strips of thin sheet brass, each 1in. long and about ¼in. wide, are made to wrap, with a small degree of spirality, round the supporting screws, as shown at W' W', Fig. 1. When the screws are passed through their appropriate holes, then through the little brass tubes thus provided, and lastly screwed down into the table, the pressure of the spiral coils keeps the stage perfectly steady, while by tightening or relaxing the screws, W', to a small extent, the level of the stage and thus of the prism can be adjusted with very great accuracy.

The pillar, X', should be turned out of cherry or mahogany, and may conveniently have a height of 6in. At Y, a hole is bored to a depth of about 1in. In this should fit tightly a 1in. length of brass tube about ¾in. diameter. This again is soldered round the centre of X X, a plate of ⅛in. brass about

2⅜in. in diameter, fixed by three or four small brass wood-screws to the underside of the table, A A, thus serving as its attachment to the pillar, X'. The foot, X'', is of tripod form, and may be sawed out of a piece of dry cherry. It has a central hole for the dowel or projecting end of the pillar, X'. The three extremities of the tripod rest on feet, Z, only two of which are represented. These may be conveniently cast in lead round common wood-screws, which serve as their attachments to the tripod, and also answer for levelling the complete instrument.

It only remains to refer briefly to the eyepiece for the view telescope. Instructions for making eyepieces have already appeared in this journal, and it is not proposed to repeat them here. Any astronomical ocular of low power may be adapted to the eyetube, II; but if there be a choice, the *positive* or Ramsden's form will give the best result as regards flatness of field. One having an equivalent focus of about 1½in. will be found very suitable.

A few words will be necessary as to the assembling of the various finished parts and their adjustment. In Fig. 4 the arrangement of the telescopes and prism is shown. The collimator, B^1, should first be attached to the table, AA, by the screws, W''', passed through its support, G^1. Its optical axis should coincide with a diameter of AA, being directed to the centre of the table. Place a small spirit-level on the table, AA, and level the latter by turning the feet, Z, Fig. 1. Apply the level to the collimator tube, and bring the bubble central by turning the screws, H^1, Fig. 1. Focus the view telescope, B, upon any very distant object, say a star, and attach to AA by the screw, W'', which must not be made so tight as to preclude motion round it as a centre. Bring the view telescope opposite to the collimator, direct the slit toward the sky or other source of moderate illumination, and by means of the collimator draw-tube focus till the slit appears as a fine bright line in the field of view. If it should be too high or two low, bring its image central by means of the adjusting screws, HH, in the view telescope support. Place the prism stage approximately in the position shown at T^1T^1, Fig. 4. Put the prism under its support, V, and secure it by the screw, V^1, interposing beneath the point of the latter a small disc of blackened cork or leather for the protection of the prism. Ascertain that the support, G, has room to move between the screws, W'; put the brass spirals round the latter under the stage, and screw down into the table, AA. Turn the slit toward any source of light, and move the view telescope till the spectrum appears in its field; if not centrally placed, bring it into position by turning the screws, W^1. Place the scale telescope in such a position that its axis makes an equal angle with the view telescope at the last surface of the prism; put a candle flame before the scale, and the latter should appear by reflection in the field of view, otherwise move the view telescope a little till it does appear, and attach to A A by the screw, W'''', passing through the slot in its support. Since every change in the position of the prism will necessitate a corresponding alteration of the scale telescope, the slot is designed to admit of such adjustments, and therefore the screw, W'''', must not at first be clamped too tight. The reflected image of the scale must be made to appear just over the spectrum by means of the scale telescope adjusting screws corresponding to H and H'. The spectrum will most probably appear inconveniently broad, and its width must be reduced by placing a diaphragm of black card with a ⅛in. central aperture just behind the slit in N^1. If the spectral lines should not be seen truly perpendicular, the slit-plate must be revolved a little till they have their proper position. The instrument will give the best result only when the prism is placed at the angle of minimum deviation for the particular rays under study, but for directions on this point the reader must be referred to some of the standard works on spectroscopy.

A Monster Trout.—A monster trout was captured the other day in the river Itchen, at Winchester, weighing 16lb. 2oz., and measuring 32in. in length, and 21in. in circumference. The bait was a live minnow, and he was not landed till two hours after he was hooked. He had haunted the stream for years, was almost as well known in the city as Queen Anne's statue in the High-street, and had acquired quite a reputation for the number of rods he had broken and the quantity of fishing tackle he had carried away. His captor was a labourer named Turpin, who disposed of him for £1 to a fishmonger, on whose slab he attracted almost as many visitors as a monarch lying in state. He was in splendid condition, and has now gone into the hands of a taxidermist for preservation.

A FINE violin by Antonius Stradivarius, 1715, *from the loan exhibition* at South Kensington, was *sold by auction for £450.*

SCIENTIFIC NEWS.

THE death is announced of Mr. Braithwaite Poole at the age of 83 years. The deceased gentleman was associated with George and Robert Stephenson, with Trevithick, Locke, and other pioneers of the railway movement, and held important posts in the service of the London and North-Western and the Great Western companies. For many years Mr. Poole was chairman of the London Railway Clearing-house, and did much to organise and perfect the extraordinarily complicated arrangement of that department of railway work.

An American-born engineer, well known in this conntry, was buried the other day at Norwood. Martin Benson was born at Cincinnati in 1824, and settled in this country as a patent agent about thirty years ago. He introduced many well-known inventions, and was deservedly esteemed by a wide circle of friends.

A tablet to the memory of Charles Darwin is to be placed on the house in Lothian-street, Edinburgh, where he lived when studying at Edinburgh University.

An American correspondent forwards us some extracts from a letter by Prof. Holden, of the Lick Observatory, from which we learn that Prof. Schaeberle has commenced the task of fixing with the greatest precision the "fundamental star" by means of the Repsold meridian circle. The time service for railway use is now conducted by Mr. Hill, which leaves Mr. Keeler free to make the necessary studies of the great star spectroscope, which is one of the most important accessories of the 36in. equatoreal. Mr. Barnard is assiduously observing comets and nebulæ with the fine 12in. equatoreal, and getting the photographic appliances in readiness to be used with the great telescope. He has already discovered twenty new nebulæ, found in the course of his sweeps for new comets. "To show you," says Prof. Holden, "some of the advantages of our situation here, I may tell you that Prof. Swift, of Rochester, has a fine 16in. equatoreal by Alvan Clark, and has discovered many faint nebulæ by its use. Two nights ago, Mr. Barnard was examining some of these excessively faint objects by means of the 12in. telescope (which gives only a little more than half the light of Prof. Swift's), and in the field of view where Prof. Swift had mapped only one nebula Mr. Barnard found three, two, of course, new. This is due not only to the observer's skill and keenness of eye, but in great measure to the purity and transparency of our atmosphere here."

Prof. Holden says that the big telescope needs peculiar conditions for its best performance; but when those conditions are present it acts superbly. He has had views of Mars and Jupiter, of nebulæ, the Milky Way, and some of the stars, as no other astronomer ever before had. Jupiter especially is wonderfully full of detail. The discs of his moons can be readily noted in smaller telescopes; but here, says Prof. Holden, they are full and round, like those of planets. He is almost of the opinion that the curve of Jupiter's shadow might be seen on the surfaces under favourable circumstances when the satellites suffer eclipse.

The Milky Way preserves always the "background of unresolved nebulosity on which hundreds and thousands of stars are studded," while the famous cluster in Hercules (where Messier declared he saw "no star") is one mass of separate individual points. The central glow of nebulosity is thoroughly separated into points. Prof. Holden compares his views with the drawings made by Lord Rosse with his giant 6ft. reflector. Theoretically his telescope should show more, for his collected the most light. But the definition (sharpness) of his is far behind the Lick. For example, the ring nebula in Lyra is drawn by Lord Rosse with no central star. At Washington one small star can be seen in the midst of the central vacuity, but here, says Prof. Holden, we are sure of seeing three such at least.

Mr. Tebbutt, of Windsor, N.S.W., writes to the *Astronomische Nachrichten* (No. 2,849) that the brightness of that remarkable variable star in the southern hemisphere, η Argûs, has increased by about half a magnitude since the spring of last year. At the end of April, 1887, he found it still only seven and a half, but on the 19th of last May it was fully equal to a seventh. "As this sudden and marked increase," he says, "may be the beginning of another magnificent outburst of this remarkable variable, I shall continue to watch it at short intervals." This star (which was first suspected to be variable by Halley when observing at St. Helena in 1677) surpassed in brightness all other stars excepting Sirius in 1838, and again in 1843; but after the latter date it steadily diminished, and has not been visible to the naked eye since 1867.

Among the Civil List pensions granted during the year ended June 20, 1888, were the following:—To the Rev. F. O. Morris, in recognition of his merits as a naturalist, £100; to Mr. William Kitchen Parker, F.R.S., in recognition of his services to science as an investigator, £100; to Mrs. Balfour Stewart, in recognition of the services rendered to science by her late husband, £50.

According to announcement, the London and North-Western commenced on Monday last to run the 10 a.m. from Euston to Edinburgh in eight hours, and the train, it appears, actually reached the Scotch capital by 5.52 p.m. On the Caledonian section 100½ miles were covered in 104 minutes. The train will run throughout the month, is of all three classes, and stops only at Crewe, Preston, and Carlisle.

It has been stated that the longest run in the world is that of the Limited Express on the Pennsylvania line, from Fort Wayne to Chicago, 146 miles; but Mr. H. B. Colthurst, of Dublin, points out that, according to the time tables, the "American mail" runs on Sunday mornings from Kingsbridge, Dublin, to Cork without a stop, a distance of 165½ miles.

Experiments made in the United States on an express locomotive show that "slip" at high speeds is practically *nil*. The wheels, by calculation, should have made 298·98 revolutions per mile; but a counter showed that 298·62 revolutions only had been made.

A bureau of electrical testing is to be established at the Johns Hopkins University under the direction of Dr. H. A. Rowland, the comparisons being made by Dr. G. A. Liebig, assistant. The University possesses the standards and apparatus required.

The telephone line between Paris and Marseilles is now complete, and has been opened to public use. The charges are—for five minutes' conversation between Paris and Lyons, two francs; between Paris and Marseilles, three francs. The line appears to work satisfactorily.

"Traité Elementaire de l'Accumulateur Voltaique," par Emile Reynier, is the title of a treatise recently published by Baudry et Cie, Paris. We understand that an English translation is in preparation; but, meantime, those who wish to learn all about accumulators will find the information in this well-printed, freely illustrated work.

The International Meteorological Committee will hold its fourth meeting at Zürich on September 3. This will be the final meeting of the Committee as so constituted. For various reasons it has been found impracticable to organise an International Meteorological Congress, more than one Government having declined to take part in such an assemblage. It is probable that, in future, occasional meetings will be held of a body to be composed of the chiefs of the various existing meteorological services, to whose meetings nothing of a diplomatic character will attach.

At a recent meeting of the Leeds Town Council a committee was appointed to report on the feasibility of holding an international exhibition at Leeds in 1890. It was stated that the only exhibition ever held in Leeds of any great importance was in 1875. The exhibition realised £32,000, the profits on which were just over £7,000.

We may remind our readers that an exhibition of the skill of workmen in their own trades will be opened at the Crystal Palace on August 18th in connection with the National Co-operative Festival. The competition will be amongst working-men members of the Industrial Co-operative Societies throughout the kingdom, and the special facilities offered to them to compete, by their respective societies agreeing to pay carriage on all exhibits, should open the door to a very large and sepresentative display of individual work. The prize list is a good one, and the Council of the Society of Arts—who have promised to appoint the judges—will also award one of their bronze medals in eighteen of the principal classes. The secretary, Mr. W. Broomhall, 1, Norfolk-street, Strand, will supply any further particulars.

The report of the Federal Government with regard to the progress of the phylloxera in Switzerland is not encouraging, as it states that in the course of last year 609 vines were attacked in the canton of Neuchatel, 111 in that of Geneva, 49 in that of Zurich, and 12 in that of Vaud. The use of sulphate of carbon is general; but up to the present time the proposal to introduce American vines into Switzerland has not met with much favour, though they have been found useful in France.

USEFUL AND SCIENTIFIC NOTES.

Tobacco-growing in Russia.—The tobacco plants in the Russian Government of Bessarabia have of late years suffered greatly from disease, which has almost threatened ruin to the industry of tobacco-growing. Prof. Lindemann, having been asked as a specialist to study the subject, has found three kinds of disease, the most important of which by far is a kind of consumption to which the plant is subject, caused chiefly by larvæ of the beetle Opatrum intermedium, Fisch. This grub attacks the underground part of the stem and the leaves. The female lays her eggs from the middle of April to that of May, and in loose ground not yet covered by the plants. The larva lives two and a half months, and the pupa stage is fourteen days. The insect does not breed till the following spring. The lava feeds at first mostly on wild plants, atriplex and convolvulus, but never on leguminosæ. It attacks gramineæ (maize, wheat, &c.), but only the embryo of the grain, and when germination has begun the grain is avoided. Though the time of possible attack is thus short, maize culture in Bessarabia has suffered much in this way. To protect the tobacco, Prof. Lindemann recommends sowing the fields in the end of March with mustard or rape, so that the insect at the time of egg-laying may be hindered by the thick cover of vegetation. Another insect (Pedinus femoralis, F.) acts just like opatrum, but does more harm to maize than to tobacco. Prof. Lindemann further describes two minor diseases affecting the leaves, and making the tobacco unsaleable. One (thrips) is also caused by an insect; the other (mosaic disease) seems to be due to some condition of the ground.

Long Run of a Furnace.—Mr. G. C. Stone, of the New Jersey Zinc and Iron Company, Newark, N.J., reports that one of their two furnaces recently blew out after the longest blast ever made at the works, and the longest run on spiegel that has yet been made, being three years and two days. The product was:

	Tons.	Cwt.	lb.
First year	3,340	10	70
Second year	3,443	13	57
Third year	3,090	8	79
Total	9,874	12	94

The average yield of ore was only 31·5 per cent. The spiegel averaged 19·55 per cent. manganese. It required 2 tons 9cwt. 22lb. of coal to the ton of iron, and made about 6,000lb. slag to each ton of iron.

Collecting Diatoms.—In an interesting article in the *Bulletin of the Torrey Botanical Club*, Mr. C. Henry Kain discusses the "Diatoms of Atlantic City and Vicinity." Speaking of the bright brown patches of diatoms frequently seen covering the surface of mud, he recommends that they be collected in the following manner: Half-fill a bottle with water. Touch one of these brown patches lightly with the tip of the finger, and the diatoms will adhere: then place the finger over the mouth of the bottle and shake. The diatoms are, of course, washed off and remain. By repeating this process again and again, the water finally becomes quite brown. By the time the collector reaches home the diatoms will have settled to the bottom, and the water may be poured off and the diatoms cleaned. It is worth while to examine under the collecting lens every promising patch of brown mud, for very pure gatherings of quite different species may often be collected within a few feet of each other.

DURING the spring of the present year some 200 eider-fowl were caught in fishermen's nets on the south coast of Sweden.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, *332, Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

*** *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

MM. HOUZEAU ET FOLIE—THE DIAMETERS OF THE FIXED STARS—PAPERS BY DR. ANDREWS—TELESCOPE.

[29072.]—I HAVE been a good deal struck by the report in the *Journal de Bruxelles* of the *éloge* pronounced by M. Folie at the funeral of the late lamented astronomer, M. Houzeau. Considering how widely the great dead Belgian differed from his successor, both in theology and politics, the touching and dignified address of which I am speaking confers very great honour upon M. Folie, whose graceful recognition of those qualities which raised Houzeau to the high position he occupied does him the greatest credit.

Let me assure "Capella" (letter 29029, p. 477) that I have in no way whatever misunderstood him. Any one of the lines in his Fig. 1 may represent the sheaf of rays by which he views his star at any given instant; but, *ex necessitate*, as the earth travels on she meets fresh and fresh rays. Does he seriously imagine for one single second that when we get outside of one of the supposititious cylinders of light in his Fig. 2, it is to plunge into the blackness of darkness!? I am greatly afraid that the overwhelming majority of "astronomical readers" will not bother their heads in the slightest degree with what is (I must be forgiven for saying) such very obvious nonsense to anyone possessing the least smattering of optics.

Mr. Peal (letter 29030, p. 478) would have materially assisted me if he had referred me to the volume of the *Proceedings* of the Royal Society in which Dr. Andrews's papers appeared. As it is, I have hunted through the *Philosophical Transactions* for the last twenty years, and have wholly failed to find them. I do not see *Nature*.

If the object-glass described by "Peep" (in query 66052, p. 510) is merely a double-convex lens, it would *not* be serviceable—but very much the reverse.

A Fellow of the Royal Astronomical Society.

THE ORGAN.

[29073.]—I HAVE read with great interest and profit the things that have appeared from time to time in your journal in regard to the pipe organ. I am not an organist, neither am I interested in any way in the organ as a matter of money; but I have that intense interest in this mighty instrument that I can hardly imagine one as not having who has ever listened to its majestic voice. I do not know why only professionals—virtuosi or fabricators—should be absorbed in this subject. It is pardonable in me, therefore, though I append a new signature, to want to take a little part in the discussion that has gone on for some time in regard to the use of the swell. This article has been written here and there while I have been about in the pursuit of my duties; and I am under the disadvantage of not having at hand the numbers of the "E. M." which contain the various letters on this subject. I trust I shall be able to quote ideas, if not words, so accurately as not to misrepresent anyone.

It is claimed by the antagonists of the swell-box that the conditions under which this department of the vocal organisation of the instrument is restrained effect serious modification in these imprisoned voices of the organ. I design to review some of the ideas advanced in the light of the teachings of natural philosophy, and I shall try to give an exposition of the physical character of the instrument, which exposition I have looked for from the pen of some authority in musical science. So far, no one has pointed out specifically those things that I consider fundamental to a correct way of thinking on many matters that are now in dispute.

Speaking from the impression left upon my mind as I have read, I think that some of the writers are possessed of the idea that the swell-box with its shutters partially, or, say, entirely, closed is the scene of a windy tempest, a fierce battle of miniature cyclones, and that each pipe as it speaks emits a rampant battalion of swirling molecules, which hustles into and adds to the general *mêlée*. With this conception of things, I judge, one correspondent has spoken of the air within the swell chamber as being "dense," as though the air were forced in in volume through the speaking pipes and were struggling under the pressure or tension imposed upon it by fresh consignments from the source of supply. In like manner a more recent writer speaks of the "congested" state of the air in the swell-box, while yet another writer still recounts the facts of the tone of a pipe being demoralised by the passage across its mouth of a current of air, which current may even have the effect of taking the pipe entirely "off its speech."

Granting the relation here taken between a current of air and the speech of the pipe, is the deduction a logical one? It seems to me that this is the argument:—A current of air in proximity to the mouth of a pipe is injurious to the speech of the pipe, and therefore, since such currents of air of necessity exist in the swell-box (an assumption), the swell-box is an impediment to the full tonal efficiency of the inclosed pipes; or, since currents of air in proximity to the mouth of a pipe are fatal to the speech of the pipe, and, since the pipes in the swell are deficient (a fact, sometimes) in pure speech and intonation, therefore, the trouble is to be attributed to the currents of air in the swell-box. Traversing the circular path of this argument in both directions, we are confronted with the importance of exercising judicial discrimination between matters of fact and matters of assumption, and also between matters of fact and matters of fact about other facts. For instance, it is a fact, as expressed above, that a current of air will affect the speech of a pipe, and it is another fact that the effects of the pipes in the swell are sometimes disappointing and far from satisfactory; but it is *not* a third fact that these two facts have anything to do with each other. We think we establish, further on, the true basis of facts on which bottoms the question of inharmonious effects in the swell. It is not a fact, either, that the matters of currents about the mouth of a pipe has anything at all to do with the question intrinsically. The theories of the anti-swell side have been, as it seems to me, successfully refuted by Mr. G. A. Audsley, Mr. Wm. Robinson, Mr. W. H. Crosby, and Mr. Clarence Eddy, of this city. In order to find ground for agreement with them, let us hasten to a brief consideration of nature's law of transformation of energy. For, while these gentlemen are authorities, the whole truth about anything is many-sided, and every thinking man may add his own idea. Let me state the case at once by saying that the organ may be looked upon as a great engine for the transformation of mechanical force into sound, for the transformation of a motion of translation into a motion of vibration, for the transformation of the energy of a current of air into the energy of vibrating molecules of air. It may be profitable to consider one or two common illustrations. Drop a leaden bullet from a distance to the pavement; its motion has been suddenly arrested, and, as far as the sense of sight is concerned, the display of force which we have just witnessed has ceased, apparently like the snuffing out of a candle. An inspection of the bullet, however, will show that there is a marked difference in its temperature, as observed by the touch or by instrumental means. The motion of translation which the bullet had has been transformed into a molecular motion. Let us take the more easily observable case of a mill-wheel. The water rushes upon it with a force due to the head of pressure behind it. It attacks the wheel, starting it and keeping it in motion, and after its work is done it falls listless and inert into the tail-race. In this case, the water exhausts itself of its mechanical energy by transferring it to the wheel. In a speaking organ pipe there exists an analogous state of affairs. A current of air is set in motion by the bellows; passing through a wind-trunk, and through the foot of the pipe, it impinges with all its force against the top of the pipe. There was a current of air—now there is a tone. The energy in the motion of translation of the body of air from the bellows has been suddenly transferred into the motion of vibration which takes place in the column of air in the pipe, and, in a manner well understood, I believe, in the material of the pipe itself. As the bullet was suddenly changed into an inert mass with evolution of heat, so the current of air is changed into an inert mass with production of sound. This theory, which is strictly true, is confirmed by Mr. Crosby, who says that there is very little, if any, disturbance about the mouth of a sounding pipe. Now, if air were admitted into the swell-box through so many holes in its floor, without any contrivance to change its energy into any other form, there would be air in a state of commotion, and also under pressure in the swell-box if its shutters w closed air-tight, just as there is steam un pressure in a steam boiler, and this pressure would maintain no equilibrium with the pressure of air afforded by the bellows. Mr. Robinson's gauge would then be kept busy; but his suggestion of a funnel leading off from the swell-box to relieve the pressure is wrong. With all the conditions satisfied that would result in pressure in the swell-box, this method would relieve the pressure and, in so doing, produce the currents of air, the presence of which is harmful. Wherever forces act we will get pressure or motion according as there is, or is not, equilibrium between the forces. We acknowledge that the sound of pipes in the swell-box is sometimes short of its potential excellence, but, having shown, as we trust, the fallacy of some of the theories put forth in explanation of the phenomena, we suggest that the true reasons are to be arrived at from a consideration of the fact that we are dealing with acoustical and not mechanical problems. The subject of investigation is waves of sound, not currents of air. It seems to your correspondent that the situation of the swell organ in its swell-box is that, on a smaller scale, of the organ at large in its environment. The problem is, with regard to the swell, to give the inclosure such proportions and dimensions and the pipes within such an arrangement that the waves of sound will be produced under conditions that comply with nature's laws. But, to repeat, this is the problem that demands a practical solution when the organ is considered as a whole with reference to its situation in the auditorium. It is necessary to exercise extreme caution in the matter of founding our theories on the proper facts in order to avoid the error, which some seem to have fallen into in this discussion, of believing that some result follows some condition, whereas a more acute analysis of all the phenomena may assure us that the result in question is coincident with, and not consequent upon, said condition. We do not forget that, as in the case of the mill-wheel, the same identical amount of water must flow off through the tail race that rushed upon the wheel above, so in the case of the organ pipe, the same identical amount of air forced in by the bellows must fall out at the mouth of the pipe. If we have been correct in our application of the law of nature that we have tried to set forth, this is just what the air does do —it falls out. It does not rush out charged with life and vigour. It has parted with its mechanical virtue in compelling the pipe to speak. It has speeded along within the confines of a narrow channel, and at the moment that its mission is accomplished at the lip of the pipe it is turned out, and lost in the broad expanse of air before it, and, under the influence of the law of gravitation, it tends to sink down to the bottom of the inclosure. Having gained a correct conception of the phenomena attendant upon speaking pipes, we may look at such circumstances as seem to modify the final result with some probability of being able to estimate the same at their due value. Suppose sufficient "worked-out" wind to accumulate in the lower region of the swell-box to warrant the term "congested," it will be seen that the duct, proposed by some of those who have taken part in this discussion, to relieve the swell-box, would be of no use at all unless opening into the swell-box at the bottom. But there is no reason why we should consider suppositions. The facts can be gotten at by theory, I think, which are demonstrated practically by Mr. Crosby—that the waste wind really cuts no figure at all in the closed swell-box, its presence being inappreciable as far as any deleterious effects are concerned, or any effects whatsoever. Atmospheric pressure, which may be taken at 14·70lb. per sq. in., supports a column of water—say, 37ft. in height. By Boyle's law, a given weight of air varies in volume inversely as the pressure, or, with a given volume, the weight of air increases directly with the pressure. With a swell-box hermetically sealed, the bellows (supposing them of sufficient strength) would need to be weighted to 34ft. or 408in. of water to create a pressure within equal to one atmosphere. Now, as 3in. of of water are, I think, a fair figure to assume for the real working condition of the bellows, it will be seen that when our hermetically sealed box is filled with wind until the waste valve in the bellows is opened, there would be a pressure of only one one hundred and thirty-sixth part of an atmosphere; that is, ·101lb., or $1\frac{3}{5}$oz. Even this is an ideal condition, towards which, in actual practice, no measurable approach is made. Swell-boxes, though they may be made so tight as to effectually prevent egress of the sounds within, yet afford many opportunities for so elastic a fluid as the air to equilibrate itself with the body of air outside, provided there be within the slightest imaginable surplus.

Again, suppose as an extreme case, that out of a total of 61 pipes forming a stop or register, the organist opens 10 with the hands and two by the pedals, thus making a total of 12 pipes speaking at *once* out of the 61. Here is at most a total of *only 20 per cent. of the whole capacity of the swell organ to bring wind into the swell-box. In addition to this is the fact that* while the organist is opening or closing the shutters is the time that the swell organ is being put to its individual peculiar use; the actual time during any performance that the swell-box is entirely closed being very small indeed. With all of these considerations in theory, and the actual practice of Mr. Robinson and Mr. Crosby, I think the bugbear of all these harmful "goings on" in the swell-box, is pretty thoroughly pulverised. It might possibly be a very pretty and profitable experiment to place a smoke mixture at the inlet of the bellows, and watch the conduct of the current as it comes up through the pipe and into the air. Likely this or kindred ideas have been actually carried out, but I do not call to mind any account of the fact.

It is said by some, and rightfully too, that the swell does not afford a true diminuendo or crescendo. Here, again, we must look carefully into the hidden or less obvious relations of things in order to maintain our defence of the swell on such grounds only as do not bring us in conflict with the teachings of nature. No doubt as good a starting point as any for for the purpose is the oscillation of a pendulum. It is known that within certain limits the amplitude, or, let us say, the period of vibration of a pendulum is independent of the time. With a given pendulum, and within a certain limit of arc, all vibrations, be they long or short, are made in the same time. The vibrations of the pendulum under the restriction noted above are typical of the aërial movements of waves of sound. All sound is produced by some vibrating instrument, and conveyed to the ear by some vibrating medium —generally the air. The pitch of a tone depends upon the time of the vibrations. The more vibrations taking place with a given time the higher the pitch. Loudness of tone depends upon the amplitude of the vibrations. When our given pendulum is making its greatest allowable amplitude, it corresponds exactly to the particles of air when they are making their greatest wave length—that is, their loudest tone—and when the pendulum is accomplishing a very small oscillation it corresponds to the particles of air when they are making their shortest wave length—that is, a faint sound. In both of these cases the oscillation, whether long or short, are made in the same time. A shorter pendulum corresponds to a higher tone in pitch, though the same kind of ratio does not exist between different lengths of pendulums as between tones of different pitch. A loud tone being caused by the energy of the vibrating molecules of air—their extent of amplitude—it follows that a true diminduendo can only be afforded by the source of the sound itself. The shutters of the swell-box simply interpose, or remove, as the case may be, an obstacle in the path of the vibrating medium. The tone is smothered or cut off when the swell-box is closed, while at the same time the molecules of the air within, influenced or governed by the resonant columns of air in the sounding pipes, are still maintaining their same amplitude—that is, their loudness of sound. Someone has very aptly said that the swell-box "takes the bloom off" of the tones of the pipes in the swell. If the things just written are true, Nature says so too. But this argument cannot be held to demolish our ground for defence of the swell; it only goes to establish the consistency of making said defence on truly rational grounds. Some of the anti-swell advocates may say, "Having established the fact that the swell-box affords but an artificial and unnatural gradation of tone, you are driven to the necessity of yielding the situation." We, on our side, would reply: "Then let us *all* be consistent." Let us dismantle our organ of mixtures, fifteenths, twelfths, principals, &c., as the same afford an entirely artificial and unnatural method of supplying harmonics.

I think the first text-book on natural philosophy that comes to hand will prove to be my ally in the statement that the pipes of an organ, notably the flue-work, are deficient in harmonics. The open and stopped diapasons sound the fundamental with almost a total absence of those upper harmonies so necessary to richness and sympathy in tone—those precious qualities that place the human voice beyond the hope of emulation by man's inventive skill, and the possession of which in a great degree by the violin and violoncello lead us to speak of the tones of these instruments as almost human. It is not logical to speak of the tone of a diapason as being "rich," though it may be pure. In view of these facts, if the "anti's" still cling to the mixtures, &c., let the "pros" have their swells, and let both factions be thankful that human invention has made so much out of fields that nature has left so unpromising and hopeful that the genius of the future may persuade nature to yield up her precious secrets.

"Whoever thinks a perfect work to see
Thinks what ne'er was, nor is, nor e'er can be."

We therefore agree with the advocates of the swell, because the end to be gained is most desirable, and the swell-box has gone farther towards that end than any other device so far brought out. The tone of an organ pipe is a specific, determined, arithmetical quantity. Science and art can, at the present time, point out no way to introduce at the fountain-head those much-longed-for harmonies, nor can they instruct us how to influence the unyielding tones so that they may differentiate the power of their voice and speak with those subtle *nuances* that express the mind and heart of the musician who rules their speech.

We fail to see, therefore, why it is not wise to avail ourselves of such methods of expression as the best thought of the age has afforded us.

The swell is not a "necessary evil." The necessary evil seems to lie in the very constitution of the organ itself, which presents problems that seem incapable of any solution that will satisfy correct theories. The swell is a necessary advantage —a common-sense arrangement to produce certain effects that the great king of instruments seemed to deny.

To recapitulate. We hold that all really unpleasant effects resulting from the use of the swell may be obviated by an adherence to the teachings of the laws of acoustics in the practical construction. If, after this, the tones of the swell lose a trifle of their bloom, who has proved that they have any less value from an æsthetic standpoint because they have undergone a differential modification? It is more true that their value has been transformed into a desirable equivalent than that it has been depreciated by the process, while an indispensable effect is gained, for the loss of which we have no compensation at all. A broad estimate of this question should be taken, and not a view so far shortened as was that of the youth who begged the captain to stop his ship because he had lost his apple overboard.

Chicago. **Charles F. Owen.**

MATHEMATICAL TERMS.

[29074.]—"K. L." (let. 29038, p. 480) says:—"As a line that had length without breadth would belong to a world admitting of one dimension only," &c. The inference to be drawn from this remark seems to be that lines having length but not breadth, and points having position but not magnitude, are not possible in this world. Indeed, I have seen this opinion stated by other correspondents. Supposing I were to paint the lower half of this page yellow, what would be the breadth of the line formed by the junction of the white and yellow? If I were then to colour the right-hand half blue, what would be the magnitude of the point where the white, yellow, blue, and green meet? It seems to me that we could construct in this way mathematical figures, the lines of which would have no breadth and the points no magnitude.

W. J. Rendell.

MISCEGENATION BETWEEN GENUS HOMO AND THE QUADRUMANA.

[29075.]—I HAVE no intention of saying one word on the evolution question, on which, by the way, I am neuter, standing as an acknowledged "know-nothing" between the two contending parties. I merely want information on the above subject from those able and willing to give it, through the pages of the ENGLISH MECHANIC, if you will allow it; if not, then directly to myself (see my advertisement in "Wanted" column).

In your issue of June 22, p. 370, appeared a most remarkable letter signed Thomas May, 151, Fulham-road, S.W., in the latter part of which this subject is touched on, and an astounding instance given. The question is—Is it true? Without some more evidence for the affirmative than a mere newspaper communication, I, for one, cannot credit it. Will our very interesting and intelligent contributor, "Eos," give his opinion?

Edward M. Richards.

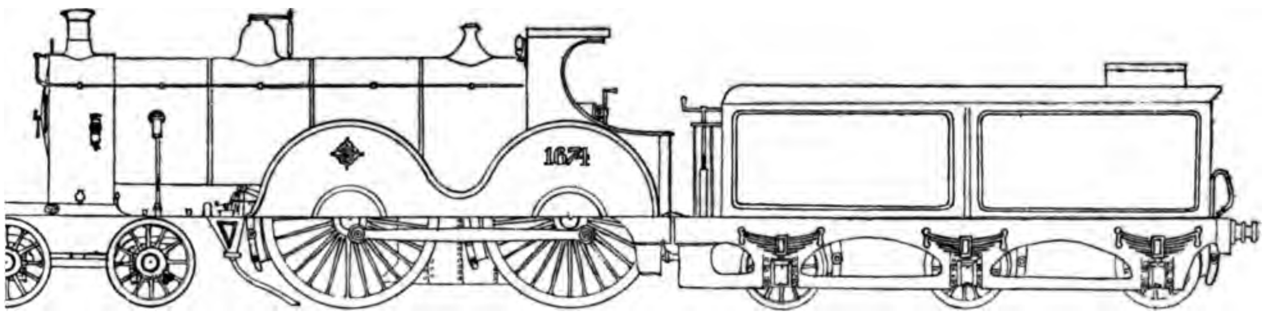
Grange, Enniscorthy, Ireland, July 30th.

[This is a delicate subject, but *we know Mr. Richards well enough to be sure he has legitimate motives in putting his question. Still, we shall be glad if replies are sent direct to him, and not to* us for publication.—ED. E.M.]

BALLOONING.

[29076.]—THERE are many [illegible] in balloons as possibly a practi[illegible] motion, and argue if the sea is [illegible] the air ought to be by balloons. Bu[illegible] the great difficulty of carrying sufficie[illegible] power, and the enormous resistance of a b[illegible] compared to a ship with an equal load, there [illegible] further to be considered. The currents in the [illegible] seldom or never exceed four miles an hour, and fairly well drawn and to be depended on. But [illegible] average motion of the air is at least twelve m[illegible] an hour, rising at times to fifty miles an ho[illegible] whilst their force and the direction are utte[illegible] unknown beforehand. Now, if the currents in th[illegible] sea were as strong and uncertain as those of th[illegible] air, the sea would practically be unnavigable.

Simplex



FLYING SCOTCHMEN— (2) MIDLAND.

-As promised, I inclose sketch of No. 2, d Scotchman. The Midland Scotchman ided into the Glasgow express and the . Each portion consists of about three ne Pullman drawing-room car, and two locos are both of the 4-coupled bogie er sketch), design by Johnson. The ain leaves St. Pancras at 10.30, and sh Town runs to Leicester (about 100 ving at 12.25, and leaving at 12.29, gets on at 2.13, and after a stoppage of 25 eparts at 2.38, and reaches Carlisle at asgow at 7.50.

nburgh flyer leaves at 10.40, and runs Nottingham without a stop, arriving leaving at 1.9 runs to Leeds at 2.47, 5.47, and Edinburgh at 8.25. The Mid- is the longest to Edinburgh, and the lasgow; but nevertheless the running be said to be behind either of the other

d. **H. E. Bickerton.**

-As these trains are now exciting a nt of interest, I think it would be use- paring the results if we knew the fol-

ny miles of dead level, and what is the adient of the remainder of the line ondon and Edinburgh by the North- reat Northern, and Midland; also the ight of these trains, and the number f stoppages.

Monday, August 6th, the North-Western running to Edinburgh in eight hours, ly at Crewe 5min., Preston 20min., and nin., or 7½ hours to run 400 miles—an 53⅓ miles an hour.

this is the fastest long-distance run in at all events, it contains the longest Euston to Crewe, 158 miles in 3 hours, ng the Fort Wayne to Chicago record s by 12 miles and 1 hour 10min.

using 7ft. 6in. singles from Euston to Jumbos from Crewe to Carlisle. We d to see Mr. Bickerton's sketch of Mid- reat Northern engines, but hope they ter proportioned than that of City of

ugust 6th. **J. G. H.**

FFECT OF LIGHTNING.

-ON Monday afternoon, July 30, a great m occurred here, in the vicinity of My house is situated on the top of a hill, at one end a turret surmounted by a k.

reports were simultaneous with the urring flashes of lightning appearing head, I fully expected that the turret, highest point in the vicinity, must be . placed myself so as to observe the

hundred paces from the house on the of the hill I have some large old Two, that we call "the twins," are ether that their branches intermingle. m measures 8½ft. in girth, taken 4ft. ound. Both of these were struck simul- by the lightning. The largest was the bark ripped off in three streaks in direction from the top to the ground. tree has only one score, the lightning a spiral course, making over one turn unk.

es cut by the passage of the electricity niform in width till near the ground, become wider. The bark was taken wing the white wood beneath; but in f each there is a dark line, caused by ip of adherent bark. The ground at e trees was in no way disturbed, but of bark were flung off some yards

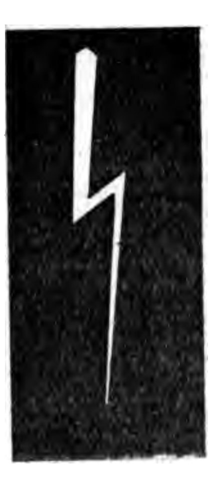
arity of this occurrence is that the ould have struck two trees, and that me way down the hill, and their tops consequently much below the weathercock on the turret, that this, having no lightning conductor, should have escaped. This leads me to infer that in the open country conductors attached to a house may be a mistake, because they are likely to attract lightning. If one or more conductors were placed in the vicinity, or led up some neighbouring tall tree, they would fulfil the purpose of protecting a building, particularly if connected at the top by a telegraph wire.

I believe some statistics have been published of the kind of trees most liable to be struck by lightning, but at present I cannot find the information. Firs seem very likely subjects, on account of the numerous pinous leaves serving as collectors. It is almost certain that anyone standing against the trunks of either of these trees as a shelter from the storm would have been killed by this flash.

F. H. Wenham.

PHOTOGRAPHS OF LIGHTNING.

[29080.]—It is with diffidence that I venture to add an item to the information so lucidly supplied by such an eminent contributor as "F.R.A.S." (29026); but as it is in accordance with the extract from "Montaigne's Essays," I will no longer forbear. The American quoted on p. 476 may consider it "tall," and others may think it would make three if added to Ananias and Sapphira; but it was witnessed by myself about the year 1863, whilst walking one of the roads on the Somersetshire side of the city of Bristol, and proves that the zigzag lightning of the artist has truly a counterpart in nature, notwithstanding "F.R.A.S." and Mr. Abercromby. What is not and what cannot be done, has been so often disproved that the incautious expressions under this number have led me to take notice of this one. Whilst walking along the road mentioned, with a lady friend, and thinking of anything but lightning, an astonishingly bright zigzagged flash rent a very dark cloud, much to my delight, but to the discomfort and vexation of the lady mentioned above. I have often thought of the occurrence, and often watched for a similar treat, yet it has not come; but, instead, similar ones to those mentioned on p. 475. How many "forks"—as they are sometimes called—I could not tell, as the houses hid all but one very distinct one, and herewith is a correct view of its appearance.



West Norwood. **John Williams.**

ELECTRICAL ACTION AS GENERATED IN HUMAN AND OTHER BODIES.

[29081.]—That the current generated (letter 29049) was akin to electricity or galvanism, appears to be conclusively established by Mr. Rutter's later experiments.

That it was not mechanical or muscular was shown by a set of three pendulums connected directly with one and the same brass ball, but the current in the centre one intercepted by the interposition of a non-conductor instead of the brass wire from which the other two pendulums were suspended.

This centre pendulum remained motionless, whilst the movements of the two others were in unison. This fact was held to settle that point, although involuntary muscular impulse might be possible in the arrangement described by "X." I do not understand what is meant by "palladium 90°, antimony 270°, and oxygen 360°; perhaps "X." will explain.

As to size, I think the only effect will be to lessen (or increase) the swing of the pendulum in accordance with the usual law. I have seen a leaden weight suspended by a silk fibre some 4ft. long, held by the finger and thumb at the end, and passed through a tripod by way of stand, and I see no reason why the size should do more than control the swing of the pendulum. I do not know "what sort of electricity" it may be. Mr. Bottone is quite right in his objection to having any unknown cause of movement ascribed to electricity without apparent reason, but Mr. Rutter also constructed a galvanometer which measured the "quantity" or E.M.F. of a current (generated by muscular action) through a very long length of wire, I think he said two miles (or it may be that the resistance was equal to two miles of wire). I have lost his pamphlet, but I think he described his instrument as a "magnetoscope," and possibly under that head it may be read at the B.M.

I suspect the writer of letter 29052 has used glue, lacquer, or varnish somewhere in his work. Mesmerism is generated by exerting the will, and although it can exert great force by causing muscular contraction, does not appear to have any direct connection with the "sort of electricity" shown by the electroscope.

Mr. Rutter's experiments were numerous and public. It was, I believe, Reichenbach's book on "Odic Force" which led both Mr. Rutter and myself to experimentalise, and I, being at that time one of the most powerful mesmerists (although not exhibiting or lecturing), was naturally led to investigate the phenomena.

Rutter's galvanometer consisted of a flattened coil of insulated wire (exceedingly fine) suspended by silk fibre in close proximity to the poles of a powerful compound magnet, two basins contained water not acidulated, and a square inch of platinum terminated the line at either end, and this line wire was so connected up that the current passed through the suspended wire coil, mercury cups being used to make contacts. Upon placing the platinum squares in the basins the operator closed, with muscular force, one hand, having the other relaxed and open in the other basin, and a current passed and defected the galvanometer-needle, reversing the movement of the hands, the deflection was, of course, in the opposite direction. This current, developed or evolved from muscular action "was, of course, the converse of that by which galvanism and electricity cause muscular contraction, for, although a powerful mesmerist, my muscular force was feeble, and only deflected the needle some 15° or 20°, whilst by strong men I have seen it deflected 40° or 50°.

If desired, I will send Editor sketch of galvanometer used. It was not unlike Varley's, although many years prior in date.

I think a pendulum 6in. long would be convenient size. The circular motion is evidently the effect of two impulses at right angles. I think I have replied to the various remarks made, and there are many other interesting details for which in this week I fear to ask space to describe.

Senex.

[29082.]—In my last note, 29049, p. 499, on M. Boehr's experiments, I confined myself to the influence on the pendulum of the substances placed beneath it. I may now briefly observe that in the description of his experiments a position facing north is said to give a motion precisely opposite to that caused by a position facing south, that the movement, when the pendulum is held by a man is opposite to that when it is held by a woman, and when held by the right hand opposite to that when held by the left (by which is meant a difference of 90°), the right hand of a man corresponding with the left-hand of a woman.

I suppose there is no reason to doubt that Boehr produced the results he describes; but as to this anyone can try for himself when the weather is dry; but whether they were occasioned by the cause he attributes them to or not nobody knows. My own idea is that the result is due to a combination of causes, one of them being involuntary motion of the hand, or vibration of the ground. The magnetism of the earth appears to have something to do with it, and possibility electricity of some kind, known or unknown, or something of that nature.

It will be remembered that in Reichenbach's experiments the north pole of a magnet and the right hand of a man gave a blue light, while the south pole and the left hand gave a yellowish-red light; also that a metal bell or the strings of a violin put in vibration became luminous.

Notwithstanding the heading of this note, which I take for convenience from that of "Senex's" letter, I do not mean to assert that electricity or magnetism are the whole or any part of the cause of these phenomena; neither do I intend to imply that they are not.

A subject more strictly in accordance with the heading, on which I should like some information, is the shock of the torpedo. How is it communicated and how generated (I do not mean a description of the organs)? I have heard of people who could give similar shocks, and should like to know whether this power could be acquired or how it is accounted for. **X.**

ELECTRICAL ACTION.

[29083.]—Some thirty years ago I saw Mr. Rutter produce results like those described by "Senex." He admitted that no one else could do so, and I am sure that he had unconsciously acquired the knack of making the ball oscillate by small motions of his hand. **M.**

SCOTT'S BOILERS.

[29084.]—As regards the internal tube (letter 29034), I believe it was in the specifications for a patent applied for last year, the internal tube being placed in the centre of the flue tube connected at the top and bottom, the internal tube commencing past the bridge and terminating at back end of the boiler, leaving as much room round the internal tube as was over the bridge, using the ordinary fire-bars and draught. I know where they have been experimenting with the internal tube a long time. **Fireman.**

COIL BOILER.

[29085.]—In reply to Mr. A. M. Monteath (letter 29035), coil boilers are perfectly practicable and highly successful if properly constructed and intelligently worked. They have their advantages and also their drawbacks, in common with most things.

I cannot perhaps do better than briefly describe one that I made and fitted in a 24ft. launch, with 5ft. 6in. beam, a few years ago; the engine being of special construction (not on account of coil boiler), and having two 3in. single-acting cylinders with 4in. stroke.

The boiler consisted of a single-spiral coil of solid-drawn copper tube ⅝in. external diameter, and about 80ft. in length. It was coiled in the form of a dome, or rather bee-hive, about 18in. diameter, in largest coils; the convolutions were spaced about ¼in. apart, so that the products of combustion passed between and entirely enveloped the whole coil, which was encased in a double iron cylindrical casing having an air space between the inner and outer cases; a few fire-bricks and a grate at the bottom built around the inner casing formed the furnace. In the upper part of casing above the coil was a feed-water heater consisting of a flat coil of ½in. copper tube about 12ft. long, which abstracted heat from the waste gases before they entered the funnel. The inner end of the heater coil was connected to the top end of the main coil, and the outer end to the feed-pump; the bottom end of main coil was connected to a vertical copper steam receiver 6in. diameter by 2ft. long, at about mid-height, so that any water carried through with the steam falls to the bottom, and is blown out at intervals by a cock connected with the bottom, and any surplus steam can be blown overboard by same means if desired. The steam-pipe, safety-valve, gauge, and whistle were connected to the top.

The boiler was fed by a small donkey-pump, as being more convenient than driving pump by main engine, so that a small supply of water could be kept up regularly, which is necessary to regular and successful working. A handle in the flywheel of donkey-pump converted it into a hand-pump for raising steam in first instance. The working pressure was 120lb. per square inch, and the boat travelled exceedingly well. I have at times got under way in six minutes from the time the match was applied to light the fire, which is very sharp work; but I could always do it in ten minutes.

Undoubtedly coil boilers are very sensitive, and require careful handling; but they have their merits—notably absolute safety from destructive explosions, and the great saving of time in raising steam.

Worcester. **John J. Cam.**

THE BOEHM FLUTE.—VI.

[29086.]—The harmonics or sequences of a flute beginning at low C are as follows:—C 1, C 8, G 12, C 16, E 20, G 24, B flat 28, C 32. Now it is remarkable that, in Prof. Dolbear's table, showing the quality or composition of the sounds from various instruments, the flute tones have the following overtones sounding along with the primary tone C 1—viz., C 8, G 12, C 16; and narrow open organ pipes, which are considered as flutes, have with C 1—C 8, G 12, C 16, E 20, G 24. The ratio of vibrations are 1, 2, 3, 4, 5, 6, 7, 8. The clarinet also shows a similar relation between its sequence and overtones. Its sequence being 1, 12, 20, 28, 36, 44, its overtones are 1, 12, 20, 28, 36, and its vibrating numbers 1, 3, 5, 7, 9, 11; these corresponding exactly with those of a narrow stopped organ pipe. I have not seen these facts stated before, but these data make one inclined to believe that "the sequence of an instrument approaches closely to its overtones or tone quality." To those who desire to investigate further into this interesting subject, I recommend the following books—viz., "The Scientific Basis of Music," by Dr. W. H. Stone; "Hints on the Fingering of the Boehm Flute," by C. Mahillon; and "Sensations of Tone," by H. L. F. Helmholtz, M.D. The mouth-hole of a flute is usually oval in shape, although Boehm preferred it to be a parallelogram with rounded corners. The angle and height of the sides of this hole have a great influence on the intonation, quality, and quantity of the sound produced. Boehm says that the sides should be 4·2 millimètres high, and have an angle of 7 degrees. The best size of hole he states as 12 millimètres long by 8½mill. broad. I find for my blowing that this hole is too narrow, and not quite high enough in the sides; this, of course, is regulated by the amount of air and its pressure at the performer's command. The effect of raising the height of the mouth-hole sides is to increase the volume of the lower octave, but at the same time making the extreme top notes difficult to reach with facility.

Some years ago, along with an eminent professional player, I examined a large number of flute heads by various makers, compared their shape of parabola, sizes, capacity, and their qualities of tone, volume, intonation, and facility, but could find very little agreement between the good ones as a class, or sufficient data to make any improvements. Each trifle sometimes so contributes to either an improvement or otherwise; and again, some flute heads would stand a good deal of alteration without any perceptible change. The quality of tone, facility, and in a less degree the volume, are affected chiefly by the size and shape of the mouth hole. The length of parabola affects chiefly the intonation, and in a less degree volume and facility. The capacity or depth of parabola affects volume and intonation, and in a less degree quality. These few facts were eliminated after much trouble and experiment. The length of parabola in a Boehm flute, I find, is generally about 15 centimètres. Boehm states that it should be equal to one-sixth of the entire length, which would make it no more than 10 centimètres. The distance from the middle of the embouchure to the stopper or cork should be about 17 millimètres, or equal to one thirty-fifth of the length of flute. The tubes for the parabola head of flutes are drawn down from a larger size of metal tubing. The general mode is as follows:—A steel mandrel is turned up in the lathe to the exact size and shape of the desired parabola; at all points the diameter must be exact to a thousandth of an inch after it is carefully polished and as smooth as possible. This mandrel must have a thin long neck suitable for being attached to a powerful drawing machine. The tube to be drawn should be softened, polished inside, and a tight fit on the larger part of the mandrel. One end of this tube is cressed or reduced in size for about ½in., so as to catch firmly on the shoulder of the mandrel, allowing the neck to project through it. It is then put into the machine, and slowly drawn through four holes in succession, in a plate of lead about ½in. thick, and being lubricated with tallow, it forces its way through, widening the holes in the lead, but at the same time, gets crushed down to the exact size of the mandrel. It is then removed, softened, polished inside, replaced again on the mandrel, and drawn through several holes in a sheet of block tin about $\frac{3}{10}$in. thick. It then, being removed, is cut to its proper length, the exact place for the embouchure being found by a gauge. If the tube is to be used as a lining for a wooden head, its thickness should not exceed 15 thousandths of an inch; but if of silver, and to be mounted without a cover, then the thickness should be about 25 thousandths of an inch. A fairly good
ing machine can be made from a screw 18i
and 2in. in diameter, with 10 threads per
having a suitable nut at least 3in. deep, an
to be firmly attached to a lathe-bed, say abo
long, with two very strong bolts. A crank o
wheel with 6 arms, about 3ft. in diame
attached firmly to one end of the screw, v
strong swivel joint is at the other end.

To make a wooden head, the cutters to fo
parabola may be made as follows:—Tw
mandrels are turned up, one of them being fi
at a hundredth of an inch less at every p
size than the other, and fluted spirally to t
with 9 flutes. The other, being full size, i
spirally to the right with 13 or 15 flutes, eac
being made sharp enough to cut; but care r
taken that this full-sized rimer cuts no mo
its correct size. These two rimers need
tempered, as the risk of bending is very
but for cutting ebonite it is almost neces
temper, as the wear quickly would alter i
Correct gauges are required to insure that
interior of the head is correct. My set con
about 24 small circles of thin brass, No. 22 I
with a hole in the centre of each, to allow t
be turned up to correct size in the lathe, a
when in use, to be fastened by a small n
shoulder on the end of a metal rod. The
thousandths are stamped on each, and the d
in half-inches is marked on the met
The diameters run from ·660in. to ·750in.
to a difference of 90 thousandths of a
each being about four thousandths less than
next to it. If one desires to save time, it
sufficient to select the head required, and ad
gauges to the 14 sizes given in the table
heads, which I now append, all of which ar

FLUTE HEADS.

Lot, Paris, 1884	Boosey, 1884.	Millereau, Paris, 1884.	Munich, 1876.	Rudall Carte, 1881.
1	2	3	4	5
·669	·656	·669	·662	·668
Cork				
·678	·666	.675	·669	·673
*·685	·679	·684	·679	·682
		*Mouth hole		
·695	·694	·690	·688	·692
·704	·706	·698	·698	·701
·714	·716	·708	·706	·712
·721	·726	·717	·714	·720
·729	·733	·724	·721	·726
·736	·739	·732	·726	·731
·710	·742	·737	·731	·736
·743	·744	·743	·737	·741
·745	·746	·747	·742	·745
·747	·747	·748	·748	·747

SCALE OF HALF-INCHES.

yet each has some slight difference from the
and I prefer either No. 2 or No. 5. No.
simple cone, the sides being straight lines.
put here for comparison. If one desires t
the curves of these parabola, let the length c
be kept only full size, but let the diameter
points be multiplied by 50 or 100. Thus an
can be drawn along with another and comp
these individual measurements are conne
each other by straight lines.

Errata.—Chap. III. (28891), third line,
long F sharp, read the long F natural.

Vulca

SOME LITTLE-KNOWN PLANTS OI FLORA MEDICA.

[29087.]—Berberaceæ: Besides the c
berberis of Europe, there are several Hin
species, the chief being—1, Berberis Lycium
beris aristata; every other known kin
appears to possess febrifugal properties.

A yellow colouring matter and an a
bitter principle exists in them all. A wat
tract called Rusot in the Indian markets is p
in the mountainous districts from the sli
stem, and branches of these shrubs. Dr.
identified it perfectly with the celebrated
ινδιχον of Dioscorides and *Hoozis hindee*
Arabs. Alone, or rubbed with equal parts
and alum and diffused through water, it is
used as an external application in incip
chronic ophthalmia, being applied round t
Drs. Royle, Playfair, and other high aut
speak in very favourable terms of this p
Rusot of best quality, when fresh, is a pale
uniform, pasty extract, soluble in wat
alcohol, to which it communicates a brilliant
colour, exceedingly bitter to the taste, a

smell, blackened by salts of iron, precipitated ution of gelatine, and consequently contain- nnic and gallic acid. The bitterness of this :t is due to the presence of a principle . "Berberite," discovered in the root of ıropean barberry by Buchner in 1835, 'hich is found in the Rusot of India, a pro- n very great demand by the native dyers. found the market supply old and of poor :y, I prepared a quantity with my own hands e simple method practised in the Himalayas. ı the shrub was in full flow of sap, I bared oots and cut out a few pounds of chips with e, putting them in an earthen water-pot till it full to the neck. I then nearly filled the l with water, and set it to boil very slowly on of sticks for some hours. I then poured out ot liquor into another pot, refilling with fresh , and repeated the process two or three times, ı resulted in the extraction of a thick, heavy on straining which it was put on the fire to further reduce the amount of water; , evaporation in shallow vessels exposed to eat of the sun rendered the extract stiff and , when it was fit for packing in a jar. The of this manufacture finds its way to the dyers Iindostan. "Berberite" is obtained from t by a particular process. It is a light er formed of minute silky, yellow needles, d of smell, excessively bitter, little soluble ld water, but hot water dissolves it freely; le also in alcohol, insoluble in ether. It ɔo alkaline or acid properties; is rendered . by sulphuric, red by tannic, and is pre- ıted by gallic acid. In alkaline solutions reilow colour is indistinct, but returns on ation with acids. "Berberite" is precipitated its solutions by corrosive sublimate, nitrate ver, tartar emetic, and many other metallic but not by acetate or sub-acetate of lead. It :y easily destroyed by a temperature not much ding that of boiling water. On analysis berite" is found to contain azote 1, carbon ydrogen 18, oxygen 12 atoms. The trials in- ed on the medicinal virtues of Rusot led to satisfactory results. The bark of Berberis .ris was first used in Europe as a remedy for ; then M. Buchner found ten-grain doses of berite" tonic of considerable merit. Lastly, ntense bitterness of this principle, and its ing "azote" in ultimate analysis led to its oyment in the treatment of periodical fevers. rburg's Fever Drops" (a very expensive ıt medicine) is said to contain a large per- ge of "Berberite," to which probably the rful diaphoretic action of this secret com- nt is due. I have known tropical fever cases, hopeless type, subdued by the little bottle, ining two doses only. More than thirty years I was travelling in the Himalayas with a d, who had not long returned from Europe, home for a bad form of malarious , of which he appeared to have been . by the long sea voyages to and fro. We were oring a hot and picturesque valley in the ıt sunshine when my companion said he could) further, and laid himself down with a pallid and shivering body under a tree, exhibiting all ymptoms of an attack by the lurking enemy. ıad sent on our servants and baggage miles to our intended halting place across the ıtain, and the day was more than half gone— ven a hut to be seen and no medicines in our ets. There was a sparkling rivulet and a shady erness of Berberis aristata for our consola- and druggist's store. With my pocket-knife s soon at work on the roots of an overhanging eris, collecting enough chips to make a strong sion in a metal mug we carried in our knap- . In less than an hour the draught acted as :ent sudorific, and we managed by slow steps ach our destination at sunset.

sot is best given as a febrifuge in half-drachm , diffused through water, and repeated thrice or more frequently, daily. It occasions a feeling reeable warmth at the epigastrium, increases tite, promotes digestion, and acts as a very e but certain aperient. The skin is invariably t during its operation. In over 30 cases of an ague (several complicated with spleen) the r was checked on an average within three days commencing the Rusot. In eight cases of tian, six were cured. The cases of common idian successfully treated were so numerous they were not recorded. In no instance was -ache or constipation produced, but Rusot was d to exasperate the symptoms of chronic ıtery and hepatitis when complicated with

Eos.

LATHE MATTERS.

)088.]—OWING to the kindness of Mr. J. cott, I have now before me the drawings of bury's differential gear, as they appeared in *m and Work* for April 27, 1878. I must say the system does not appear to me to be at all a one.

I have no doubt that many of your readers can refer to the diagrams which appeared in former numbers of the ENGLISH MECHANIC, I may be permitted to state my objections. This I do with the object of gaining information, not of finding fault with a contrivance which may be very excellent. If any mechanical reader who lives in Birmingham could get a peep at the gear in actual operation it would be far more satisfactory than any amount of theory.

The shape of the teeth in both the wheels is the first thing that strikes me as being wrong. They are really not teeth at all, but simple waves, and it appears to me that power would be greatly wasted by such teeth. The eccentric marked *d*, which revolves in the inner wheel, would also cause a great deal of friction. In my lathe, whose mandrel is 1⅜in. in diameter, that eccentric would be 2½in. at least, and such an eccentric grinding round with the velocity of the quick pulley would cause friction terrible to contemplate in a 6in. foot-lathe. The system of arms rushing up and down, backwards and forwards, with every revolution of the speed pulley would increase the friction materially. I suppose the want of uniformity in the motion of the mandrel caused by the rocking of the arms would not have any injurious effect in practice.

I do not criticise this system with any sinister motive, and I would be very glad indeed if my objections are found to be groundless, as I could then fit it to my lathe.

In this month's *Amateur Work* "F. A. M." has kindly copied for my edification an extract from Holtzapffel, Vol. IV. p. 113, which describes another internal gear which appears to be free from the objections against Jewsbury's, but it would have nearly as much rattle as the ordinary kind. Perhaps some of our readers have seen this kind, and can speak of its merits.

Is there not a vertical slide which can be fixed to the slide-rest of any lathe, and is useful for milling, &c.? I am sure I have heard of such; but my query some weeks ago met with no response.

Perhaps some of our clever ones would give drawings or dimensions of a 6in. lathe-head for light wood turning? My 6in. headstock is very hard to drive at high speeds, and, rather than get a new lathe for wood, I propose making a new headstock. I would like very much to have opinion of some of your readers as to the best form in casting mandrel bearing and pulley, and whether there should be a small flywheel on the mandrel, as there is in fret machines and some lathes.

J. L. D.

THE FRONT-SLIDE LATHE.

[29089.]—I HAVE read from time to time the letters which have appeared in your paper on the front-slide lathe, and think that perhaps my experience on this subject may be of interest to your readers. I have now had in my possession for over a year a 3½in. front-slide lathe, the slide-rest of which has a vertical slide, and the conclusion I have come to after doing work of all kinds on it is, that this is by far the best form of lathe for a skilled amateur.

The time and trouble saved by being able to slide the rest out of the way beyond the tail centre without disturbing the work is very great; but what I like best of all is the vertical slide. This arrangement does away with the nuisance of packing up tools, and by its use one is enabled to set the cutting edge (far more accurately than by packing) to exactly the right height, and this in an instant, simply by turning a small handle.

It is necessary that such a lathe as I am speaking of should be made by a first-rate maker, as all the slides must be very carefully fitted, for I can imagine that, if badly made, the vertical slide might be a cause of "chattering"; but I have turned up in my lathe work as large as it will take in without the slightest symptoms of "chattering." I think that any skilled amateur who uses a slide-rest with a vertical slide will never willingly go back to the old form.

While I am writing to you I should like to say a word about the American (Whitcomb Watch Co.'s bench lathe) split chucks.

Some time ago, if I remember aright, they were characterised in your paper as "toys." This they certainly are not: they are thoroughly practical, useful tools, and hold the work very tightly, absolutely truly, and do not damage it.

Notogsden.

ABERRATIONS OF MIRRORS.

[29090.]—"ORDERIC VITAL" (letter 29048) writes under some mistake as to my letter 29037. I do not make the assumption he attributes to me, nor the deduction he supposes, either. My statement is the one he says is correct and easy to prove —that $B^1 B^2 = 2 F^1 F^2$. There is no difference betwixt us here.

But I beg to point out that $B^1 B^2$ is not the displacement of the normal: it is the displacement of ray incident on C from B^1 and the normal bisects the angle at C. I had supposed the incident ray to be unaltered in direction in each case, and that to produce the focal displacement of parallel ray reflected from element C to F^1, we had to rotate element C 2″. Then the reflected beam would move 4″. Now I see no escape from the conclusion that ray incident from B^1, instead of returning to B^1, will now make an angle at C of 4″ also, and thus return to B^2. Neither do I see how the angular motion of the normal can be other than identical with the angular motion of the revolving mirror, and, therefore, in each case half that of the reflected beam. I have to thank him for reference to previous volumes. I have already read them. I need not discuss his additions to my construction, since they do not affect above at all.

Edwin Holmes.

CURVATURE OF IMAGE BY PRISM—SEXTANT GLASSES.

[29091.]—WOULD "A Fellow of the Royal Astronomical Society" kindly explain why the image seen through a prism when looking at a window-bar parallel to the refracting edge of the prism is strongly curved, with its convexity towards the base of the prism?

2. In the sextant the horizon-glass extends upwards, beyond its silvered portion, and the direct object has to be viewed through the transparent portion of the horizon-glass. Is there any practical reason why this transparent portion should not be cut off, so that the one object could be viewed directly over the silvered portion of the horizon-glass, while the image of the other object would be seen by its side after two reflections?

3. In both the index and horizon-glasses of the sextant the reflected object has its definition impaired by reflections at the two surfaces of each glass. Are there not many uses of the sextant in which black index and horizon-glasses truly flatted and highly polished would reflect abundantly and give sharper images, while doing away with the errors arising from interposing the coloured shades?

4. With very dim objects, reflectors of speculum metal or face-silvered glass would give more luminous as well as sharper images. Is it not possible to improve the sextant in some of these respects?

It occurs to me that by the use of various mirrors—interchangeable like small lathe-chucks in tubulures where the index and horizon-glasses are fixed—some improvements might be made. In that case, when taking solar or lunar observations, the black-glass reflectors might be inserted, and no shades except those in use before the ocular would be needed. On other occasions the metal or face-silvered glass mirrors might be inserted, and a variety of mirrors like small chucks might be part of the furnishings of the sextant. The face-silvered mirrors might easily be resilvered if they were injured or blackened, as is the case whenever silver is exposed to sulphurising influences.

I think that there would be no insuperable difficulty in making the interchangeable mirrors fit accurately. Five chucks in the tubular mandrel of a delicate lathe may be made to centre and place themselves with extreme accuracy.

M. O. H.

DOES THE MIXTURE OF BLUE AND YELLOW LIGHT MAKE GREEN LIGHT?

[29092.]—YOUR readers are aware that, chiefly on account of an experiment and reasoning by the celebrated physicist, Prof. Helmholtz, of Berlin, the scientific world has given up or modified Sir David Brewster's old theory of primary colour-combinations, but on apparently insufficient grounds.

Helmholtz's simple and beautiful experiment was the placing a half-silvered bit of glass in such a position that a blue wafer seen through the unsilvered part, mingled its colour with that of a yellow wafer reflected from the mirrored moiety of the glass, in the observer's eye, when the resulting colour is certainly not green. The flaw in this will be presently shown.

At the 1881 meeting of the British Association in York, the President, Sir John Lubbock, stated in his address that it was now definitely settled in science that, although a mixture of blue and yellow pigments produced a green colour, on account of the impossibility of obtaining pure colours in that way, it was quite a different matter when we come to manipulate with coloured light. Having taken a blowpipe, and some materials with me to the York meeting, I wrote to Sir John next day, and offered to show him that atacamite, or chloride of copper, which yields a very pure blue light when heated before the blowpipe, will, if intimately mixed with a very small proportion of any sodium salt (which gives yellow when heated by itself) and treated B B, affords a perfect green light.

Sir John politely replied that the subject was extremely interesting, and that this view of it ought to be followed up; but that he preferred the more simple optical treatment of the matter, as with a prism, &c. On returning home, I followed Sir John's advice by focussing the bright sun-rays with a lens upon the face of a prism, in the hope that the ordinary coloured solar spectrum would be strengthened in this way, and a distinct green shown in the spot where the blue converges with the yellow.

You may imagine my astonishment on perceiving the intense white light of the concentrated solar pencil of rays converted into a brilliant *green beam*, which was produced from the solar focus right through the prism. I then procured a number of crystal paper-weights of different thicknesses, and found that the intensity of the green light thus produced was strictly proportional to the mass of glass through which the focussed rays were made to pass; and that, as the green beam was a direct prolongation of the solar beam into the mass, the green colour of the former could not be the effect of refraction or dispersion. When the sun's rays were focussed on a thin plate of glass, there was no apparent change of colour, the solar pencil passing through unchanged.

Thinking over these results, it seemed to me that on Sir David Brewster's theory of the primary colours being red, blue, and yellow, the red rays of a concentrated beam of solar light must be absorbed by colourless or blue glass of a certain thickness, for I produced precisely the same effect (the green beam) by employing a block of blue tinted glass.

To prove this I made the following experiments:—

1. I fastened with Canada balsam a thin plate of glass tinted canary-yellow (which colour has, of course, the property of obstructing the blue rays) on the surface of one of the colourless blocks of glass, and focussed the solar rays upon it, when the resulting beam produced in the vitreous mass was pure yellow!

2. I took a thick plate of about 5 millimètres) of violet-coloured glass (I could not procure any red glass that thickness), and another plate the thickness of an ordinary window-pane of the same colour, and focussed the sun's rays upon each of them successively over a sheet of white paper. The spot of light appearing under the thin glass upon the paper, was precisely the same colour as the glass—namely, violet—the spot appearing under the thick glass was nearly blue.

On focussing the solar rays upon transparent, colourless, or blue blocks of glass, I noticed that bubbles or flaws all along the path of the green beam produced had the property of brilliantly reflecting the solar rays, and that the reflected light thus produced was invariably white.

This would account for the failure to produce green light by means of Helmholtz's experiment.

I published an account of these experiments at the time in *Knowledge*, with the result of calling forth some rather vulgar "chaffing" remarks (at that time permitted by the editor of that paper) to the effect that "the gallant colonel's Venetian blinds were probably green, which accounted for the 'green beam' of light in his glass," &c., &c.

On showing the green beam afterwards to Prof. Stokes, P.R.S., in one of the rooms of the Royal Society, when it (the green beam) was passed through a square block of transparent, colourless crystal about eight centimètres thick, he remarked that this was probably a curious and new representation of the ultra-violet rays discovered by him which he has termed "fluorescence"; but I soon convinced the professor that this could not be the case by the simple expedient of asking him to hold the tail of his black coat under the glass block, when the green beam immediately commenced to burn a hole in it, showing that it could not possibly be due to fluorescence, which is an effect of dispersion.

Belgium, 2nd August. **W. A. Ross.**

P.S.—In the smoking-room of Berry's Hotel at Boulogne a bright sun shining through red curtains caused the yellow flames in the fireplace to seem quite green.—W. A. R.

SEEING WHAT DOES NOT EXIST.

[29093.]—ALTHOUGH the human eye is by no means a perfect or complete organ, optically speaking, yet I fail to understand how it is that flashes of lightning which appear decidedly zigzag to our sense of vision can be, practically speaking, parallel, either vertically or otherwise. The conventional flashes of lightning, as represented by our artists, are decidedly as lightning is seen by the naked eye. There is no media intervening the space from the observer to the lightning, which would cause (by refraction or otherwise) a straight ray of light to appear in its angular zigzag form that I am aware of. Hence, will "F.R.A.S." kindly express his opinion as to the cause? Also whether these photographs and data of the Thunderstorm Committee can be accepted as right? My opinion is, that with the enormous velocity *with which lightning* travels, it is impossible for *a sensitive plate*—although it is exceedingly rapid *with self-luminous bodies*—to represent a definite outline of the flash. It has not time. Therefore the reproduction is a mere streak, possibly the last straight ray of the zigzag flash. In taking a cannon-ball in motion—although the velocity is not to be compared, and, of course, it is a non-luminous body —it is necessary to follow the ball, for an instant, with the camera suspended, before a definite outline can be obtained. I can understand the discharge from a Wimshurst machine appearing as an almost parallel ray; but not so with the discharge during a thunderstorm.

High-street, Acton. **H. Urquhart.**

THE COMMON HOUSE-FLY AND FLEA.

[29094.]—SEVERAL communications appeared in your last issue (No. 1,218) on the common house fly, and a query (65967) respecting fleas in carpets and furniture, and asking for best means of destroying the same. None of the statements as to life-history of the common house-fly are fully satisfactory, and having made a special study of this pest I venture the following remarks. The common house-fly (Musca domestica) in such numbers at this period of the year, may be found in vast numbers in gardens, and in near proximity to closets and the like necessary offices, especially near dung-heaps—in fact, anywhere, if moist decaying vegetable refuse is to be found. It is in this putrefying vegatable refuse the beautifully-winged eggs are laid in patches of from 60 to 90 in number. This laying is repeated several times in a season. I had a captive that laid 472 eggs in some decaying horse-dung (under a large glass globe with a piece of sugar for food) last summer. In about three days these hatch, and the maggots eat up the decaying vegetable matter in which they find themselves placed with great greediness. Because of this we may class flies in their larval stage as nature's scavengers. The maggot in eleven days assumes a barrel-shaped chrysalid form (to be found in great numbers floating on the edges of pools near to or flowing from dung-heaps), from which in a varying number of days, according to temperature, the perfect fly comes forth.

There are two species of this fly, a smaller one (Musca domestica minor). I mention this because it is a common error that this smaller fly is one and the same, only in a younger stage. Insects are full grown when they emerge from the chrysalid form, and do not grow in size afterwards. To have less of these pests we must, therefore, look principally to our surroundings, and have no decaying vegetable refuse about. An untidy house attracts flies for sustenance; but not production. It has been calculated that in one season a single female fly may be the progenitor of some two million offspring. Birds, of course, keep down this very large production to a great extent. The later chrysalids remain in that stage through the winter. I had some 20 or 30 this last winter which were several times frozen for days together. They all hatched in May. A number of perfect flies live in sheltered crevices the winter through. No object for a dark-ground slide can surpass the beautifully indented and winged eggs of this fly. They should be dipped in hot water. This prevents hatching, which spoils to some extent the beauty of the case.

The Flea (Pulex irritans) is produced from eggs which the females stick fast by a kind of glutinous matter to the roots of the hairs of cats, dogs, and other animals; or to the wool in blankets, rugs, carpets, or other similar furniture. They lay ten or twelve a day for several days in succession, and they are hatched in the same order five or six days after being laid. From the eggs come little whitish maggots with annular divisions, covered thinly with long hairs and no feet. They adhere closely to the body of the animal or substance on which they were produced, and feed upon the scurfy excretion of the skin, the downy parts of linen or floss of any kind. They are about ¼in. in length, very lively, and active. When alarmed, they roll themselves into the shape of a little ball. They may be kept in a little box and brought up with dead flies, which they eat with great voracity. In eleven days from being hatched they leave off eating, and lie as though they were dying; but if viewed with a microscope they will be found weaving a silken covering around them, in which they change to the chrysalid form. They continue for nine days in this form, first white, and by degrees darkening as they acquire firmness and strength. They now appear like perfect fleas, but have no motion. As soon as they issue from this bag, they become perfect fleas, and leap away. The white and dark dust mentioned by "Vexation" in query 65967 I suspect are these eggs and chrysalids. If he would kindly send me a few with the floss swept from his carpets in a small box through the Editor, I will determine for him. All his carpets and rugs should be removed, and submerged in water with a quantity of ammonia for several days, or constantly shook and swept in the open air and kept there. The floors and furniture in the mean time should be frequently washed with the same fluid, and allow no fleas whatever to remain in crevices. Brushing carpets with benzine would be of use. **Jack.**

VEGETARIANS AND EVOLUTION.

[29095.]—THE letter of "Gamma Sigma," on p. 504, is a curious instance of how prone the pot is to make derogatory references to the kettle's blackness. The vegetarians may, of course, like other people, be sometimes inaccurate in their reasoning, and may be in error when they conclude that man by nature is a frugivorous animal. But why anyone in endeavouring to show that should take such pains to walk into a logical trap himself is another of "those puzzles which seem insoluble." Permit me to remark, then, that it is far indeed from being "an obvious conclusion" that, because the teeth and intestines of man are neither those of the lion or the ox, therefore, he should eat the food of both those animals; or, in fact, that there is sufficient reason from structure alone to pronounce man "omnivorous" in any legitimate sense of the term. Those who fail to see that might test the argument by applying it to some other instances. Thus, because man in stature is midway between a giant and a dwarf, therefore, when he clothes himself, it should obviously be with the garments of *both!* There is little difficulty in perceiving in that instance that the argument was faulty as the conclusion is grotesque. So far as the peculiarities of structure in man point to anything at all, they would certainly seem to indicate that he would hardly deal satisfactorily with the food of either the ruminant or the carnivora, but would require, or at least do better, with a diet of his own. Whether this little deduction that the vegetarians use as a sort of starting point be a sound one or no, they at least endeavour to test it by the approved logical method of experiment, performed, be it noted, upon their own persons. Whatever just cause of complaint, then, can the flesh-eating world have against them? If they succeed in their experiment, they will be entitled to gratitude for having been the pioneers in a better way; while if they fail, some knowledge still results from their rash enterprise, and as they do the suffering, while the rest look on, it would be ungracious even then to complain of them; while, in the interim, to bring a charge of illogicality against people who are submitting a doubtful matter to the only logical test it is capable of would be comical if it were not irrational and unjust. Whether success or failure will ultimately crown this attempt to break the bonds of custom, which in diet, as in other matters, make slaves of us all, I do not venture to predict. One thing, however, may be asserted. Should the food-reformers at length demonstrate that the slaughter-house is not an indispensable adjunct to our civilisation, they will relieve sensitive minds from a load of disgust which the present method of supplying our tables not infrequently creates. This idea is generally pooh-poohed as "mere sentiment," and so long as the moral sentiments are thrust in the background by a real or supposed necessity, they have naturally no influence on the question of flesh-eating. But only let the necessity vanish, and I suppose almost everyone would promptly decide the question in the negative on moral grounds alone. And now just a word on the concluding paragraph of "Gamma Sigma's" letter. Whether it be wise to confuse what should be a scientific discussion by dragging in the intentions of the Creator, others must judge. But if we are at liberty to gather those supposed intentions from known facts, we cannot help noticing that some nine-tenths of the world's inhabitants have been, are, and seem likely to remain non-flesh-eaters. Whence we are forced to conclude that either the Omnipotent could not get His intentions carried out, or else that the said intentions are exactly of the opposite character to that so confidently assumed. Taken all round, "Gamma Sigma's" criticism of Dr. B. W. Richardson and the vegetarians does not seem a particularly happy one; and if the doctor and his confreres do not get more effectual demolition, "the craze," as it is termed, is likely to spread. **W. J. B.**

Cold Solder.—According to *La Metallurgie*, an alloy useful when metals are to be soldered together at a low temperature can be made as follows: Copper in a fine state of division is obtained by precipitation with zinc from a solution of sulphate of copper. From twenty to thirty parts of this, according to the hardness required, are mixed in a cast iron or porcelain mortar with concentrated sulphuric acid, to which is finally added seventy parts of mercury, and the whole triturated with the pestle. The amalgam thus formed is thoroughly washed with water to remove the sulphuric acid, after which it is left untouched for from ten to twelve hours, at the end of which it is hard enough to scratch lead. To use the alloy for soldering it is warmed till it has about the consistency of wax, and in this state it is applied to the joint, to which it adheres very firmly on cooling.

of mixing? (2) Are the cells pint or quart? (3) To which piece and where is the piece of brass screwed? What thickness? Could he give the mode of fixing? This is not given in the diagram. (4) The carbons are to be ⅛in. apart, but the zinc ¼in. Are the carbons together then? How does he connect up the cells? I don't understand what he means by a sawcut between the Z and C, and so connecting. X. Y. Z.

[65959.]—**Small Organ.**—"G. J. J." can get a well-built organ of two manuals for about £120; all depends upon the profit the builder considers remunerative. I append a specification for a two manual and pedal organ suitable for the purposes he named:—

GREAT ORGAN (CC TO G^3, 56 NOTES).

		Notes.
1	Open diapason metal, seven lowest wood	56
2	Dulciana metal, wood bass..................	56
3	Harmonic flute wood and metal	56
	SWELL.	
4	Stopped diapason, wood	68
5	Gamba, bass from 4	56
	PEDAL.	
6	Bourdon, wood 16ft.	30

COUPLERS.

7	Octave swell	9	Swell to Pedal
8	Swell to Great	10	Great to Pedal

It will be seen from the above that the swell has great advantages, being supplied with the super octave of pipes, and is equal to four stops. The case would be, of course, stained wood; the action should be of the highest quality for that sum.

WM. ROBINSON.

[65961.]—**Infinite Series.**—In my answer of last week I find that in the formula (2) the letter S, denoting the sum of the series, has been accidentally misplaced in printing, and appears as a factor of the right member of the equality. The only correction required is to transpose S from the right to the left of the sign of equality.

Charing, Kent. J. R. C.

[65961.]—**Infinite Series.**—The law of the series being that each term is to be equal to the sum of the two previous terms, it must take the form—

$$+5, -3, +2, -1, +1, 0, 1, 1, 2, 3, 5$$

extending to infinity in both directions, the terms to the left of zero being alternately positive and negative. To find an expression for the general term, I will adopt Todhunter's method (see his Algebra, Chap. XLIX.) This particular case is, however, not given there. The terms of the series are derived by dividing 1 by $1 - x - x^2$ by common division, and then making $x = 1$. Now the expression $\frac{1}{1 - x - x^2}$ can be divided into two other fractions thus: equate the denominator to 0, and solve the quadratic; it will be found that—

$$x = \pm\frac{\sqrt{5} - 1}{2} \text{ or } \frac{1}{1 - x - x^2}$$

$$= \frac{-1}{\left(x - \frac{\sqrt{5}-1}{2}\right)\left(x + \frac{\sqrt{5}+1}{2}\right)}$$

This can be divided into two fractions by the method explained in Art. 647. Thus putting $a = \frac{\sqrt{5}+2}{2}$ and $b = \frac{\sqrt{5}-1}{2}$ for shortness—

$$\frac{1}{1-x-x^2} = \frac{1}{\sqrt{5}}\left\{\frac{1}{a+x} + \frac{1}{b-x}\right\}$$

$$= \frac{1}{\sqrt{5}}\left\{\frac{1}{a} - \frac{x}{a^2} + \frac{x}{a^3} - \&c. + \frac{1}{b} + \frac{x}{b^2} + \frac{x^2}{b^3} + \&c.\right\}$$

We can now make $x = 1$, and the general term will be—

$$\frac{1}{\sqrt{5}}\left\{(-1)^{n-1}\cdot\frac{1}{a^n} + \frac{1}{b^n}\right\}$$

Clear of fractions, remembering that $a \times b = 1$, then replace values of a and b, thus the general term will be—

$$\frac{1}{\sqrt{5}}\left\{\left(\frac{\sqrt{5}+1}{2}\right)^n(+-1)^{n-1}\cdot\left(\frac{\sqrt{5}+1}{2}\right)^n\right\}$$

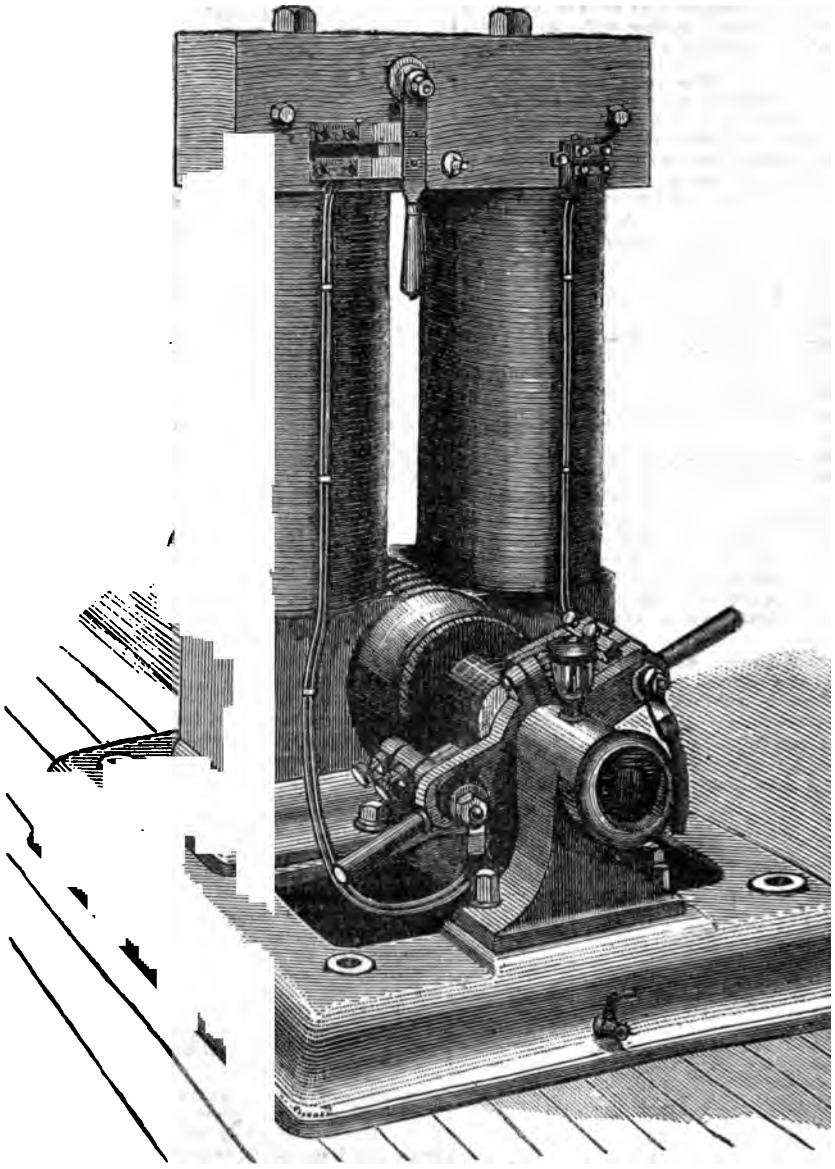
The factor $(-1)^{n-1}$ is to show that the second term is positive or negative, according to whether n is odd or even. This will give the exact value of any term for a given value of n. If $n = 0$, the formula gives 0; if $n = 1$, it will give 1; if $n = 2$, it will again give 1; so there are two 1's in the series, as shown above. Now, as regards the series ½, ⅔, ⅗, &c., the general term will be made up of the general expression given above for the numerator, and the same for denominator, but *with $n + 1$ put for n*. Now the second term is a *proper fraction; consequently, for very large values* of n it disappears altogether, and the general expression will, therefore, reduce to $\left(\frac{\sqrt{5}+1}{2}\right)^n \div \left(\frac{\sqrt{5}+1}{2}\right)^{n+1}$ or $\frac{2}{\sqrt{5}+1}$. Multiply numerator and denominator by $\sqrt{5} - 1$, and the limit which the terms eventually approach is $\frac{\sqrt{5}-1}{2}$.

It is curious that this is the cosine of the "Euclidean angle," as "E. L. G." calls it. It is the cosine of the angle that the sides of the Great Pyramid make with the plane of the base.

Bath. M.I.C.E.

[65963.]—**Manchester Dynamo — Edison Pattern.**—TO MR. BOTTONE.—The sketch sent last week represents neither Manchester dynamo nor Gramme pattern. I annex sketch of a real Edison dynamo of the latest pattern. Referring to the sketch sent last week, the cores of the F.M.'s are very much too thin in proportion to the size of the pole-pieces. They should be at least 2½in. in diameter, and stand in the centre of the pole-pieces instead of quite at the edge. They should be 8in. in height, and the top yoke, instead of being of inch stuff only, should be a massive piece of wrought iron at least 2in. thick. The armature and the pole-pieces should both be about 4in. deep. You could put about 4lb. of No. 14 wire on the armature and 12lb. No. 22 on the field-magnets. Connect up as a shunt machine. By this means you will get easily from 16 to 30 volts, driving from 1,000 to 2,000 revs. per minute, with an output of from 12 to 15 ampères, which will charge your cells quickly and well. Your engine is, I am afraid, barely powerful enough to get the best effects. It would consume ½H.P.

S. BOTTONE.



[65966.]—**Chemical Weather Glass.**—I have seen a couple of dozen of these toys in a chemist's window, each indicating a different kind o
This tells slightly against their value.

ARTHU

[65969.]—**Timber Sawing and S
mering.**—A book may be had on woo
machines, in which there is a little info
sawing, published by Wm. Rider. I
of any book treating on sawing and h
To hammer a saw in a scientific mann
skill and great experience. There are
ing the country who call themselves
merers; but though my experience is v
in saw-hammering, I can hammer a saw
most of them, but would not prete
instructions on the hammering of saws
write much on the subject; but the g
would be theory, and not practical exp
would advise "Sawyer" to send his s
maker when they get so crippled as not
to do good work with them, where h
them done by men who have learned
art of saw-hammering. Saws very fre
put aside as useless when they ar
crippled, when, with a little care in p
sharpening of the saw, it may be made
work. To see a saw cutting a piece of
doing good work is one thing; but t
saw in order so as to do its work well
time is another thing. There are a scor
points to be borne in mind. To sharp
a proper manner there is, as in hammer
and it requires good experience, and to
satisfactorily requires practice.

Scorrier Saw Mills.

[65974.]—**Mowing Machines.**—Pr
first condition of easy draught is to have
sharp. The second is to have the ma
oiled, and gears greased with a really g
The third, to have the balance of
correct. "A Poor Farmer" may have
mower, but assuredly he cannot have k
by Walter A. Wood, or they would not

at pressure of 45 volts, this will be equal to an output of 9,000 watts. Taking 746 watts as one horse-power, this would be equal to a little over 12 horse-power. Suppose you allow 20 per cent. loss in leads and motor, you might expect to get 9·6 horse-power. S. BOTTONE.

[66017.]—**Dynamo.**—Let me know the gauge and weight of wire on the armature, and then I can assist you. Without these data it is impossible to answer satisfactorily. S. BOTTONE.

[66021.]—**Electrical Magnets.**—The power of an electro magnet depends on the two combined; or, as electricians state it, on the number of ampère turns. Suppose we were able to energise a soft iron bar to the point of lift 1lb., by sending a one ampère current through a single coil, we should be able to get exactly the same power if we sent $\frac{1}{100}$ of an ampère through 100 coils wound round the same bar. S. BOTTONE.

[66024.]—**Organs.**—The able electricians, S. Bottone, "Sigma," and others, whose generous contributions constantly adorn the pages of the "E. M.," are much better qualified to give you the particulars you require as to batteries and motor than I am. At the same time, I shall be pleased to render you any assistance I can relative to the application of the same to organ-blowing. My opinion is, that I fear you would find batteries unreliable and far too expensive for the purpose, and would suggest that some near friendly user of steam power would for a trifling amount run a dynamo for you to charge your accumulators as often as found necessary. The motor described in "E. M.," April 6th, would probably be large enough for your purpose if properly applied, and it would not present much difficulty in manufacture, especially as I observe Mr. Bottone advertises to supply the parts. As the instance I mentioned is, I believe, the first absolutely successful application of electricity to organ-blowing in this country—as a permanent installation—the following particulars may interest:—The current is supplied by a dynamo driven by steam power, and is located about a quarter of a mile from the church. The accumulators are placed in the church tower, together with the motor and specially constructed blowing apparatus. The motor is nominally of one-half horse-power, and when at full speed makes 1,500 revolutions per minute. The current can be "switched on" either through a resistance or full, according to the organist's requirements. When on full it is not possible to exhaust the wind under the most severe legitimate tests. When the bellows are full the current is cut off and the motor stops, until an automatic switch completes the circuit again. The motor and blowing apparatus are about 42ft. from the bellows of organ, but there is not the slightest unsteadiness, the supply being perfectly smooth. I am acquainted with various forms of machine-blowing by water and gas, but this is by far the most satisfactory, noiseless, and luxurious method. I may add that the dynamo and motor are not of amateur make, but of the very best description, and the excellence of the latter may be judged when I say the organ has about 30 sounding stops (which include three 16ft. stops on the pedal and two on the manuals) and can be fully coupled. J. E. M.

[66030.]—**Silver Solder.**—"Warwickshire Longshanks" will find 1oz. sterling silver and ½oz. brass the right proportion and colour.

Southampton. A. E. B.

[66030.]—**Silver Solder.**—Why not get some German-silver solder for your silver solder? Do not use ordinary brass wire for making up, but good pins, dress pins, short whites; equal parts of each—i.e., silver and pins.

JACK OF ALL TRADES.

[66030.]—**Silver Solder.**—Hard solder is made of four parts fine silver to one part pure copper. Soft silver solder for German silver, &c., is made of two parts fine silver to one part brass wire and a little arsenic. Always use fine silver, the least touch of tin or any other soft metal would ruin your solder. You cannot be too cleanly or careful; use plenty of borax to prevent burning, which spoils the colour of any silver soldering. Tenpence an ounce seems a tremendous price to pay for flatting. DENS.

[66030.]—**Silver Solder.**—1oz. fine silver, ½oz. brass pins (not brass wire), the pins are very slightly coated with tin, which helps the solder to flow easily. Of course this is not the object of tinning the pins. Melt the fine silver first, see it is well melted, then drop in brass pins; directly they are melted, stir, and pour into mould. If the pins were put in before the silver was melted, they would burn, and the solder would not run nicely. Cost is about 2s. 6d. per oz. I cannot understand paying 10d. for flatting such a small quantity; 3d. or 4d. ought to be the outside. H. D. G.

[66033.]—**New Algebraical Symbols.**—To "F. S. S."—I overlooked this query. There are *two dots in my copy* at place mentioned, but they *are nothing—only printer's* error. Prof. Chrystal uses no such symbol. The context surely is as "plain as a pikestaff."

A PUPIL OF CHRYSTAL'S.

[66034.]—**Dynamos.**—To MR. S. BOTTONE.—1st. Wind the armature with 4 or 5lb. No. 12 d.c.c. wire, say, about 40 yards. Wind the fields with about 12lb. No. 20, connected in series with each other, but in shunt with the brushes. By this means you would get a charging current of about 16 or 20 ampères, against an outside resistance of about 0·12 ohm. 2nd. I cannot understand the form of this dynamo, which has an armature only 8¼ by 1½, and yet the F.M.'s form an 8in. circle on top of 2in. F.M.'s. I can only say, Wind armature with 4oz. No. 20 wire. Put 6lb. No. 22 on fields; connect up as a shunt machine. You should get 3 or 4 ampères at 20 volts pressure, against an outer resistance of about 5 ohms. S. BOTTONE.

[66037.]—**Violin Playing.**—Get Berthold Tours's book on the violin (price 2s.) from Novello, Ewer, and Co. FELIX HOLT.

[66038.]—**To "M.I.C.E."**—I do not wish to anticipate the answer to this query from the proper source, but only to mention that, as one of Prof. Rankine's first pupils, I do not think "Stud. Inst.C.E." will have any difficulty in understanding Rankine's formula if he adds to what he has already studied "Analytical Trigonometry" and the "Differential Calculus." As to the use of advanced mathematics to a civil engineer, it is very probable they may never be called into play directly, but as a means of education nothing could be better.

Plymouth. B.Sc.

[66038.]—**To "M.I.C.E., Bath."**—No, I don't think that the higher mathematics are of much use to a young civil engineer; at any rate during my 25 years in India in the Public Works Department and on railway work, I did very well without them; and it was not until I returned from India in rather bad health that I took up the Calculus, out of mere curiosity, to find out what it all meant. I never had any help in this, but worked patiently through Todhunter, omitting the difficult parts. A young engineer, especially in India, should be a sort of Jack of all trades, quick at figures, and able to show the natives how to make a door or a staircase, or to turn out a kiln of bricks. Rankine is not of much use to a practical man; even now I have some difficulty in understanding him. I was articled to Brunel, and getting tired of office work, I asked to be sent to Swindon works on the G.W.R., where I spent a couple of years in the shops; this training I found useful. Then I had a couple of years on one of the branch lines of the G.W.R.; and during all these years I hardly opened a mathematical book, and yet I have been tolerably successful. Since my time I see that the Graphic method of solving problems is more in vogue than formerly, and I think that this should be studied. A good book is "Economics of Construction," by R. H. Bow (Spon and Co.); also Stoney's "Theory of Strains" (Longmans). The latter, however, is not on the Graphic method.

Bath. M.I.C.E.

[66043.]—**Physics.**—You will find what you want in Ganot's "Physics."

Plymouth. B.Sc.

[66043.]—**Physics.**—Consult Ganot's "Physics," published by Longmans, Green, and Co. Also get a catalogue of physical apparatus from Mottershead and Co., Exchange-street, Manchester.

J. A. HOGG.

[66044.]—**Painting Tapes.**—Take equal parts of japanners' gold size and raw linseed oil; good lampblack is preferable to white lead or spruce ochre. These colours, being elastic, are not so likely to crack. JACK OF ALL TRADES.

[66045.]—**100 Volt Dynamo.**—To MR. BOTTONE OR MR. EAVES.—Let the armature be 12in. in diameter by about 8in. deep. Wind it with 24lb. No. 10 d.c.c. The F.M. core should be 5in. in diameter and 15in. long, wound with 40lb. No. 18, connected up in shunt with the brushes. It will take 10 horse-power to drive this machine at an armature speed of 1,300 revs. per minute.

S. BOTTONE.

[66046.]—**Sleep.**—Let "B. H." try plugs of cotton-wool. PONTO.

[66048.]—**Rouge.**—Why not use turps, benzoline, methylated spirits, or paraffin oil?

JACK OF ALL TRADES.

[66049.]—**Fumigating Machine.**—Make a fire in a small devil, and, when burnt up, charge it with some damp straw chaff; then drive in with your machine. I do not think anything will stand that, and it is cheap.

JACK OF ALL TRADES.

[66052.]—**Telescope.**—You don't say whether your 4in. object-glass is achromatic or not. Assuming that it is not, you should get a simple lens 1in. in focus, which will give you a power of 360. If then you cover all your object lens except about an inch of the centre, and mount the glasses in a tube, you will get a fair view of Jupiter's moons and similar easy objects, but nothing more. Of course, if the lens is achromatic, it would bear a very much higher power; but its short focus rather tells the other way. ARTHUR MEE.

[66055.]—**Spring Motor.**—The requirement is perpetual motion, and therefore impossible.

S. BOTTONE.

[66057.]—**Silver Soldering.**—Make a long staple of iron wire similar to a hair-pin, and lay your job on it and bind, seeing that all is clean. Use borax and silver solder.

JACK OF ALL TRADES.

[66057.]—**Silver Soldering.**—This loop-handle soldering is done in the usual or ordinary way on the charcoal with mouth blowpipe, using plenty of borax, and a solder made as follows: silver solder for steel, two parts fine silver, one part brass wire, and three-quarter part of arsenic. DENS.

[66058.]—**Air-Gun.**—You did wrong by binding; when turned as near as you can get it; damp it with caustic potash, and press into place; leave there until dry; then oil.

JACK OF ALL TRADES.

[66058.]—**Air-Gun.**—Let "W. J. B." try a piece of hard vulcanite fibre, although either horn or ivory should do well. See that seat of valve is true and polished. If he uses vulcanite, fit it as true as possible, oil seat of valve, put valve in place, and make seat pretty hot, allowing it to cool in position.

Southampton. A. E. B.

[66059.]—**Chloride of Sodium.**—Take a tea-spoonful of salt and dissolve in half a pint of water. Get some very fine wood charcoal, and wet this up with solution like damp sugar; well work. To this add one part of finely-powdered pipeclay to two parts charcoal; well work this, and line your crucible with it nice and firm.

JACK OF ALL TRADES.

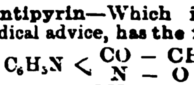
[66060.]—**Fumigating Pastilles.**—I never met with any such in Hindostan. In religious ceremonies, and for the expulsion of mosquitoes from rooms, either "benzoin" or "olibanum" is placed on charcoal embers, carried about in an earthen saucer. In my young days I made large quantities of superior pastilles from the numerous aromatic woods, drugs, gums, leaves, &c., so abundant in India, using charcoal powder, made into a paste with gum-water, in which a fraction of nitre was dissolved, as the combustible vehicle. In China, "joss-stick" is a popular kind of pastille, cow-dung, scented wood-dust, and other additions being moulded into slender cylinders, for temple use. Besides these there is a sort compound expressly for travellers' boats, without which protection from the legions of gnats and mosquitoes swarming in Chinese waters there would be no sleep. Two sticks cost about a farthing; their composition is unknown to Europeans. ECS.

[66061.]—**Stained Glass.**—Take any transparent colour you can get to mix with turps, and mix with pale copal varnish.

JACK OF ALL TRADES.

[66061.]—**Stained Glass.**—The colours sold for painting lantern slides, using as a medium either Canada balsam, copal, or mastic varnish. The effect will depend upon the skill available in laying in the tint. This does well for a northern exposure; but no colour will stand the sun unless fired. DENS.

[66062.]—**Antipyrin**—Which is to be taken only under medical advice, has the formula—



$$C_6H_5N < \begin{matrix} CO - CH \\ N - O \\ CH_3 - CH_3 \end{matrix}$$

and is used chiefly as a febrifuge. It has been used with some success as a preventive of sea-sickness; also to relieve nervous headache, facial neuralgia, sciatica, angina pectoris, asthma, and whooping-cough. Externally, it checks bleeding. It is used both hypodermically and by the mouth. Burroughs, Wellcome, and Co. have a small leaflet giving some particulars about its use. I cannot say how it can be detected in analysis.

F.R.S.E.

[66062.]—**Antipyrin.**—The formula for antipyrin is $C_{11}H_{12}N_2O$. It is prepared from chinolin (C_9H_7N), and is chemically termed dimethyloxy-chinicin. Chinolin is a derivative of cinchona bark, but is now made synthetically. 1. An aqueous solution (1 in 100) of antipyrine gives with solution of tannic acid an abundant white precipitate. 2. Fuming HNO_3 (two drops to two c.c. solution) turns it green; if boiled and an drop added, it becomes red. Physiologically febrifuge and anodyne. In fever, thirty every twenty minutes for three doses pr fall of temperature of from 2° to 4° Fahr. about five hours. In some cases its ef accompanied with dangerous depression o action and profuse sweating. One death ed, no doubt from too large a dose. The has found it invaluable in migraine and s headache, two doses of ten grains each at ur's interval generally cutting short both ies. Its latest application has been for ating the pains of childbirth. There is such and for this drug just now, that much adul- d rubbish is thrust on the market.

T. R. H.

)62.]—**Antipyrin.** — Antipyrin (dimethyl- inicine) belongs to the chinolin group of tives. It is an alkaloid in the form of a powder, soluble in half its weight of warm . Though only recently discovered, the ex- ents of numerous physicians go to show that rin possesses properties which place it above her antipyretics. This is above all other lies hitherto used for the reduction of heat er, and its administration has never been ed by any serious result. It has been used ry disease in which a high temperature has eached, but with greatest effect in rheuma- typhoid, typhus, erysipelas, and phthisis. If istered in doses of 30 grains every hour for three hours, the temperature falls gradually, nit being reached in about three hours; the rature then remains low for seven or eight . It has been recently found by Mingazzini kairin (hydrochlorate of oxyethyl-chinoline de) and antipyrin (when administered ier) produce a much greater diminution of rature than an equal quantity of either ly administered by itself, and that the low rature lasts for a longer period.

D. J. COLLINS.

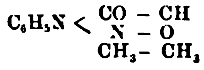
)62.]—**Antipyrin.**—Antipyrin is one of a of derivatives from a base to which the name hinizin" has been applied, having a formula N_2. These "chinizin" derivatives are pro- of the action of diacetic ether upon one of ydrazines, a class of bodies represented as con- g the nitrogen groups $= N - N =$, of which ur affinities are saturated either by hydrogen ohol radicals. Phenylhydrazin is obtained e reaction of diazobenzene sulphonate with urous acid. When equal molecules of it iacetic ether react in the cold, the elements ter are eliminated, and the residue combines m phenylhydrazindiacetic ether, which upon heated to 100° C. parts with the elements of c alcohol, and is converted into methyloxy- in.

$$N_2H_3 + C_6H_{10}O_3 = H_2O + C_2H_6O + C_{10}H_{10}N_2O$$

nylhydrazin Methyloxychinizin.

conversion of methyloxychinizin may thus ected by heating to 100° C. in a tube a mixture ual parts of methyloxychinizin, methyl , and methyl alcohol, treating the residue strong soda ley, shaking the heavy oil that ates with ether, and evaporating, when dime- xychinin ($C_{12}H_{12}N_2O$) separates in crystals ng at 113° C. This substance is called pyrine," and has been investigated principally r. Knorr. The group to which antipyrine gs is a very complicated one, producing lties in nomenclature of which the following specimen:—"Phenylizinchizinohydrobenzol- nsaurester." Antipyrin gives in aqueous ion with perchloride of iron a deep red colour. nitrous acid a dilute solution gives a blue solution and a concentrated one a separation e crystals. FREDERICK DAVIS.

062.]—**Antipyrin.**—Antipyrin is the trade of dimethyloxychinizin.



$$C_6H_5N < \begin{matrix} CO - CH \\ N - O \\ CH_3 - CH_3 \end{matrix}$$

an artificial alkaloid, and was discovered in by Knorr of Erlangen. Its source is the ever- l aniline, and so, strangely enough, this im- nt medicine is made by a German firm icing acids, alkalies, and coal-tar products. yrin is a febrifuge of certain action, ing the temperature for about five or six . It is used in neuralgia, rheumatism, sea- ess, lumbago, sciatica, angina pectoris, renal whooping cough, asthma, megrim, zona, and t every disease that flesh is heir to. Accord- Professor See, it is "the remedy for sufferers or pain." The crystals, which are character- when completely dried, melt at 110° C. They luble in their own weight of water at 12° C., olution being neutral. Tests.—$KClO_3$ and Upon boiling, the liquid becomes reddish w; upon cooling, minute, bright red, oily separate. This red liquid is taken up by oform, which it colours greenish orange- w. Ether removes the colouring matter from oform, and is coloured golden yellow. Millon's ent.—2cc. of reagent and 4cc. of 1 per cent. ion in neutral solution give a white precipi- in a yellow liquid; in presence of HCl a w precipitate, turning red. In an acid solu- of 1 in 1,000 yellow precipitate and green l; in acid solution of 1 in 20,000, a white pre- ate and yellow liquid. Fröhde's Reagent.—Nothing. Dragendorff's Reagent.—In acid solution, green precipitate. Bouchardat's Reagent.—Brick red precipitate, perceptible in acid solution 1 in 4,000; in alkaline solution, to 1 in 600. For other tests see paper by Gay and Fortuné in *Journal de Pharmacie*, June 15, p. 594.

J. A. HOGG.

[66067.]—**Accumulator Plates.** — They are usually rendered more porous by dipping in a mixture of nitric and sulphuric acids. You will find information on this point in my book, "Elect. Inst. for Amateurs." S. BOTTONE.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

Since our last, A. M. Bushell has replied to 65460.

65446. Bending Copper Tubing, 314.
65460. Great Western Railway Brake, 314.
65463. Potential, 314.
65478. Distilling Sea-Water, 315.
65480. Locomotive Power, 315.
65489. Engineer's Lathe, 315.

65704. Emigration, p. 402.
65705. Gaseous Paraffin, 402.
65706. Vulcabestos, 402.
65728. Trash Ashes, 402.
65732. Electric Light Dynamo, 402.
65735. Magic Lantern, 402.

USEFUL AND SCIENTIFIC NOTES.

Colouring Porcelain.—In a paper on colouring porcelain in a high-temperature furnace, Herr H. Seger (*Chem. Zeit.* 12) states that the best porcelain hardly ever contains less than 0·5 per cent. of ferrous oxide, mostly 1·0 per cent. and more, and that the more highly coloured Chinese and Japanese porcelains contain as much as 2·5 per cent. The yellow colour of porcelain is due to the presence of this iron in the state of ferric oxide, the green colour to its presence as ferrous oxide, the colour actually produced depending on the nature of the burning. The grey colour due to a mixture of the two oxides seldom occurs, and then only in fusible porcelains. The yellow colouration is far more intense than the green; the latter results when a reducing flame is employed, and porcelain coloured pale green thereby becomes yellow by repeated heating in an oxidising flame, the ferrous iron being converted into ferric. The green colour of Indian and Chinese celadon porcelain is due to its containing 1·5 to 2·0 per cent. of ferrous oxide. Normal white porcelain, when slowly cooled, assumes a yellow tinge, also due to oxidation, and for this reason it is customary to cool the mass rapidly. The author has never observed any yellow colouration produced by sulphates—in fact, sulphates only occur in very basic and not in very acid silicates, such as porcelain. Also the magnetic oxide of iron is reduced either to ferrous or ferric oxide in presence of silica, and in its absence the metal would result, so that the idea that the whole of the iron is converted, at the high temperature employed in the burning into Fe_3O_4, is out of the question. These remarks regarding the colouring of porcelain also hold good in the case of glass.

A CORRESPONDENT writes to *Notes and Queries*:—In the years 1840 and 1841 I had occasion to travel frequently from Manchester to York. The clerk took down my name and address and entered it into a way book before giving me my ticket. The ticket was of paper. At one time the tickets were all collected at a barrier before entering the train. But this did not long continue, for persons took advantage of the opportunity of travelling for a long journey while taking a short-journey ticket. The train was started by a bugle, on which the air "I'd be a butterfly" was played. Carriages were made to resemble stage coaches as much as possible. Luggage was placed on the top, much to the detriment of the luggage, besides giving a great deal of unnecessary labour to the porters. The guards sat in seats on the top of the carriages, where they were exposed not only to wind and rain, quite unnecessarily, but to the far greater inconvenience of receiving all the cinder-dust of the engine into the eyes and mouth. My experience of railway travelling goes much further back. I travelled on the first railway that carried passengers, the Stockton and Darlington line, which was opened for passenger traffic five years before the Liverpool and Manchester. Its first passenger carriage was the body of a stage coach fixed to a railway truck. The majority of the passengers on the present day of opening had to content themselves with places in empty coal waggons.

QUERIES.

[66072.]—**Calibrating Ammeter.**—Will Mr. S. Bottone kindly tell me how to calibrate an ammeter which I am making? It is jewelled at both ends. The needle lies between two copper strips. What battery must I use? Will you also tell me what weight of No. 36 s.c. copper wire to get 200 ohms resistance, or 150 ohms?—C. E. W.

[66073.]—**Plaster Pedestals.** — Will any of my brother readers kindly inform me how to make a few small plaster pedestals for small ornamental figures?—J. M. P.

[66074.]—**Mullein Plant.**—Would "Eos" or some kind reader give a few hints as to the best time for cutting and preserving above? Also the best mode of extracting its medicinal properties?—SILVER GREY.

[66075.]—**Ribbon-Winding Clock.**—I have one defective, for when the ribbon is pulled down the spring winds up, but does not remain up; as the ribbon is slackened the spring unwinds? Will anyone please tell me what is wrong and how to remedy it?—J. J. D.

[66076.]—**Chilling Iron Wheels.**—Can any brother-reader kindly give me the best process of chilling and annealing wheels to run on metals? Also what amount of carbon is contained in pig iron, and what amount of silica contained therein?—H. B.

[66077.]—**Canvas for Canoe.**—I have just finished making the frame for a canvas canoe, and should feel much obliged if any of your readers could give me any information as to where to obtain the canvas, how to dress it so as to make it waterproof, and also how to paint it.—ROB ROY.

[66078.]—**Champagne Corks.**—I was interested in the answers given by "F. R. S. E." and "F. W." in regard to corking, and have made every effort to wire and tie them down, so as to assume the shape, but cannot succeed. I shall be glad if "F. W." or any other of our friends can explain how it is done.—W. H. M.

[66079.]—**Double Current Indicator.**—I have some drop indicators mounted on a circular iron base about 2½in. diam. The drop is about same size and has a piece of paper cemented on to the front side, evidently to prevent it sticking to the cores of electro-magnet. Projecting from the hinge on which drop indicator works is a short flat spring, I suppose, to assist in pushing it away from poles. The magnet is evidently double wound, inner coils of thin white s.c. wire, and outer of somewhat thicker green s.c. wire. There are four projecting ends to each pair of electro-magnets, so will someone please tell me how to couple them up with the battery. I thought, perhaps, it was a polarised arrangement, but I cannot find the slightest trace of residual magnetism in the iron on which electro-magnets are fixed.—M. S. A.

[66080.]—**Electrical.**—Given a bobbin of certain dimensions, it is required to wind on a quantity of wire which shall give a resistance of 60 ohms. Would any electrician show how to find the amount and size of wire necessary to do this for any size bobbin and for any amount of resistance?—R. H. R.

[66081.]—**Guttapercha Moulds for Electrotyping.**—Having seen a way of making these (some years back) by boiling the guttapercha with linseed oil, I should be very glad for particulars. I know about softening the guttapercha and then pressing on medal, but I want to know about the boiling process.—HANOVER.

[66082.]—**Indian Sauce.**—To "EOS."—Having made an Indian chutney from a recipe you gave some time ago, I should be glad if you could give me a recipe for an Indian sauce, which would be cheap to make, and another which would be of better quality. I inserted an advertisement in the "E. M." for June 29, asking "Eos" to communicate with me; but I suppose he did not see it.—F. FOWLER.

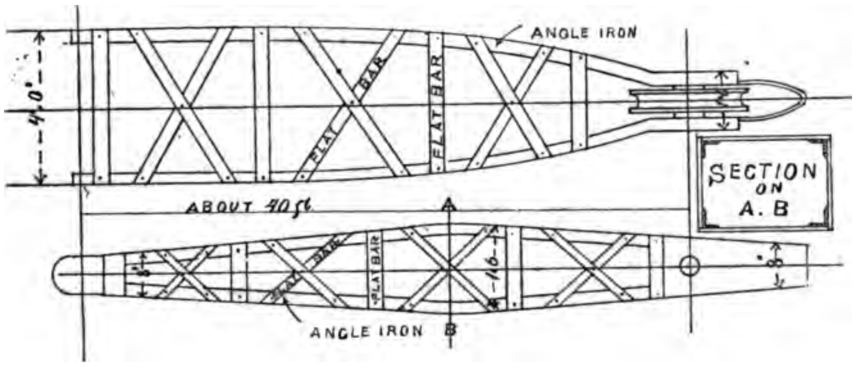
[66083.]—**Electric Lady.**—There has lately been an exhibition of an electric lady in this town. Can any reader give any information how I could make up and conceal in carpet or furniture enough electricity to give a small shock when the person is touched? I am thinking this would make endless fun for bazaars, parties, &c. I am sure that the person exhibited gave vibrations, which proved that the electricity passed through a contact breaker concealed somewhere.—MAGNA ELECTRO.

[66084.] — **Driving Shaft by Electricity.** — Would some of our electrical friends suggest the best method for driving a shaft absorbing about 12H.P. by electricity and to work a very powerful electric light, using a single wire for both purposes; but I want to turn the light on and off at will, and still keep the shaft running. The shaft and lamp would be about two miles from dynamo supplying the current. Kindly give size of wire required.—ELECTRICAL.

[66085.]—**Direct Transformers.** — TO MR. W. PERREN MAYCOCK.—Have made direct transformer, but fail to get a spark through secondary—in fact, the current is only just strong enough to be borne by the tongue being placed between secondary terminal wires. Have used a 1-pint chromic-acid cell, which works primary well. The only way in which I have departed from your directions has been as follows:—Could not get ⅜in. rod iron of proper quality, so made two tin tubes ⅜in. diam. each, and filled each with No. 18 soft iron wire well annealed, and then soldered two soft iron circular nuts in ends of each, drilled and tapped for studs to screw into. Wound primary with six layers of 18c.c., insulated with paraffin wax, and secondary with 18 layers 38 s.c. insulated with paraffin wax, and one sheet or layer of paraffined paper between each layer. So you will see both primary and secondary wires end at same end of coils at which I commenced to wind on at. The two primary ends come out at armature end and the two secondary wires come out at yoke end of coil. Have done this in each case so as to more conveniently make connections under base board. I get a vivid spark at platinised connections between make and break. There is very little attraction at secondary pole piece, but get a deal at primary pole piece. Have taken yoke and pole pieces off, but can find no cause for it there. The secondary has been very carefully wound, and there is no part of same insulated. Have covered primary and secondary with a tin tube each sliding tight on to bo- cheeks.—W. MILNES.

[66086.]—**Wimshurst Machine—Accumulators—Recovering Bichromate.**—Will any of your readers kindly give me a few particulars about Mr. Wimshurst's lecture on his and others' electrical machine as published in your No. 1,212, June 15, the last at hand here? 1. What is the exact meaning of this sentence of Mr. W. about the Carré machine:—"In my experiments with it I found that the quantity of electricity might be more than doubled by adding a segment of glass between the amalgam cushions and the revolving plates." What means that word "between" and which is the revolving plate quoted here? The orator while speaking showed the place most probably, and rendered it intelligible to any who had the good fortune of listening to his lecture. 2. The metallic sectors on the revolving discs—are they on the outside faces or on the inside faces of these discs, or on both together, and in the latter case is any connection established between these sectors on two faces of a same disc? 3. Are the combs of this machine shaped in the horizontal horseshoe form, so as to face at the same time the two metallic sectors now inducing one another, or are they slightly oblique to the said direction of the two metallic sectors passing one in front of the other? In this second case the sectors should pass only successively before the said horseshoe comb, each one before its respective branch of it. Owing to the long time required for asking information and reading it in your columns, I will ask Mr. Bottone to kindly answer two questions more. 4. Could any portable accumulator be made of pasty matters surrounding both lead sheets and making a kind of secondary dry pile? Obviously this accumulator is intended for a very small E.M.F., say, 15 or 20 volts, and below. 5. Is there any easy means of recovering the bichromate of potash from the black-greenish salt coming from ancient bichromate cells with zinc and carbon?—R. B. J., Trichinopoly, July 13.

[66087.]—**Crane Jib.**—Can any of your readers assist me in getting out the strains on the crane jib, as per annexed sketch—that is, strain down angle irons and strains on diagonal bars and cross struts? The jib is composed of 4 angle irons, 5in. by 5in. by ⅝in. down sides, and diagonal bars and struts, 3in. by ½in. flat iron, and is loaded with a strain of 10 tons down centre line.—STRAINS.



[66088.]—**Fumes from Sulphuric Acid.**—Will some one please tell me what fumes arise when sulphuric acid is poured upon ivory or bone black, and are they injurious?—B. B.

[66089.]—**Refrigerator.**—Will any reader kindly tell me how to make cheaply a small apparatus capable of cooling, say, half-pint of water at a time, for use aboard ship when in the Tropics as I am about to take a trip to the Antipodes, via the Red Sea, and I know by experience what the heat is?—TRAVELLER.

[66090.]—**Spoilt Spirit.**—TO MR. GREY OR "CHEMIST."—I have a quantity of methylated spirit in a drum and something has got into it and turned the spirit a dark green colour. Hyposulphite of soda turns it blue, an alkali changes it to a dirty yellow, and if it be neutralised with an acid it turns to a green again with a slight whity precipitate. Can you suggest a mode of getting rid of the colour without distilling it?—E. E. B.

[66091.]—**Muzzle Energy of Guns.**—Would any of "ours" kindly inform me the formula for obtaining the above? Perhaps "Garrison Gunner" would oblige.—PARABOLIC.

[66092.]—**Asphalte.**—What is the change, chemical or otherwise, that occurs when the above is laid down (in the form of a brown powder) and stamped with hot irons, so as to render it compact and hard? What is the composition of the brown powder?—PARABOLIC.

[66093.]—**Chromic-Acid Cell.**—TO S. BOTTONE.—I have a chromic-acid cell, bottle shape, one of the carbons of which has got detached. It seems to have been fastened to the brass with some red cement which stains steel black. Will you kindly tell me what this red stuff is, and how I can refasten the carbon?—CARBON.

[66094.]—**To "T. C., Bristol," or Others.**—What size turbine must I make to get 1,000 revs. per min. when under work with 80lb. pressure per square inch, and 196ft. head of water? I am only allowed to have a ½in. pipe. What power shall I get?—SHALDON.

[66095.]—**Tobacco.**—I have promised to give a lecture on the effects of tobacco on the body, chemical and physiological. I shall be glad if any of "ours" can tell me how to prepare nicotine and of any experiments I can do with it, or of any other experiments in connection with the subject. I have plenty of chemicals and apparatus.—SCHOOLMASTER.

[66096.]—**Microscope and Magic-Lantern Combination.**—Will one of your correspondents kindly inform me how I can combine a magic-lantern and a microscope so as to throw a magnified image of a microscope slide on a sheet?—AGNEW.

[66097.]—**Annuity.**—Will some correspondent kindly give me the present value of an annuity payable quarterly the first payment due in three months? The term of the annuity is 90 years, and the amount £100 per annum. Kindly give the value calculated both on a 2¾ and a 3 per cent. table.—ANNUITY.

[66098.]—**Comet Sawerthal.**—I shall be obliged by readers of the "E. M." kindly telling me if this comet is now visible through a telescope of 2½in. aperture, and if so—being without equatorial mounting—I shall be glad to know the position of the comet in relation to some of the stars.—OMICRON.

[66099.]—**Electrical Sparks from Body.**—How can I draw sparks from the body when it is dark? A friend told me that he was once held by a shocking machine, and the operator could draw sparks from him anywhere by putting his hand on him. I have tried, but cannot succeed. I should be glad if some kind friend would tell me how it is done.—C. F. FOWLER.

[66100.]—**Frictional Electricity.**—Will any and what metals generate electricity by friction? I want to store electricity generated by continuous, or nearly continuous, friction of two or more metals. Is it to be done? Will any cheap book (and what) help?—A BEGINNER.

[66101.]—**Midland Locos.**—There are some locomotives on the Midland Railway similar to those on the Metropolitan Railway with outside cylinders. They work their metropolitan underground traffic between Kentish Town and Victoria. Would some of your correspondents oblige me with the numbers, and how many there are of them?—A. M. BUSHELL.

[66102.]—**Old Westminster Bridge.**—I am told that in the middle of each side of this bridge there was an alcove, and that if a person whispered in one anyone in the opposite alcove could hear what was said, notwithstanding the noise of the traffic. How was this accomplished?—IGNORAMUS.

[66103.]—**Parabola.**—I wish to make a small parabola with a sounding plate inside, so that whatever is spoken into the parabola shall be increased in sound and thrown upwards. Will some of "ours" tell me how to do this, or give a rough sketch, saying what metal is best to use?—AMATEUR.

[66104.]—**Thunderstorms.**—Can anyone give me the reason why a thunderstorm occurs, and why we have so much more this year than last? Is the theory accepted that the friction of rain against the atmosphere produces enough electricity to charge earth and clouds?—F.R.S.E.

[66105.]—**Mechanical Motions.**—Can any of my fellow-readers tell me the best way to obtain a sudden upward or lateral motion with each revolution of a fly-wheel? A gradual motion is useless.—WEST INDIA.

[66106.]—**Moist Water Colours.**—What is the mixture used in making moist water colours? I am constantly troubled by my moist water colours becoming too dry and more water seems to increase the tendency to dry?—R. G. J.

[66107.]—**Artificial Caoutchouc.**—Can any reader give me some particulars about the manufacture of above from boiling linseed-oil varnish with dilute nitric acid?—J. K. O'C.

[66108.]—**Legal.**—Can articles of clothing or workmen's tools be distrained upon for rent?—LEVER.

[66109.]—**Fusees.**—Can anyone tell me the composition of a fusee match?—E. E. B.

[66110.]—**Steaming Hay.**—Owing to the wretched weather we have experienced, I fear the hay crop is comparatively useless for feeding purposes unless steamed. Will correspondents of "Ours" kindly favour me with description of necessary plant for that purpose by which it may be economically effected? I may add I have a portable engine for generating steam.—ROB. HARRIS.

[66111.]—**Cutting Glass.**—In the ENGLISH MECHANIC of 27th May, 1881, a process of drilling or cutting glass by means of German silver impregnated with diamonds is spoken of. I should be glad to know if anything more is known of this process, and if so, where Chemnitz is, to enable me to apply the inventor.—ARQUES.

[66112.]—**Clockwork Blower.**—I want a gentle current of air to flow constantly (preferred) or intermittently through a tube of ¼in. bore. Could any reader tell me of a clockwork movement I could adapt to the purpose with the aid of a fan or miniature bellows, the machine to work for an hour at least without rewinding, and not to be too bulky—no room for weights? Or is there any other means of obtaining the current without clockwork?—F. W. W.

[66113.]—**Hydraulic Cup Leathers.**—After making cup leathers sometimes I get leathers that lose their shape when they are softened in work. At other times they are as good as can be desired. Of course, I know it is the fault of the leather, which is the best that can be got for the purpose; but large makers of cup leathers put some chemical or otherwise in the water that softens the leather previous to moulding, and which keeps them in shape when in use. If any fellow reader will tell me what is used he will oblige.—LEACUP.

[66114.]—**Rubbings of Brasses.**—Can any of the readers of the "E. M." give me any information on taking rubbings of church brasses? Is there a book on them, and is there a composition to give a bronze colour instead of using black heel-ball. As an amateur any information will be welcome.—BRAZENOSE.

[66115.]—**To "T. C., Bristol."**—I want a small engine about 1½ horse-power to drive aërated-water machines. Do not want steam-engine, gas is not obtainable, coal is £1 10s. per ton, kerosene oil about 1s. 6d. per gallon. Should it be hot-air engine or petroleum engine. Will you kindly advise me what to purchase? Engine must be strong, simple, and easily managed. Wanted for out-of-way place in India. Kindly reply soon, have only one month in England. See Address Column.—EVOS.

[66116.]—**Boiler.**—I am wanting a boiler for a rotary engine of about 1-man power, and should like to make one similar to that described by Mr. Monteath, letter [illegible], July 27th. Would that gentleman or some one interested in engineering tell me? What size coil should I want, and could I make it myself? also size of pump, and could I pump in at the bottom of the coil? and should like to know if I could use a paraffin lamp for a fire, as in the American stoves. Any information will be very acceptable.—HAL.

[66117.]—**Power of Engine.**—A semi-portable engine, 25H.P. working at 70lb. pressure, what difference would there be in the power with the governor half open and fully open. And for every 10lb. of steam less than 70lb. with governor open, how much less would the power be?—VERY GREEN.

[66118.]—**Poignard's Method.**—Can any one say in how many different ways it is possible to form, say, the seven-square by this method? My method gives 406,[illegible] times, but I am not quite sure it is right. Is there a short method of calculating "factorial N." by logarithms?—REYMOND.

[66119.]—**Grandfather Clock.**—I have a "grandfather" clock, whose age I am anxious to ascertain. It has a very handsome brass dial, with scrollwork of dolphins and female heads, the case is black, covered with Japanese figures, and designs in gold. On a circular boss at the top of the dial is the name "Thomas Martin, London." Can any of our readers tell me when this clockmaker flourished, or give an opinion as to the probable date of the clock?—CHRONOS.

[66120.]—**Bronzing Brass.**—Can any one tell me how to bronze brass electro-deposited on iron a good dead black without eating the brass? Also, can this deposited brass be stained green by some kind of liquid applied with a brush, but not lacquer? I want a nice clear emerald green if possible. I should like to know the title of a good work on bronzing metals.—NYAT.

[66121.]—**Windmill.**—I am desirous of constructing a windmill to work two small force pumps of about 1in. diam. and 3in. stroke. I purpose making a wheel of about 6ft. diam., the vanes of which shall adapt themselves automatically to varying wind pressures. Will any correspondent kindly suggest the best way to do this, or quote any books which treat of the subject? I should be obliged for a hint for translating wind pressure into work.—AQUARIUS.

[66122.]—**Bevel-Gear Cutting Machine.**—Can any reader give me a few hints and sketch on the principles of above machine theoretically correct, that is, all lines of the teeth meeting in one point. The work I intend for it to do is patterns. I have seen one for cutting spur gear, so I understand about change and dividing wheels. Please give as full details as possible and cheap.—CONSTANT READER.

IT has often been stated that the cause of paper becoming brittle or tender is to be found in the presence of alum or sulphate of alumina in the paper. Herr C. Wurster's observations, according to the *Papier Zeitung*, extending over ten years, tend to the conclusion that neutral or basic sulphate of alumina exercises no decomposing influence at ordinary temperatures on paper, whether size be present or not, but that sulphate of alumina has a strongly caustic action if chlorides, such as those of sodium and calcium be present, especially at higher temperatures. In this case an injurious action on the paper arises from the formation of aluminium chloride or free hydrochloric acid, which acts by abstracting hydrogen, or the elements of water, from the cellular substance. The manufacturer should therefore endeavour to remove, as far as possible, by washing, from the fabric any sodium or calcium chloride resulting from the bleaching powder. It is accordingly not advisable to kill the bleach by antichlor without subsequent washing. From these considerations, the testing of paper should include a qualitative or quantitative examination of the chlorides present, which, the *Journal* of the Society of Chemical Industry says, have hitherto been regarded as quite harmless.

THE fourth yearly report of the Berlin branch of the German Meteorological Society for the year 1887, shows that the number of members has increased from 37 in January, 1884, the time of its foundation, to 117. The president for the year 1888 is Dr. Vettin. The present report contains an account of the special rainfall investigations at 20 stations in and near Berlin, and comparisons of the different rain gauges employed.

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Subscribers receiving their copies direct from the office are requested to observe that the last number of the term for which their subscription is paid will be forwarded to them in a PINK Wrapper, as an intimation that a fresh remittance is necessary, if it is desired to continue the Subscription.

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Lathe Wheels speeded for gut and band, heavy ones, cranks complete; 12in. Circular Saw complete. Offers. Approval.—W SMITH, Bilston-road, Wolverhampton.

Electric Machine, glass cylinder, 9in. by 8in., large prime conductor, Leyden jar, discharging tongs, insulating stool, box experimental sundries. Exchange value 30s.—W. J. WARD, West Jesmond, Newcastle-on-Tyne.

Organ Pipes, small metal and wood; Orguinette, plays 12 tunes; and about 200ft. of Rosewood and Mahogany Veneers.—W. JOHNSON, 12, Moxley, Wednesbury.

Engine, horizontal slide-valve, 2in. bore, 4in. stroke, 12in. flywheel, iron bed-plate, on teak stand, all complete, in perfect working order.—P. SMITH.

Boiler, vertical, complete, two 2in. tubes, fireplace, ashpan, chimney, tested 100lb., work at 50lb., fitted with pump, gauge, and cocks.—P. SMITH.

Engine. 2in. bore, 2in. stroke, 8in. flywheel, complete and perfect. Bargain. Offers. Stamp reply.—P. SMITH, 58, Charrington-street, London, N.W.

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What offers for 8 and 12-hole **Indicator**, 2 Morse sounders with keys, 3 induction coils and relay.—P. HUDDLESTON, High-street, Woolwich.

Otto Bicycle, perfect condition. Exchange offers. Photographic or mechanical.—THOMAS BURGESS, Hatfield, Herts.

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Double-action **Air Pump**, equal new, by Watkins, London, cost £8. Exchange for lantern slides or good field glasses to value £4.—As above.

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Model horse and trap **Perambulator**, well made, and quite new, fitted with gears and reins, indiarubber tyres, and springs, very strong, value 3 guineas.—SCHOFIELD, below.

King Mendham's No. 3 **Electro-Motor**, 6 carbons and 3 zincs, 6 by 3, binding clamps, 2 pint cells, Daniell's battery and magnet machine. Will exchange above lots for rear-driving Safety, or offers for separate lots.—SCHOFIELD, 58, Bury-road, Edenfield, near Bury, Lancs.

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Wanted, Model Gas or Hot-Air Engine. Offer Repeater WATCH, strikes hours, halfs, quarters; Pocket Batteries, Electric Pipe Lighter, &c.—Below.

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The **Designs** are all new, and are not copies of the stereotyped models of other firms.

We Court Comparison for novelty of design, finish of engines, and quality of castings.

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S. Bottone, Carshalton, supplies the following Electrical Books and Apparatus. Invaluable to Electrical Amateurs and Engineers.

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Ladies should send to Mrs. HERBERT, Woman's Confidential Adviser. Valuable information to over-child-bearing wives, 3 stamps and addressed envelope.—21, Queen-square, Leeds.

Best Weldless **Steel Tubing**, any size to order, prices on application.—GILBERT, Oxford-road, Sheffield.

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Watts' Gas Engines, work without noise, are easily made up. Lists, 3 stamps.—Belshaw-street, Homerton, London, E.

Hot-Air Engine Models, perfectly safe, efficient and cheap from 11s. each, carriage paid.—J. SEAL.

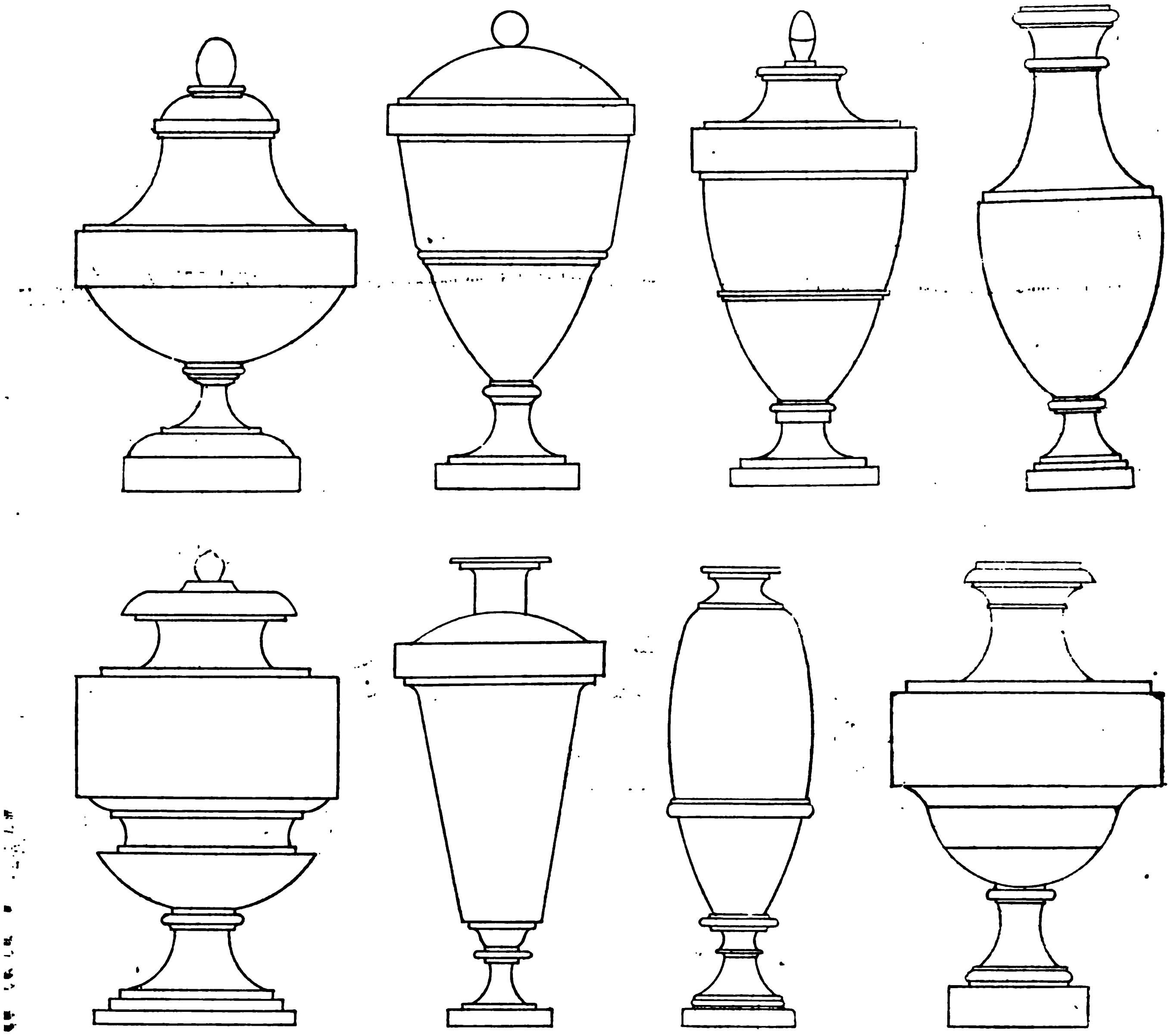
Hot-Air Engine Models, various sizes, particulars and testimonials stamp.—J. SEAL, 67, Carthew-road, Hammersmith.

The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, AUGUST 17, 1888.

EXTRACTS FROM BERGERON.—XI.

Turning a Ball—(*continued*).

WHATEVER care may have been taken in the operations which we have described, it is not to be considered an easy matter to obtain a perfectly spherical ball. It is rare, if not impossible, to attain such perfection, and it is here especially that any fault in the accuracy of the mandrel, of manual dexterity, or of truth in the chuck will make itself felt. For, reasoning mathematically, nothing should prevent such ball from being accurately round; but the very slightest error produces considerable defects. If it is desired to judge of the greater or less regularity of the shape of the ball, it suffices to return it to the lathe in a chuck hollowed out to its curvature so as to lay hold of the half of it in another direction to that in which it was turned, and the tool will act on those parts which are out of round.



A surer method is to make, with a thin bit of board or a piece of sheet brass, a template or calliper, the opening of which is exactly that of the diameter of the sphere. This is to be applied to the ball in all directions, and it should pass through without meeting any resistance, and without showing daylight anywhere. This exactness is of very great importance in the case of billiard-balls, which ought to be as truly round as possible, without which the effects which ought to be expected from the striking of two bodies and the laws of motion will be ceaselessly defective. The ball set in motion strikes this or those at rest in a certain direction resulting from the place in which the blow has been given. If the form of the ball is regular it should keep up this motion and communicate a portion of it to the ball which is at rest in proportion to its mass and form. If, on the other hand, one or more of these balls is out of shape, the blow and the displacement will vary in proportion to these irregularities. Thus it is evident of what importance it is to take all possible precautions to make them accurately. Despite the rules which we have laid down, and although it appears as if, by carrying them out, there should be perfect success in ball-turning, it cannot be denied that great skill must have been acquired in order to turn them accurately. There are but few toymakers in Paris who succeed perfectly, and from whom the others get their supplies.

Ivory is so compact a material that it seems as if a ball once correctly made could not subsequently contract any irregularity. Nevertheless, however little one reflects, it can be understood why, after a certain time from their being newly purchased, they become sensibly oval, or, at any rate, bad spheres. The tusks of an elephant are an assemblage of longitudinal fibres something like those of wood. When, therefore, a ball is made, those parts which were originally inside are exposed to the action of the air, and this air causes a shrinking which can only take place in the direction of the thickness of the tooth, and very slightly indeed in that of its length. However slightly the thickness of the material diminishes as the fibres approach each other, the shape of the ball must be sensibly altered. For this there is no remedy but returning it to the lathe; but this needs to be done by a very skilful hand. Of late there has been invented a complex tool, by means of which balls of every size may be made with the most perfect accuracy. A description of it will be given in the second volume.

[I conclude the extracts from Vol. I. with a sheet of drawings, being designs of vases, traced from Bergeron's book. There are many others worthy of reproduction, and I may perhaps send a few from time to time, and even revert to Vol. I. by-and-by; but at present I think it desirable to pass on to more advanced work described in the second volume, which, old as it now is, contains much that cannot be considered obsolete. It must always be remembered that Bergeron was a standard work many years before anything of the kind appeared in the English language, and that the lathe appliances then used were capable of executing such work as any modern latheman might be proud to execute. When there was no such thing as a planing machine, moreover, and all such work had to be done with file and scraper, it argues well of the skill of the workmen that they could turn out such complicated apparatus as is described in the second volume, with sufficient accuracy for its intended purpose. But this again is an argument in favour of our "extracts," inasmuch as it will stimulate the amateur in his own attempts of making such apparatus. If file and scraper sufficed then, the same tools will suffice still, and home-made lathe appliances need not be beyond the aspiration of a persevering amateur.] **O. J. L.**

STENO-TELEGRAPHY.

WE have occasionally given notes of the method of telegraphing by stenographic signals invented by M. Cassagnes, of Paris, and there is some reason to think that in time a universal telegraphic code will be adopted, so that it will not matter in what language the message is handed to the operator, nor of what nationality the receiver may be. M. Cassagnes has already taken out several patents in this country, and has recently procured another for the invention we illustrate below. This invention relates to apparatus for the automatic transmission of steno-telegraphic signals, which apparatus consists of a perforator actuated by compressed air, and an automatic transmitter. The perforator is intended to perforate the paper tapes employed in the automatic transmitter, and is actuated by means of compressed air supplied by a pipe or from a special air-holder or reservoir, in which such air is accumulated under pressure by means of a pump actuated by any suitable motive power.

Fig. 1 is a transverse section of the keyboard.

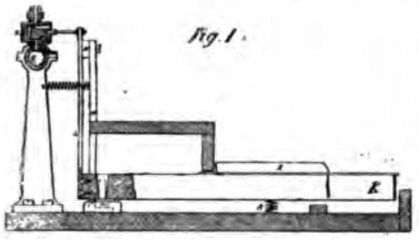
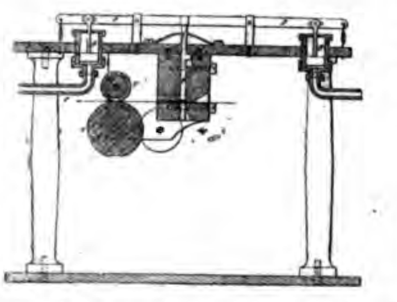


Fig. 1.

The keys K are raised, after they have been depressed, by means of spiral springs R. The further extremities of the keys K carry levers L which, when the keys are depressed, act on valves S. The compressed air pipe or main C is thereby put into communication, by means of connection tubes, with the corresponding cylinders B of the perforator (Fig. 2), and the compressed air actuates the pistons of the aforesaid cylinders. These pistons are connected to levers D, the ends of which rest on the heads of the perforating punches P. These punches, when operated by the levers perforate the paper tape T T which passes between the feed rollers V V^1.

Fig. 2



The depression of the keys (one or more at a time) causes the levers L (Fig. 1) to press against an oscillating frame M, the action of which is to open and close every time one or more keys are depressed a special valve similar to the valves S, and like them placed on the compressed air main C, and communicating with two special cylinders similar to the cylinders B, and placed in any convenient position on the perforating machine, Fig. 2. The pistons of these cylinders operate the feed rollers V and V^1 by means of any suitable mechanism (such as levers, pawls, and ratchet wheels, for example) and perforate, all along the paper tape, by means of levers and punches (similar to those shown in Fig. 2, for example), a double line of holes, like two racks which serve to guide and move the tape when placed in the automatic transmitter. The mechanism for operating the feed rollers V and V^1 from the pistons must be so arranged that it actuates the rollers after the punches have been withdrawn from the tape T T or before they enter the same. When the keys are released, the valves are returned to their original positions by the levers L; they close at the same time the admission passages from the main C, and the compressed air in the cylinders B escapes into the atmosphere. The action of the special valve is exactly similar. The holes in the perforated paper tapes correspond in position with the keys of the keyboard. If electric contacts are established through these holes, a printed tape can be obtained from a printing telegraph instrument placed at a distant station. This tape is also exactly similar to what could be obtained by sending the electric currents directly by the depression of the keys of the keyboard upon contacts placed beneath. The apparatus for automatically transmitting currents to the line by means of the perforated tape is represented in Figs. 3, 4, and 5. It consists of twenty levers *a*, one of the ends of each of which is bent and tapered as shown in Figs. 3 and 5, and enters the holes of the perforated tape when the latter, which is carried forward by means of two toothed pinions, *b b*, gearing into the double rack on the sides of the paper tape, brings a hole opposite one of the lever heads. The other end of each of the levers *a* makes a contact, according as the lever is pressed down or forced through a hole, with two metallic plates *c d*. The plate *c* is connected with the positive end of a battery and the plate *d* with the negative end. The levers are kept slightly pressed against the paper tape by means of springs *e*. They are thus always ready to enter the holes which pass opposite to them during the forward motion of the pape

Fig. 3

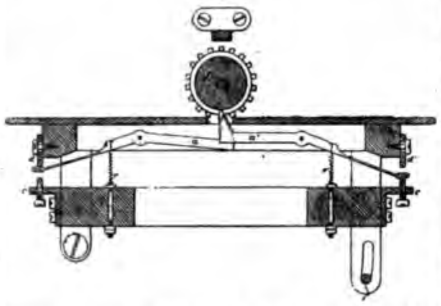


Fig. 4

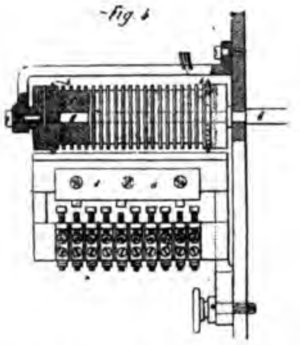
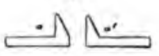


Fig. 5



The springs *e* are connected with the c pieces of a circular switch or distributor pinions *b b* are mounted on a vulcanite c *f* provided with circular grooves situate site the heads of the levers. This vu cylinder is carried by a spindle *g*, is part of a clockwork motion. A turn of the contact brush on th tributor, and at the proper inst special electro-magnet (not shown figure) releases the clockwork, which ca pinions *b b* to rotate to the extent of on and the perforated tape consequently a through the distance of one line. In facilitate the handling of the appara frame which carries the levers and the c is free to oscillate slightly round an axi is then easy to introduce or remove t forated tape. A tightening screw, *i*, ke frame in position when it is raised an for work. The contact *c* sends positive c through the line, and these are receive farthest station in polarised relays. W levers, on the other hand, touch the upp *d* (that is when the lever heads do n opposite perforations in the paper and n is to be transmitted by them) the line negative currents which help to disch and facilitate the working.

For facility of construction, the lev arranged in two groups of ten each pla group on each side of the axis *g*. The h the levers on the right-hand side are sh shown at a^1 (Fig. 5) and the heads of the on the left-hand side are shaped as show (Fig. 5). When the paper moves forwar easily disengage itself from the lever which have entered the holes.

GEARING.—XXI.

The Odontograph.

THE odontograph is shown in Fig. 13 scale of half the size. In this instr the edge A B corresponds with the l centres A B in Figs. 131, 132, in the pr article. The angle which A B makes wi is the same as that which P Q T make A B in Figs. 131, 132—viz., 75°. The di down the edge B C, B D represent th given in the tables printed upon the These tables are calculated as close appr tions only, and the error of a few m more or less, is absolutely inappreciabl we get beyond wheels of 18 or 20 teeth.

Since mistakes are apt to occur in the this scale, I will illustrate by simple di the setting out of spur gear, internal ge racks. Before commencing to lay do actual curves it is necessary to draw th circle, and the circles representing the poi roots of the teeth. Then take the pitcl down on the pitch line, and bisect it (Fi

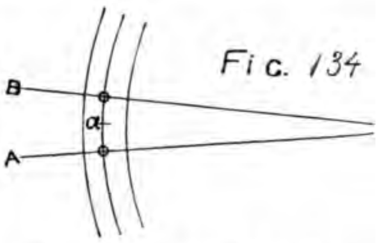
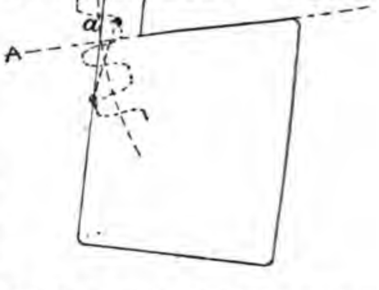
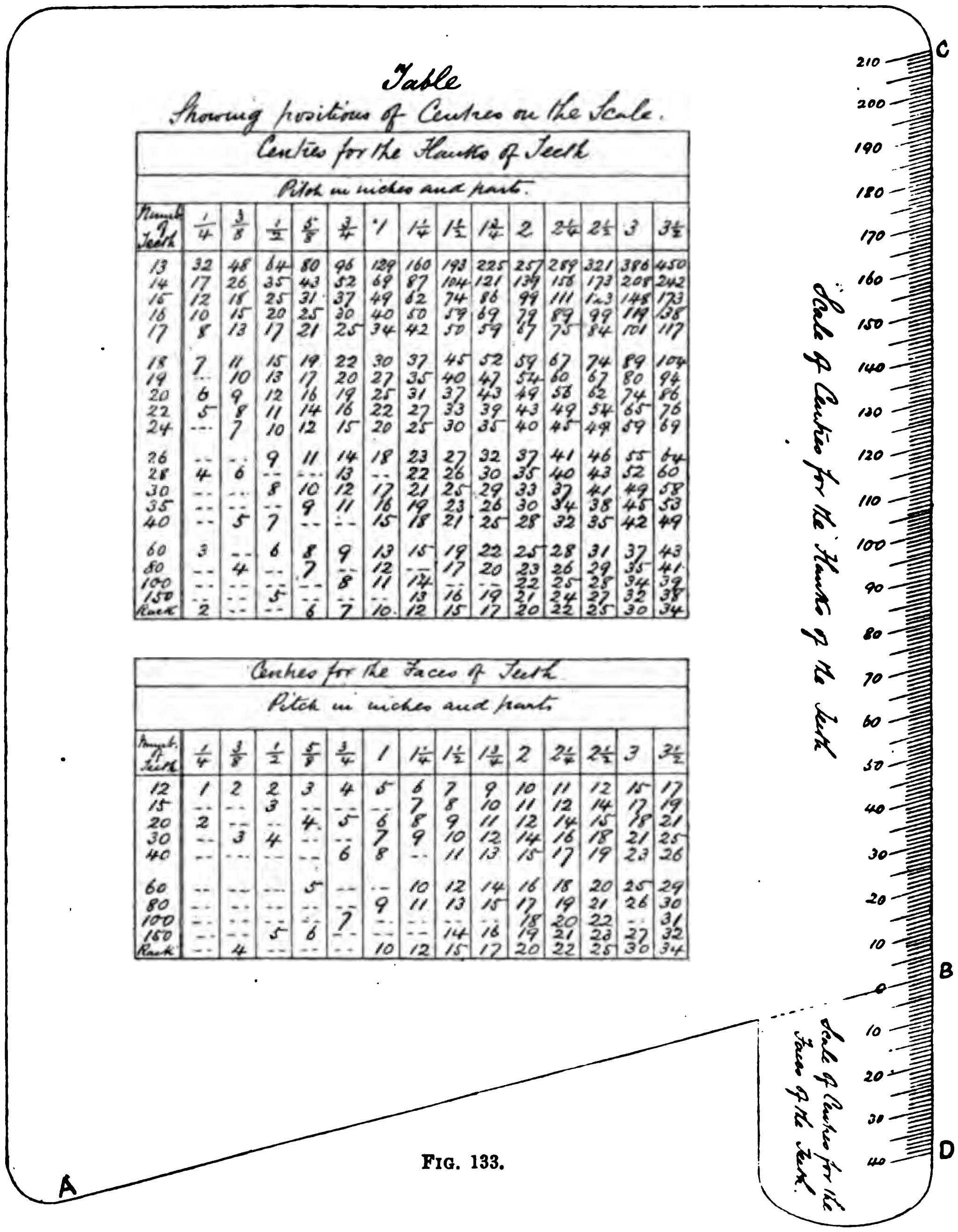


FIG. 134

FIG. 135.





Table

Showing positions of Centres on the Scale.

Centres for the Flanks of Teeth

Pitch in inches and parts.

Number of Teeth	1/4	3/8	1/2	5/8	3/4	1	1¼	1½	1¾	2	2¼	2½	3	3½
13	32	48	64	80	96	129	160	193	225	257	289	321	386	450
14	17	26	35	43	52	69	87	104	121	139	158	173	208	242
15	12	18	25	31	37	49	62	74	86	99	111	123	148	173
16	10	15	20	25	30	40	50	59	69	79	89	99	119	138
17	8	13	17	21	25	34	42	50	59	67	75	84	101	117
18	7	11	15	19	22	30	37	45	52	59	67	74	89	104
19	--	10	13	17	20	27	35	40	47	54	60	67	80	94
20	6	9	12	16	19	25	31	37	43	49	58	62	74	86
22	5	8	11	14	16	22	27	33	39	43	49	54	65	76
24	---	7	10	12	15	20	25	30	35	40	45	49	59	69
26	--	--	9	11	14	18	23	27	32	37	41	46	55	64
28	4	6	--	---	13	--	22	26	30	35	40	43	52	60
30	--	--	8	10	12	17	21	25	29	33	37	41	49	58
35	--	--	--	9	11	16	19	23	26	30	34	38	45	53
40	--	5	7	--	--	15	18	21	25	28	32	35	42	49
60	3	--	6	8	9	13	15	19	22	25	28	31	37	43
80	--	4	--	7	--	12	--	17	20	23	26	29	35	41
100	--	--	--	--	8	11	14	--	--	22	25	28	34	39
150	--	--	5	--	--	--	13	16	19	21	24	27	32	38
Rack	2	--	--	6	7	10	12	15	17	20	22	25	30	34

Centres for the Faces of Teeth

Pitch in inches and parts

Number of Teeth	1/4	3/8	1/2	5/8	3/4	1	1¼	1½	1¾	2	2¼	2½	3	3½
12	1	2	2	3	4	5	6	7	9	10	11	12	15	17
15	--	--	3	--	--	--	7	8	10	11	12	14	17	19
20	2	--	--	4	5	6	8	9	11	12	14	15	18	21
30	--	3	4	--	--	7	9	10	12	14	16	18	21	25
40	--	--	--	--	6	8	--	11	13	15	17	19	23	26
60	--	--	--	5	--	--	10	12	14	16	18	20	25	29
80	--	--	--	--	--	9	11	13	15	17	19	21	26	30
100	--	--	--	--	7	--	--	--	--	18	20	22	--	31
150	--	--	5	6	--	--	--	14	16	19	21	23	27	32
Rack	--	4	--	--	--	10	12	15	17	20	22	25	30	34

Scale of Centres for the Flanks of the Teeth
Scale of Centres for the Faces of the Teeth
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
10
20
30
40
C
B
D
A

FIG. 133.

drawing the lines A B which represent the distance of the pitch, to the centre of the wheel. The point of bi-section *a* becomes the *edge* of the tooth. Now lay the slant edge A B of the scale, Fig. 133, against line A, Fig. 135, so that the divided edge just cuts the pitch line. The required radius number is read off on the "centres for the flanks of the teeth," and one compass leg placed against that number on the edge of the scale, between B and C, Fig. 133, the other leg moved to *a*, Fig. 135, and the arc for the flank struck with that radius. Thus, if there were 20 teeth of 2in. pitch, the number corresponding therewith would be 49, and the distance from 49 on the scale to *a* would be radius of flank. If there were 80 teeth of 2¼ pitch, the number would be 26.

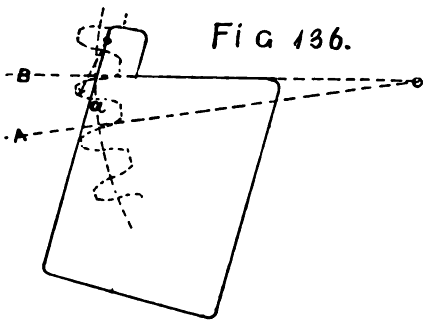


FIG. 136.

To strike the faces, the scale is moved to line B, Fig. 136, the graduated edge again cutting the pitch line, and the radius number read off on the "centres for the faces of the teeth." The compass leg is placed against that number on the edge from B to D on the scale, Fig. 133. If there were 20 teeth of 2in. pitch, the number would be 12, and with the instrument placed as in Fig. 136, the distance from the division 12 to *a* would be the radius of tooth face.

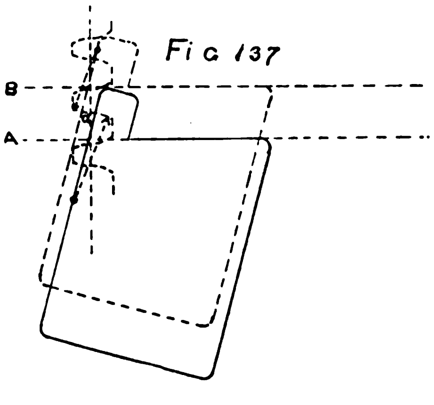


FIG. 137

Figs. 135, 136 also show the odontograph set for *internal* gears. As in spur gears, the pitch distance A B is set down on the pitch line and bisected, and the lines A B carried to the centre The slant edge is set against A, Fig. 135, the graduated edge cutting the pitch line. An appropriate number is then taken, as for a wheel *flank*, and the curve struck from that number on the scale becomes in the internal gear the tooth *face*. The scale is then set with its slant edge on B, Fig. 136, the number as for the tooth *face* taken, and the radius of *flank* struck accordingly. Thus the curves for the faces in spur gear become the flanks in internal gear. and the flanks in the first become the faces the second.

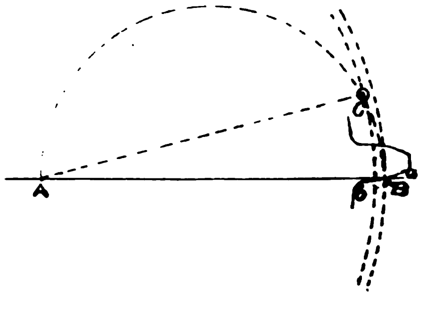


FIG. 138

Since a rack has no curvature, it is evident that the lines A B will be parallel, and the position of the odontograph will be that shown in Fig. 137, the full outline illustrating the position for striking the flank, and the dotted outline that for striking the face.

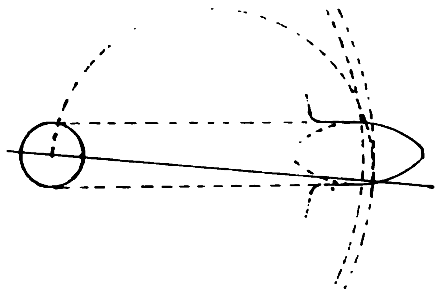
There are several methods of striking approximate cycloidal teeth by constructions other than those we have described. But there would be no advantage in illustrating them. For all ordinary wheels the odontograph affords the most simple and accurate mode of construction available, not so precise and exact as that afforded by generating circles, but sufficiently so for practical use, and saving much labour in templet cutting and tentative methods.

If it is desired to make a set of wheels whose base shall have a larger number of teeth than the odontograph gives—say 16 or 18—then the radius of the 16 or 18 toothed wheel will be the diameter of the generating circle for the system, and the whole of the gears or cutters, as the case may be, can be obtained from this. But for general work, pinions of 11 or 12 teeth should form the base of the system.

The odontograph gives no radii for pinions of less than 11 and 12 teeth. Pinions below this size will have convex flanks, undercut. Their shapes will have to be obtained directly then by means of rolling circles, the diameters of the rolling circles being equal to the radius of the 11 or 12 toothed pinion of the same pitch. In the case of very small pinions, especially when gearing with internal wheels or with racks, it is good practice to make templets to check the curves obtained by construction. It is surprising how in very small and special gears, a very slight error in construction will unfavourably affect the working of the teeth, and nothing looks much worse than to see the teeth of wheels chipped and filed in order to obtain freedom of working.

Reference was made in the last article to single-curve gears. These, though not true involutes, may be considered as approximations to that form. By construction, single-curve teeth may be formed in a simple manner. Thus, in Fig. 138 it will be found that if we strike a semicircle A B on the pitch diameter, as shown, and take a centre C on that semicircle equal in length to the fourth of the radius A B, the circle arc *a b* struck thus will correspond precisely with the curve previously obtained, Fig. 128, a line of centres may then be struck round the wheel from centre A, passing through point C, and will serve for all the teeth alike. This line of centres may be regarded as the base line of an involute gear. But in gears having less than 30 teeth, this construction has to be modified. Fig. 138 represents a gear of 30 teeth, Fig. 139 one of 15 teeth. In the 15-toothed gear, the flanks would be too much undercut, as shown by dotted curves, unless the construction were modified. This is done by making the flanks parallel for a little way below the base line, and completing the outline below the point where contact occurs, with a large hollow or radius, and slightly rounding off the points of wheels gearing therewith.

FIG. 139.



An odontograph scale has been made for these single-curve teeth. It simply consists of a bevel of sheet metal cut to an angle of 75°, and marked off on one edge into divisions of the inch. One, the plain edge of the scale, is laid upon the semi-diameter of the wheel, the acute angle touching the point B in Fig. 138, and the number on the edge of the scale corresponding with one fourth the radius is the centre C for the compass point. It simply saves the trouble of striking the semi-circle A B each time.

J. H.

PHOSPHATIC MANURES.

THE value of phosphates as manure has been recognised for years, and latterly attempts have been made to obtain them at a cheaper rate from substances otherwise regarded as waste. Mr. W. L. Wise has recently obtained a patent in this country on behalf of M. Solvay, of Brussels, for processes of converting natural and other phosphates into products assimilable by vegetable and other valuable sub-products. Every natural or other phosphate, whatever its richness and its composition, and whatever the first treatments to which it is subjected, should finally be converted into a product which may be used for agricultural purposes—that is to say, assimilable by plants. Up to the present time only two processes have been employed for this purpose in the arts and manufactures. One of these processes consists in treating the phosphates by means of sulphuric acid, so as to convert them into superphosphates; the other consists in treating the phosphates by means of hydrochloric acid, so as finally to form precipitated bibasic phosphate of lime. M. Solvay has endeavoured to effect other reactions, and to obtain other products equally suitable for agricultural purposes. Silica and alumina act as acids as regards the powerful bases, and they are more fixed than phosphoric acid. If they are placed in presence of natural and other basic phosphates, and if the temperature is carried sufficiently high, they will displace partially or entirely the phosphoric acid. He therefore operates as follows:—With the phosphate to be decomposed he mixes silica or alumina, or compounds of natural or other silica and alumina—especially those kinds having the finest grains and those most easily attacked—in such quantities (deducting the quantity of these substances which the natural phosphate may already contain) that the total quantity of silica and alumina will be sufficient to take up all the bases, either free or united with the phosphoric acid. He then heats the mixture, and, in cases where the mixture is difficult to treat, adds fuel to promote decomposition. Two cases may present themselves:—

1. If the temperature has not been carried too high, and if it be supposed that the material operated on is pure tribasic phosphate of lime mixed with pure silicic acid, there will be formed silicate of lime, with two equivalents of base and metaphosphate of lime with the other equivalent. The reaction is greatly promoted if, previously, metaphosphate of lime has been added to the mixture, the fusibility of the metaphosphate urging on the desired reactions. Metaphosphate of lime is soluble in citrate of ammonia, and may be utilised for agricultural purposes even in a state of mixture such as it leaves the preceding reaction.

2. If the temperature has been carried sufficiently high, the phosphoric acid is driven off and collected separately in water or in a dry state in chambers or reservoirs.

In the first case it may be combined with lime or with residuum silicate or aluminate of lime, if it be sufficiently friable, so as to obtain assimilable phosphate of lime.

In the second case it is simply mixed in a dry state with this same residuum or with lime, and it is employed as it is for agricultural purposes, unless it be desired to use it as an acid, for instance, for the manufacture of phosphate of ammonia.

The reactions above mentioned may be combined with the decomposition of sea-salt or chloride of potassium, so as to obtain finally assimilable phosphate of lime, caustic soda or potash, and chlorine or hydrochloric acid.

To the mixture mentioned is added chloride of sodium or of potassium, and the whole is calcined in presence of air or steam.

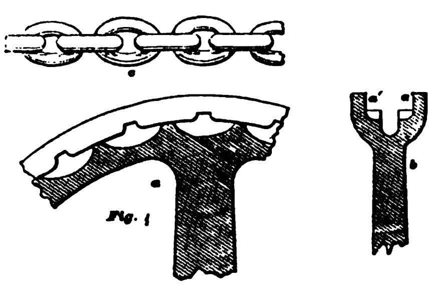
Chlorine or hydrochloric acid is set free, and the residuum contains a soluble phosphate of soda or of potash. The soluble phosphate being causticised by lime gives precipitated bibasic phosphate and a solution of caustic soda or potash. The reaction apparatus is such as is usually employed in the arts and manufactures, and need not be described; but M. Solvay points out as deserving of preference the reverbatory furnace or tank furnace known in Belgium under the name of "Four à bassin" used in glass works, or else the revolving drum or rotatory furnace used in the manufacture of soda by the Leblanc process; and in the second place, the cupola furnace used in foundries, but after having previously agglomerated the mixture into bricks or pieces, with an intimate mixture of fuel or not. He uses the forced insufflation of air, and even Siemens' and other furnaces when he wishes to attain high temperatures easily. If phosphorus is set free, which, however, only occurs in reducing atmospheres, it is reoxidised subsequently or on leaving the apparatus, and is converted in any way into phosphoric acid.

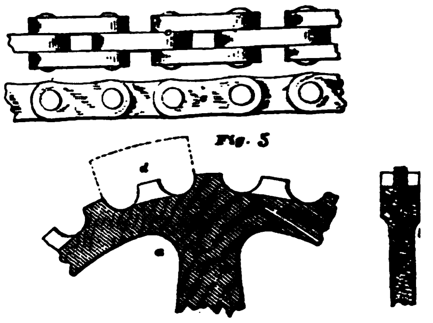
On the question of soluble *versus* insoluble phosphates of lime—of so much importance to the agriculturist—Sir J. B. Lawes and Dr. Gilbert's experiments at Rothamsted are of great value, and Sir J. B. Lawes has recently stated that phosphate of lime, if not taken up at once by the growing plant, becomes fixed in the soil, and is only recovered by growing crops over long periods of time. Also that the capacity of our agricultural crops to take up phosphate of lime existing in the soil differs in a very remarkable manner. In illustration, he says, I may select two experiments upon our permanent wheat crop. In 1844, both received alkaline salts and superphosphate of lime; in the following year both received salts of ammonia; and the salts of ammonia have been continued upon both up to the present time. One has never received any further application of mineral manure; the other received a second application three or four years afterwards. The crop which had the second application has given a better crop over the whole period, evidently due to the second application of the phosphates and alkalies. As the first application took place forty-four years ago, and the second forty, it is evident that the manures are very slowly recoverable. The other experiment I propose to refer to is a four-course rotation, consisting of swedes, barley, clover or beans, and wheat. All the produce is carried off the land, and no manure is applied. This experiment has completed its tenth rotation. The first crop of roots was fairly good, amounting to 12 tons per acre. The last nine root crops have been complete failures. The root has been unable to form a bulb, and the amount of phosphoric acid removed by the crop over an acre of land does not exceed 1lb. The barley and wheat crops have been fairly good, the last wheat crop being between 25 and 30 bushels per acre. These crops have, therefore, been able to take up phosphoric acid from the soil in very considerable quantities. In another experiment, where superphosphate of lime has been applied to the swedes, and no other manure is used during the rotation, the swedes yield about 9 tons of bulbs per acre. It is, therefore, quite clear that it was the absence of phosphate of lime in some form available for the roots which prevented their growth upon the unmanured land, and, further, that there was abundance of phosphate of lime in the soil, which the other crops in the rotation could make use of. I think we learn from these experiments that the root crops do require phosphates in a more active and soluble condition than other crops. The more soluble the phosphate the larger is the amount which the crop is likely to take up. It appears to me to be very desirable that some distinction should be made in the different forms of insoluble phosphates. I have every reason to think that the phosphate in the basic slag, although not soluble in water, is readily taken up by the roots, as well as by other plants. In the United States they value the unit of this phosphate very little below the unit of superphosphate. It is somewhat singular that while all the turnip tribes appear to derive so much benefit from the application of soluble phosphates, this result does not extend to the mangel—at least, such is our experience. When we find, as in our experiments, that wheat and barley can continue to take out of a soil large quantities of phosphoric acid for more than thirty years after the turnips had ceased to grow for want of it, it appears to me to furnish a strong argument in favour of a soluble phosphate as being the most suitable manure for the turnip crop.

Commenting on these remarks, the *Chemical Trade Journal* says they do not seem to be the carbon out, make it brittle, and spoils the saw. Sawyers who have been accustomed to use thick saws as a rule prefer them in this respect. They are just like saw-makers and saw-hammerers, but as lumber becomes more valuable manufacturers study methods of economising in sawdust, and in consequence the thick saw is rapidly getting into disfavour and must go. It is better to prepare for the change, for it is coming whether we like it or not.

As to the many reasons why saws sometimes don't give satisfaction, saw-makers and filers differ in diagnosis just the same as doctors. I never knew in my experience a manufacturer who did not honestly strive to make a good saw, but with my present knowledge had I a sawmill I would not buy from the factory who sold the cheapest saws. There are many reasons given why one firm can undersell another, but I have learned cheap steel and cheap labour is the principal factor. I am satisfied the capacity of the circular has not been gauged yet. Five or six years ago we made a 50in. circular of 14-gauge on the rim that was run at the Louisville exposition, which did as much and as good work as the thick saws and 10 and 12-gauge 60in. saws commonly used in sawing walnut.—*Manistee Advocate.*

PATTERNS FOR CHAIN WHEELS.*





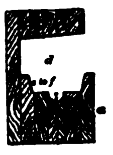
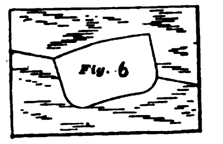
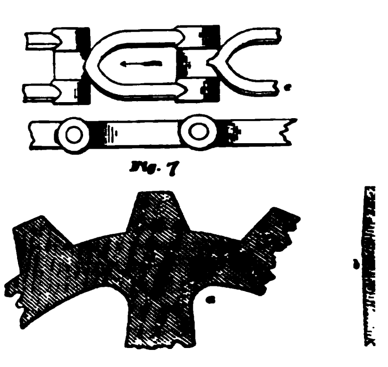
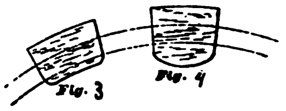
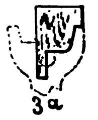


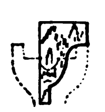
Fig. 2








3 a


4 a

LINK belts are becoming so common nowadays that it is well for every pattern-maker to know something about them, in order that he may be prepared to some extent when called upon for an effort in this direction.

Link or chain belting may not run quite so smoothly as leather belting, but there is no slipping, and for this reason they are specially adapted to short spaces, where gearing is not practicable and where leather belts are liable to slip if the speed is slow. The motion produced is similar to that by gearing. If the diameter of wheels is proportioned to the length of the links or pitch, then the motion will be smooth and the speed regular. The more teeth the smoother the motion, and vice versâ.

Fig. 1 is a very common form of a chain wheel and is made for an ordinary link-chain forged from round iron. A wheel for this chain may be made in several ways as regards the position and shape of the teeth or lugs which give the chain a hold upon the wheel. Some forms are made very cheaply, both as regards pattern work and cost of moulding; others, being more complete, will cost more; but to offset this they will wear longer and also tend to prolong the life of the belt by presenting more wearing surface. The form shown in Fig. 1 is the most complete, and is also the most expensive as regards pattern work. A portion of the rim is shown in section at *a*; *b* is a cross section of same wheel, and *c* is the chain used.

Taking all things into consideration, the best way to make these wheels is to form the groove on rim by a core. You may make the core in sections, but usually it is best to make a whole box unless it is a very large wheel.

This box may be turned in the lathe to the shape shown at *d*, Fig. 2; the distance from *e* to *f* equals one-half the diameter of iron used in making the chain. If you make a whole box it should be parted on the line *g h*.

The advantages of a whole box over a segment box are greater accuracy, fewer poor castings, and less work for the core maker and moulder. It is also better for the pattern maker, as he is less liable to make a mistake in the pitch of the wheel. The cores will always fit the moulds, while segment cores are very frequently a little too long or too short; this of course destroys the accuracy of the spacing.

Perhaps you may think that if the segment cores are made the right length, they will always fit the mould. So they would, but after the box is made just the right length, which is not easily done, and in calculating for which you must be acquainted with the core maker and also the moulder; and in a great many cases where you know the core maker or moulder, you will also know that the cores or moulds get better as the last pay day gets farther away. After all this, we shall still have to take the chances of baking. All joking aside, however, we will allow, as perfection is something rarely attained, that it is easier to get a job from a whole box. Again, if the core is made in halves, they are a bad thing to paste together accurately, and as for the extra work in making the whole box, you will find that the moulder will save the cost of that in making a very few moulds.

I have shown the core-box in section in Fig. 2. It has one side of the print left open all round. The core is rammed up through this opening and struck off level, then by lifting off the part marked *a* the core may turned out on a plate and dried. The outside edge of print is made with plenty of draft, to facilitate turning the core out of core-box and to make it easier to place the core central in the mould. After our box is turned to the shape shown at *d*, Fig. 2, the next thing is to space it up. The most common fault with all chain and sprocket wheels is in the spacing—the length of the spaces being different from the length of the links. I will try to explain how this may be avoided to a great extent. Measure off a portion of the chain 18in. or 20in. in length, being very careful to get exactly full links—say ten links are found to be exactly 20in. long, which makes each one 2in. In this way we reduce any error in measuring the length of a single link into as many parts as there are links in the space measured, on the principle that you can measure a single space with about the same degree of accuracy each time. It makes no difference what the length of the space may be, provided it is less than the length of the scale or rule used to measure with. This would ordinarily bring the space within 2ft., the length of an ordinary rule. If, then, you could measure a single link within ·01 of an inch, you could also measure ten links within ·01 of an inch, then by dividing this into ten equal parts we have reduced the error in the length of a single link to ·001 of an inch. We should, of course, measure the chain with a standard rule, and then take the same space from a shrink rule before dividing in single links.

The diameter and spacing of this wheel need not be so absolute as in making gear wheels; still, the teeth in a single wheel should be all alike, in order that the motion produced by it may be regular.

To lay out the box we will make two templets, as shown in Figs. 3 and 4. These are made with with a gauge piece that is placed against the part of the box that corresponds with the largest circumference of wheel. We will use the one marked 3 first, then with a templet like 3 *a* we will work out the spaces laid off by 3, which, by the way, will be only every other space. After these are finished lay off the alternate links by templet 4, using a second templet like 4 *a* to gauge the depth of this last cut. This completes the core-box ready for varnish. If there are to be many cores made from this box it will be best to make it of iron, which may be made from either a wood or plaster of Paris pattern. In case an iron box is wanted it will be possible to make it from a pattern of only one-half, or one side of the rim, by making the upper part of box first, then adding the bottom and outside to pattern before making the second casting.

The pattern should have the rim glued up in segments, with the arm cut in. A cheap wheel of this kind may be made by turning the core-box out to the size and shape of the chain; by this I mean of such size and shape that the chain will lie in the groove. Then to give the chain a hold on the wheel at every second or fourth link of the chain, two little pieces *a' a'*, Fig. 1, are fastened in the box, one each side. These pieces must be of such size and shape that they will go between the links of the chain as it lies in the wheels. This box is much easier to make, and it costs less, but the wheel does not wear as long, neither does it give the firm hold which the other form affords.

[The pieces marked *a' a'*, referred to in the description of the last form of wheel, using the chain *c*, Fig. 1, are also a part of the first whe will be seen by studying both *a* and *b*.]

There are other ways of making these wh but as the two ways I have explained are th tremes, one being the most complete while other has probably the least work it is possil get along with, all other ways come between two, being more or less complete copies of F and need not therefore have a special descri

Another form of chain, the construction of is shown very plainly by the two views Fig. 7, has links, which may be either pu from sheet metal or cast ready to rivet tog This is a cheap chain, for the pieces are al and easily put together.

The pattern for the wheel is also a simple to make. The rim should be laid up in seg similar to rim in Fig. 1. This rim has three of teeth on its circumference, the two outside being placed so that the teeth in one row opposite the ones in the other outside row, the middle row has the teeth opposite the s in outside rows. The middle row must be by cores, and in turning up the pattern we allowances for this by leaving that portion o rim which is covered by this row of teeth than the two sides—this width to be such th cores, which will be described farther on, wi topple over into the mould and cause the mo to break all of his New Year's resolutions.

The edge of the rim will thus be divided three equal portions, the diameter of the two side parts being the same, while the centre h radius greater than either side by an amount to a little more than the depth of the teeth.

We should put a line on each side of the rim, mark the bottom of teeth. The outside may then be laid out by a pair of dividers worked down to central part; this part should be laid off and cut through, leaving prints, shown by dotted lines *a d*, Fig. 5. Perhaps a substantial way of making the prints for centre row of teeth will be to turn the rim sq across and put on the core prints, each one itself. In this way each single print is forme one piece of wood, which might not be the ca they were cut out of the rim.

The core-box is shown at Fig. 6, and shoul fitted very nicely to the print, in order to have cores stand in just the right places.

This kind of a wheel may also be made i cheaper form by leaving off all but the centre of teeth; keeping the rim of the same thickne the chain, to give it a good support, and als keep it from becoming jammed between the t

There are several styles of sprocket wheels with a single row of teeth, one of the plaine which is shown in Fig. 7, *a* being a section of rim, showing projection of teeth, *b* a cross se of the same, and *c* the chain used. The ch cast, each link by itself, and then riveted tog

While the chain and wheel shown in Fig. 1, also the one in Fig. 5, will work equally w either direction, this one (Fig. 6) is intende move in one direction only, as shown by the a

In this wheel, as the arms are as thick a rim, we will let them in part way through the as shown by dotted lines at *d*, Fig. 7, and se them by nails. The rim should be laid up in

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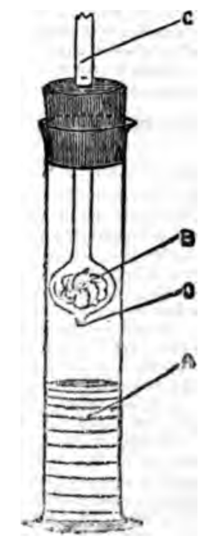
* *By F. W. BARROWS, in American Machinist.*

than three courses of segments, and the teeth better be put on separately, as if we make them rt of the rim, we may have bad work when we e to laying and working them out, whereas if ut them on each one by itself, we shall have tooth made of a single piece of wood.

SIMPLE FORM OF APPARATUS FOR GENERATING GASES.

HE apparatus most in vogue at present for generating such gases as CO_2, H, and H_2S is of Kipp. The form of apparatus described w possesses certain advantages over Kipp's, bly on the score of economy. The construc- of the apparatus will be best understood by rence to the accompanying diagram. The bulb blown on a tube C, and a small aperture is e at O. The solid substance is introduced into bulb in small lumps (e.g., marble, zinc, or ous sulphide) through the tube C. The hole ie cork should be large enough to allow the C to slide easily in it on the application of a t degree of force. The liquid by whose



ider A—height, 6in.; internal diameter 1in.; lb B—diameter, ¾in.; tube C—diameter, ⅓in.; gth, 8in.

n the gas is to be produced lies in the cylinder Now, if the tube C be pushed down until the is immersed in the liquid, the latter enters ulb through O, and generates gas by acting the solid in B. The gas escapes through C, nay be led by a delivery tube joined by rubber g to C, into any vessel designed to receive it. advantages which the apparatus possesses be perceived on using it; but two may be ed out here. The first is that when a suffi- supply of gas has been obtained, the tube C be raised till the bulb is out of the acid, when ction ceases. The second is that the acid be agitated at any time without disconnecting elivery tube, thus avoiding cessation of action spent acid adhering to the solid matter, which of the great disadvantages of Kipp's appa- .—G. S. JOHNSON, in *Chemical News.*

SIMPLE EXPERIMENTS IN PHYSICS.*

E behaviour of gases under certain conditions is of peculiar interest to the student of cs, since it involves actions which cannot be and which require purely mental effort for comprehension. There are simple ways of nstrating that certain actions do occur; but xact mode of their occurrence is left to reason ijecture. In some of the following experi- molecular action proceeds with astonishing ity. One of the best examples of this rapid is the absorption of gases by charcoal. To rate absorption according to the usual method, e of recently heated charcoal is floated upon ry, and a test tube filled with carbonic acid ammonia gas is inverted over it and quickly ed into the mercury. The absorption begins diately, and quickly forms a partial vacuum, causes the mercury to rise in the tube 1).

en a quantity of mercury is not available, xperiment may be performed very satisfactorily in the manner illustrated in Fig. 2. A glass tube, closed at one end by a cork, in which is inserted a short piece of smaller tube, is plunged open end downward into a tumbler partly filled with water. To a flask or bottle is fitted a cork in which is inserted a small glass tube, and the two small tubes or connected by a short piece of flexible rubber tubing. The flask is filled with carbonic acid gas, and corked. Carbonic acid gas for this and subsequent experiments may be readily prepared by dissolving a small quantity of carbonate of soda (say, 1oz.) in water, in a tall glass or earthen vessel, then slowly adding a few drops of sulphuric acid. The gas will quickly fill the vessel to overflowing. The carbonic acid gas being much heavier than air, may be readily poured into the flask. One or two small pieces of fine charcoal are heated strongly in a closed vessel, such as a covered crucible, or upon the top of a stove. The cork of the flask is removed, and the charcoal is dropped in and the cork replaced. If there are no leaks, the absorption of the gas by the charcoal will be immediately shown by the rise of the water in the tube in the tumbler. The coal will absorb 35 times its bulk of the gas. In the case of ammonia the volume of gas absorbed reaches 90 times the bulk of the charcoal. As the gases which are most easily condensed to a liquid state are those which are absorbed with the greatest facility, it is fair to presume that the gases absorbed by the charcoal are in a liquid state. The well-known purifying property of charcoal and other porous substances is referred to their absorptive power.

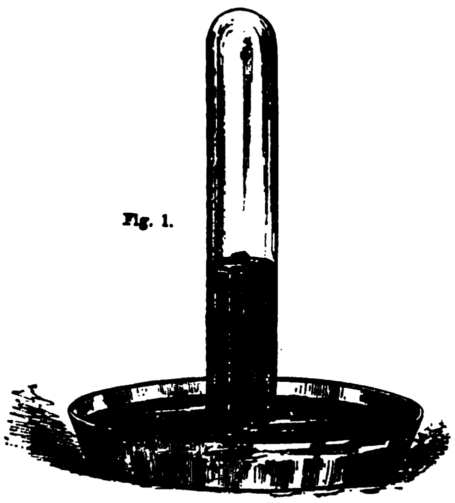


Fig. 1.

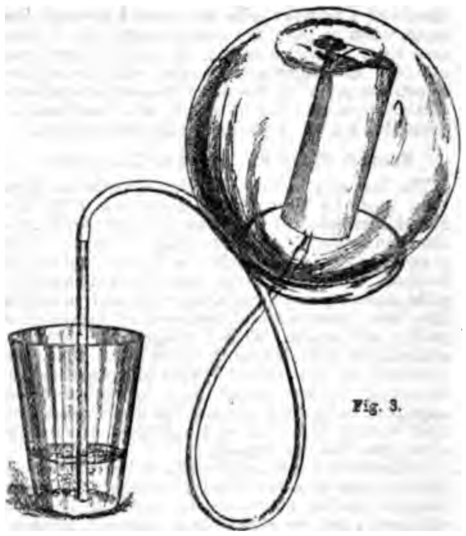


Fig. 3.

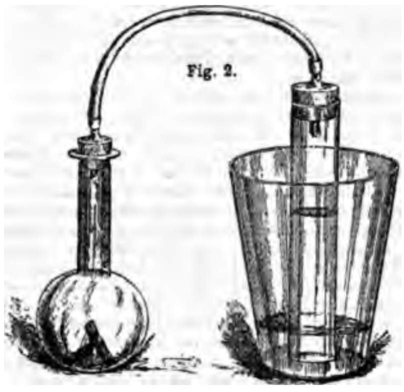


Fig. 2.

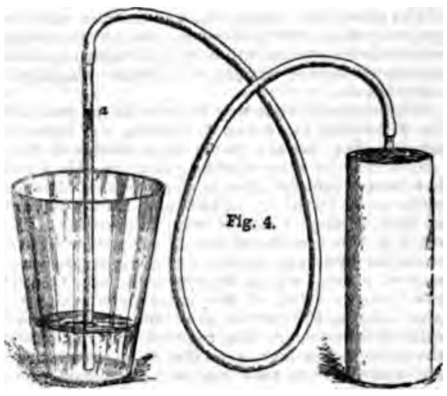


Fig. 4.

The Diffusion of Gases.—The tendency of gas to mix or diffuse one into the other is very strong. A simple experiment exemplifying this tendency is illustrated by Figs. 3 and 4. A clean, dry porous cell, such as is used in galvanic batteries, is closed by a cork in which is inserted a small glass tube. A piece of barometer tube, 6in. or 8in. long, is connected by rubber tubing with the tube of the porous cell. The end of the baromoter tube is plunged into water, and the porous cell is introduced into a vessel filled with hydrogen or illuminating gas. An ordinary fish globe answers admirably as a gas-containing vessel for this and similar experiments. It is readily filled with illuminating gas by placing it for a few minutes in an inverted position over a burner through which gas is flowing. The gas enters the porous cell so much more rapidly than the air can escape through the pores of the cell that a pressure is created which causes the air to escape through the tube and bubble up through the water.

When the porous cell is removed from the glass globe, the reverse of what has been described occurs, the gas passing outward with much greater rapidity than the air can pass in, thereby producing a partial vacuum, which causes the water to rise to *a* in the glass tube. These are examples respectively of endosmose and exosmose. In these experiments it is of vital importance to have tight joints, as the slightest leak will insure failure. The corks should fit tightly, and where they are not to be removed, they should be carefully sealed.

PRIMARY BATTERIES AND THEIR USE FOR ILLUMINATION AND MOTIVE POWER.*

WAIVING the question about the comparatively lesser cost of dynamo currents and those obtained by chemical batteries, which will not be contested, not even by the champions of the latter (if they are intelligent and honest), the problem is reduced to the choice of battery for the purpose intended. Electricians of experience know that in the various styles of electric batteries there are enormous differences between the nature of currents obtained and their behaviour during use. In order to give an intelligent review of this subject, I will divide the various styles of chemistry or primary batteries into six classes, which division is based, not so much upon their shape and mechanical arrangement, as upon the materials employed and the consequent character of the electric currents obtained.

First Class of Primary Batteries.

To the first class we must naturally count the small discs of zinc and copper or silver alternating with discs of cloth, paper, or other porous material moistened with a liquid which will chemically act upon the zinc.

To this class belongs, of course, the column or pile of Volta, consisting in a series of many such discs superposed, with alternate porous moistened discs between. The action of this pile is very evanescent or short-lived; it exhibits, however, while it lasts a very high electro-motive force, and is able to produce considerable commotion through the body when the hands are brought in contact with the extremities of the pile.

The publications of the beginning of this century contain illustrated descriptions of a great many varieties of this pile, and they also describe secondary piles which were inactive until the charge of a primary pile was passed through the same, when it gave the charge back. It is thus seen that, notwithstanding, those piles are now obsolete, the experiments made with them contained the germ of the later discoveries and even of the storage batteries, which now constitute so promising a path of pursuit to the investigator.

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* By GEO. M. HOPKINS, in the *Scientific American.*

* By P. H. VANDER WEYDE, in the *Electrical Review* (New York).

Second Class of Primary Batteries.

The first step in this direction appears to have been made by Pepys when he prepared for the Royal Institute in London his battery, which consisted in a sheet of zinc and one of copper, coiled around one another, with a porous substance between; the sheets were each 60ft. long and 2ft. wide, and suspended over a tub with acid, in which they were immersed and removed by means of a pulley and crank. This arrangement, notwithstanding it contains much more metal than was present in all the discs of Volta's pile, produced no commotion in the human body, but it exhibited considerable heating power; the discharging current burned iron wire and exhibited other signs of its great heating capacity.

We know now that this peculiar behaviour, which at that time was not clearly understood, has its cause in the low electro-motive force of a single cell, and is only produced where many cells are connected in series, as is the case in constructing a pile of Volta. The electro-motive force is independent of the size of the plate, which regulates only the quantity of electricity developed, but not the electro-motive force, which can only be obtained by combining the series: zinc, liquid, copper—zinc, liquid copper, &c.

Combining in this way large cells, as was done by Humphry Davy and Wollaston, the batteries bearing the latter's name were produced (zinc and copper in diluted SO_3); next to this comes the Smee battery (zinc and platinised silver or carbon, also in SO_3). In both of these the current, at first strong, becomes soon very weak. The cause of this is a disposition of a film of visible or invisible hydrogen, covering the copper, silver or carbon plates, which hydrogen is set free by the decomposition of the water from which the zinc takes up the oxygen, an action which has been called polarisation. The readiest way to destroy the polarisation is to give the Smee battery rest, or, better still, to take the Wollaston battery out of the liquid, for which purpose they are usually mounted suspended from an axis, by which means they can be caused to descend in the liquid only for the time the current is required. This was especially put in practice by Robert Hare, of Philadelphia, some of whose experiments the writer of this article repeated in 1835, and who had afterwards the satisfaction to see Prof. Hare in 1849, when he showed him his large deflagrators in the University of Pennsylvania, Philadelphia.

One of the batteries consisted of 250 cells, each of which contained a zinc plate of 17in. by 25in., surrounded by copper of twice that surface. When placed in the acid he produced between carbon cylinders a luminous arc, which by separating the carbons could be elongated to 1½in. to 2in. long. He melted platinium, fused heavy spar, while iron wire was burned with a kind of an explosion, and human eyes were unable to bear the light. Dr. Hare himself temporarily lost his sight by inflammation, which only was subdued after several weeks medical treatment.

Special attention is here given to these old experiments for two reasons: firstly, to do justice to the old investigators, the pioneers in the path of electrical research, whose merits are now often forgotten; but secondly and principally, to point out a grave error which Hare committed when he attempted to improve his deflagrator by abolishing the separate cups or cells, and plunging 100 pair of plates all in one large single trough containing the acids, and which he describes in the publication mentioned in the footnote, and which the writer saw when examining Dr. Hare's improved deflagrator.

If we combine galvanic elements in series so as to increase the electro-motive force, we must, in order to attain the maximum result, not only separate the liquids of the different cells, but even insulate every cell from its neighbour. In 1630 the difference between electro-motive force and quantity of current was not yet understood, volts and ampères were unknown, and an error in this respect, which was excusable then, is no more so in 1888. When at present an electrician attempts to improve a Daniell battery by connecting the plates in series, and then causes the liquid to communicate in all the cells--in fact, to have the whole of them in one single trough, and thus destroys part of the only theory in which the battery is deficient, namely, part of its electro-motive force—we must conclude that he does not understand the modern A B C of electricity. But of this further on.

Third Class of Primary Batteries.

The polarisation, which is the great drawback of the batteries of the previous or second class, as it prevents them from continuity of activity for giving the required current, is obviated in the Grove and Bunsen batteries, and the many variations made upon them, in all of which the hydrogen plates (platinum, carbon, graphite, or even cast iron) are surrounded by strong nitric acid, N_2O_5, which, being rich in oxygen, with which it readily parts, disposes of this hydrogen at once and forms water, for which purpose the N_2O_5 changes into N_2O_3 and N_2O_4, which escape as very noxious fumes. The zinc in these batteries is immersed in diluted sulphuric acid, which is separated from the nitric by a porous cup or partition. It is clear that such batteries can only be used in localities where arrangements have been made for active ventilation, so as to dispose of the fumes. This class of batteries possess almost double the electro-motive force of the former (the second class), and maintain an almost constant current until the liquids are exhausted or the zinc consumed.

Fourth Class of Primary Batteries.

The nuisance of the nitrous fumes has been overcome by the use of a solution of bichromate of potash mixed with sulphuric acid; the latter sets some of the chromic acid free, which then is decomposed and gives some of its oxygen to the hydrogen, becoming sesquioxide of chromium, forming, with the potash and sulphuric acid, chrome-alum; no fumes can be created here, but the chrome-alum deposits as crystals, whose the accumulation is a drawback, and will soon end the activity of the battery if care is not taken for their removal, also that of the remaining liquid and its renovation by fresh solutions.

Modifications of this style of battery are called Fuller's, Chutaux, Delaurier, Grenet, Fitzgerald, and Molloy. They all distinguish themselves by an electro-motive force nearly as high as those of the second class, and for this reason have been advertised as being adapted for electrical illumination for private residences, for running sewing machines, revolving ventilating fans, and performing other light mechanical work, but their activity is comparatively short-lived, in spite of the attempts to correct this defect. They require a frequent replacement of the exhausted liquids, and while this has been corrected by automatic arrangements, they are subject to the labour of frequently cleaning the cells, the carbons, the zincs, and the renovation of the latter; in the end, they are found to be very expensive, hence they are always abandoned by all who have gone through the experience of using them. They are good for nothing but for exhibiting their operation for electric illumination and for motive power to the ignorant, and by false representations induce them to buy such a battery, or, what their exhibitors greatly prefer, to buy some shares of stock in their new illuminating and motive power company, which is, according to their representations, the most profitable investment possible for small capital, claiming, as some of them do, that the electric light thus produced will cost only one cent per hour, and a horse-power can be obtained by the consumption of 1lb. of zinc per working hour. Those who are foolish enough to believe this must be impressed with the prospective profits of investing in an enterprise which surely will be patronised by everyone who wants to have at his disposal an always available horse-power for five cents per hour, and electric illumination for one-fifth of that amount.

Fifth Class of Primary Batteries.

At the head of this class stands the Leclanché, which, since the introduction of the telephone, has earned a well-founded reputation of adaptability for the circumstances under which currents adapted to the requirements of telephonic communications are needed. It possesses the great advantage of giving, for periods of that duration, currents which, if not equal to those of a Grove or Bunsen cell, are at least far superior to a Smee battery at the beginning of its action; but it has the disadvantage of being soon exhausted by polarisation when the current is kept closed for a length of time; as, however, it very quickly recuperates when the circuit is broken, and soon regains its normal strength, it is eminently adapted for currents of short duration, such as are required for the operation of the telephone, alarm bells, telegraph offices when the business is not continuous, and for similar circumstances.

In this battery the liquid is chloride of ammonium and the product chloride of zinc, while the ammonia enters the porous cell or prism and there interferes with the free action of the oxygen of the peroxide of manganese combined there with the carbon. When at rest the volatile ammonia escapes, the oxygen becomes again ready for action, and the battery is restored to the primitive condition, which lasts until the chloride of ammonia is decomposed or the lime consumed.

Before treating the sixth and most important class of batteries, we will describe some of the modern modifications of the Leclanché, which are well worth noticing, and close this article with a table of the comparative electro-motive force of various batteries, which has been reduced from Latimer Clark, by making the Daniell battery 1·25 volts. Notwithstanding that the usual definition of a volt, as given in the books, is the electro-motive force of a single Daniell cell, I find that a compact gravity battery when in good condition and tested by my voltmeter, after having it compared and corrected by the best instruments at the Philadelphia Electric Exhibition of 1884, gives for the Daniell cell 1·25 volts, which reduces the Wollaston to 1·00 or one volt.

Table of the electro-motive force of various primary batteries:—

Wollaston, at the start	1·00	volts.
" after use	0·50	"
Smee, at first	1·26	"
" after closing	0·60	"
Grove, constant	2·17	"
Bunsen, "	2·15	"
Bichromate, fresh	2·25	"
" strong solution	3·00	"
" old solution	1·50 to 1 or less.	
Daniell, very constant	1·25	volts.
Leclanché, fresh	1·73	"
" after closing	1·20	"
" later	0·50	"
" after rest	1·50	"

It is important to observe that the electro-motive force of the Daniell battery is inferior to all the others when they are freshly started, except one, the Wollaston; after closing the current, however, they mostly drop down below the Daniell, which keeps up the full amount with admirable steadiness.

ORTHOCHROMATIC PHOTOGRAPHY.[*]

At the Glasgow meeting last year I had the honour of bringing before the Convention a brief history of orthochromatic photography up to that time, and an account of some of my experiments in the same direction. Experiments with the spectrum not only confirmed the results of previous workers, but even showed that it is easy to make ordinary gelatino-bromide plates much more sensitive to the yellow and other rays of low refrangibility than to any part of the blue or violet. In order to ascertain whether plates thus prepared are of practical value, a series of comparative exposures was made. Various coloured objects, such as pottery, flowers, and paintings were photographed under the same conditions of lighting on ordinary plates and on similar plates which had been treated with a dilute ammoniacal solution of erythrosine. In the latter case a transparent yellow screen was placed between the object and the plate. The results showed that plates treated with erythrosine give much better results than it is possible to obtain on ordinary plates. At that time there was very little evidence as to the value of orthochromatic plates in landscape photography. The unaltered white light which is reflected in greater or less quantity from all coloured objects is always an important factor in the result, and tends to reduce the contrasts due to colour, especially if a full exposure is given. In landscapes the proportion of reflected white light is very considerable, and there was reason to suppose that the advantages of orthochromatic plates would not be so great as in the case of the various classes of objects previously cited. There were, however, equally good grounds for the supposition that considerable improvement might be obtained.

During the spring, summer, and autumn of last year I made a series of experiments with a view to obtain information on this point. Paget prize plates XXX were immersed for two or three minutes in a 1 per cent. solution of liquor ammoniac, and then for two minutes in a very dilute aqueous solution (1 in 10.000) of the *Erythrosin* 1 of the Badische-Anilin-und-Soda-Fabrik, to which 1 per cent. of liquor ammoniac was added. The plates were allowed to drain with their edges on blotting paper and were dried in the dark. They will not keep in good condition for more than six or eight weeks. Development is conducted in ruby light. When plates prepared in this way, or the commercial isochromatic or orthochromatic plates, are exposed on landscapes in the ordinary way without any yellow screen, the results are little better than those obtained with ordinary plates. There is a difference, and under favourable conditions (*e.g.*, towards sunset when the light has become yellowish) it can be readily recognised, but the difference is only small and is scarcely sufficient to repay for the necessity of using a dim red light when manipulating the plates.

The function of the yellow screen is to reduce the intensity of the blue and violet rays, to which the prepared plates are still too sensitive. The most convenient form is a film of collodion dyed with *aurantia*, a coal-tar dye, and gummed on the diaphragm of the lens. It should have a full emon-yellow colour, not too deep, and without any orange tint. If the screen is too deep in colour, too large a proportion of the blue and violet rays is cut off, the greens are rendered too light, and the distance becomes so distinct and heavy that all effect of atmosphere is lost.

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[*] Extracted from a paper read by C. H. Bothamley, F.I.C., F.C.S., read at the Photographic Convention of the United Kingdom.

The value of experiments of this kind depends upon whether the exposures have been made under strictly comparable conditions, and whether the ordinary plate has been made to give the best result that it is capable of giving. In the series to be described the subjects selected were as far as possible typical; the exposures were made only on days when the light was practically constant for a considerable interval, and every endeavour was made to get the best possible result with the ordinary plates. Paget prize plates XXX were used for comparison, and the exposure given to the prepared plate with the yellow screen was from two to three times as long as that given to the ordinary plate without the screen.

The defects in ordinary landscape negatives are well known; the distance is not sufficiently distinct, and if there is only a very slight haze the details are completely lost; the foliage, except under very favourable conditions of lighting, is flat, spotty, and much too dark in tone, and the different tints of green are not properly distinguished; the water is much too light, and is not unfrequently chalky, the half tones and reflections being more or less completely lost. In the examples exhibited the negatives on ordinary plates showed all these defects to a greater or less extent, although an endeavour had been made to minimise them by careful attention to exposure and development. The same views on the prepared plates (with the yellow screen) showed very considerable differences. The detail in the distances was much more distinct, whilst, at the same time, the distance was still low in tone, and thus the effect of atmosphere was not lost. In the vegetation the different tints of green were clearly distinguished, but the most noticeable difference was the improved roundness and massing of the foliage. The water showed no chalkiness, the half tones were rendered much more satisfactorily, and the improvement in the reflections was in some cases very marked indeed. These differences are to be attributed in the first place to the sensitiveness to yellow, green, and orange, which is conferred on the plate by treatment with the ammoniacal erythrosine, and, in the second place, to the reduction of the intensity of the violet and blue rays by means of the yellow screen, which not only prevents blue and violet objects from appearing as white, but likewise prevents the injurious action of the slight bluish haze which so seriously interferes with the proper rendering of a landscape on an ordinary plate. The advantages enumerated are accompanied by certain minor disadvantages. Plates prepared with the ammoniacal erythrosine bath are somewhat too sensitive to green, and hence if the yellow screen employed is too deep in tint, the greens in the picture are relatively too light. With a proper screen this defect is not apparent, and it may be avoided by using an erythrosine bath without any ammonia, or by adding the erythrosine to the emulsion as described in the Tailfer specification. In the latter cases, however, the sensitiveness of the plates is not so great, and a considerably longer exposure is required. At the same time the sensitiveness to orange is lower than when the ammoniacal bath is used. In some of the subjects it was noticeable that the shadows under the trees and overhanging rocks were darker on the orthochromatic plates than on the ordinary plates, the the latter, in fact, giving the better rendering. This has previously been observed and explained by Vogel. The shadows in question are almost exclusively lighted by reflected light of a more or less bluish character, and when the yellow screen is employed the intensity of this light is too much reduced, and consequently the shadows appear too dark. The remedy is obvious. A paler screen must be used, or if the exposure is made towards sunset and the light is very yellow, the screen may be dispensed with altogether.

A series of experiments is in progress with a view to ascertain the relative merits of the various methods of employing erythrosine—namely, in the emulsion, as an ammoniacal bath, as an aqueous bath, and in the form of silver erythroside either as a bath or in the emulsion. These experiments are not yet complete, and a report will be made subsequently, but sufficient evidence has been obtained to show that, although the Obernetter-Vogel plates, which contain silver erythroside in the emulsion, and are said to work without a yellow screen, do undoubtedly give results much better than those which can be obtained on ordinary plates, they are not equal to the results obtained with plates prepared with an ammoniacal erythrosine bath and used with a yellow screen. If, however, these silver erythroside plates are used with a *pale* yellow screen and a somewhat longer exposure, they will be found to give very satisfactory results. They have not yet been in the market for a sufficient length of time to enable me to form any trustworthy opinion as to their keeping qualities.

Photographers are not wanting who express a preference for the landscape results obtained with ordinary plates over those obtained with the orthochromatic plates. This arises partly from want of familiarity with the newer results, and is a further example of the dislike which human nature always shows to a change from anything which has become familiar. It must be admitted, however, that if the orthochromatic plates are used with too deep a screen, the results may be just as incorrect in one direction as those on ordinary plates are in the other. Orthochromatic processes must, in fact, be used with a large amount of judgment. A very important point, however, is this: landscape photographers have been accustomed to obtain the dark masses necessary to the harmony of their pictures, not from true shadows, but by taking advantage of the imperfect rendering of greens and yellows. With orthochromatic plates, however, this imperfect rendering disappears, and masses of deep tone can only be obtained from true shadows. In other words, a different manner of lighting, and in some cases even a totally different point of view, must be adopted.

The second question investigated was the relative sensitiveness of the various commercial orthochromatic plates and plates prepared by the different bath processes. The results so far obtained must be regarded as merely preliminary, as the experiments are still in progress. The standard light employed was the Siemens unit lamp, or amyl acetate lamp, which is one of the most trustworthy standards at present known. It is similar in form to an ordinary spirit-lamp, but the liquid burnt is amyl acetate, and the height of the flame is regulated to five centimètres. A Warnerke sensitometer screen was employed as a measure of sensitiveness, the distance between the light and the screen being one mètre. Immediately in front ot the screen was a glass tank with parallel faces containing a 1 per cent. solution of picric acid, the thickness of the layer of liquid being two centimètres. The light which passes through this thickness of solution is composed exclusively of the less refrangible rays—i.e., green, yellow, orange, and red. Examination with the spectroscope shows that the absorption extends to about the Fraunhofer line *b*. Light of this character and intensity has no effect on a Paget XXXXX plate, even after an exposure of one minute.

The end and aim of orthochromatic photography is to represent coloured objects with their true "values"—i.e., with shades of monochrome, the different depths of which shall truly represent the different degrees of brightness of the object or objects as they appear to the eye. The question at once arises, Which of the various methods hitherto proposed most nearly attains this end? It is necessary to bear in mind that the author is dealing with gelatine plates only, and expresses no opinion as to the relative merits of the processes with gelatine and those with collodio-bromide emulsion.

In the first place it may be well to point out that, in dealing with "values," we are dealing with subjective phenomena which do no admit of accurate quantitative measurement. The eyes of different people differ in their relative sensitiveness to different colours, and hence, of course, the "values" of one and the same subject will be slightly different for different observers. As a rule, however, the variations are not great, and there is a general agreement as to what are correct values, just as there is a general agreement as to what is good composition and chiaroscuro. At the same time we must confine ourselves to the general character of the results, and neglect small differences of detail.

Experiments with the spectrum, and a comparison between the sensitiveness of the eye and of various orthochromatic plates to different parts of the spectrum, indicate, in the first place, that no orthochromatic gelatine plates hitherto prepared will give correct values unless the intensity of the blue and violet rays is reduced by means of a yellow screen, since they are all relatively much too sensitive to these rays. Further, an ammoniacal erythrosine bath gives the greatest sensitiveness of yellow, a considerable degree of sensitiveness to orange, but an excessive sensitiveness to yellowish green and green; an aqueous erythrosine bath, or erythrosine added to the emulsion, as in the Tailfer specification, gives less sensitiveness to green, but also less sensitiveness to orange; ammoniacal rose Bengal imparts sensitiveness to yellow, and in a lower degree to green and orange, and the curve representing the effect of this dye corresponds with the curve representing the action of the spectrum on the eye more closely than the curve for any other single dye; ammoniacal cyanide imparts relatively too much sensitiveness to orange, and too little to yellow and green. A comparison of the different curves representing the effect of the spectrum pointed to the probability that a mixture of rose Bengal and cyanine would give results closely approaching a true orthochromatic effect, and that the same mixture with the addition of a much smaller proportion of erythrosine would probably be still better. A long series of comparative experiments was made with a colour chart and with the two well-known chromo-lithographs—"Bubbles" and "Playmates." The pictures are almost hopeless with ordinary plates, and afford a severe test of the merits of the orthochromatic plates. The colour chart consists of three distinct bands of coloured paper, with six colours, red, orange, yellow, green, blue, and violet in each band. The colours employed were as saturated and pure as it was possible to obtain, and any influence of the nature of the surfaces of the different papers was eliminated by using three distinct bands, with different papers in each band. Especial care was taken that the yellows reflected as little white light as possible, and were free from orange or green; also that the blues, although saturated, should be free from admixture with black. Three distinct series of exposures were made on this colour chart, no yellow screen being employed. Twelve different varieties of orthochromatic plates were employed in each series. These included the different commercial plates used in the photometric experiments—viz., Edwards's isochromatic emulsion, azaline emulsion, and Obernetter-Vogel silver erythroside emulsion, together with plates prepared by nine different baths. In one series the bath plates were Paget XXX; in the second, Edwards's instantaneous; and in the third, Wratten's ordinary. The exposures were timed in accordance with the results of the photometric experiments, and the results were precisely similar in all three series. In the case of the pictures only four kinds of plates were compared, and they were all exposed with a yellow screen—viz., Edwards's isochromatic; ammoniacal erythrosine bath 1 : 10,000; ammoniacal rose Bengal bath, 1 : 10,000; and a bath containing rose Bengal, 1 : 10,000; cyanin, 1 : 20,000; erythrosine, 1 : 20,000; absolute alcohol, 10 per cent.; and ammonia, 1 per cent. A series of exposures with a number of different plates, with or without a yellow screen, were also made on a blue vase containing daffodils (white, yellow, orange yellow).

The results were exhibited in the form of lantern slides, and may be summed up as follows:—An ammoniacal erythrosine bath does not sufficiently distinguish between different shades of yellow, and is too sensitive to green; on aqueous erythrosine bath, though requiring longer exposure, gives somewhat less sensitiveness to green, and, on the whole, distinctly more correct values. The results with with Edwards's isochromatic plates are practically identical with those obtained with plates treated with aqueous erythrosine. An ammoniacal rose Bengal bath gives still better values: cyanine gives good values, but the sensitiveness to yellow is somewhat too low. With azaline in the emulsion the results are practically the same as with cyanine, but the rendering of the yellow is somewhat better. A mixture of rose Bengal and cyanine gives slightly better values than either separately, and the same is true of the mixture of rose Bengal, erythrosine, and cyanine, but the differences are only recognisable on very close inspection and comparison. On the whole, it may be said that rose Bengal, in the form of an ammoniacal bath, although giving less sensitiveness than a similar bath of erythrosin, nevertheless gives better values than can be obtained by the use of any single dye. It will be observed that these results are in complete agreement with the deductions from the results of the experiments with the spectrum.

It is important to bear in mind that with all gelatine orthochromatic plates introduced up to the present a yellow screen is essential if a close approximation to correct values is desired. If it is not used blue and violet objects are always considerably too light. In fact, the screen is a very important factor in determining the character of the result, and places great power in the hands of the operator. By increasing the depth of tint of the screen a greater and greater proportion of the blue and violet rays is cut off, and a greater and greater prominence is given to the yellow, orange, &c. At the same time, of course, a longer exposure is required. When dealing with difficult colours, such as dark orange and reds, a deep screen must be used, with a proportionately longer exposure, and cyanine alone, or in conjunction with some other sensitiser, must be employed. For landscape work erythrosine may still be regarded as the best sensitiser, a yellow screen, not too deep in tint, being employed.

A NEW SURGICAL OPERATION.

AMONG the matters of interest brought before the British Medical Association, at the recent Glasgow meeting, was an account by Mr. Brudenell Carter of a method which he had devised of opening the sheath of the optic nerve behind the eye, for the relief of pressure. The brain is invested by firm membranes, which secrete a certain amount of fluid and are continued down to the eye in the form of a sheath which surrounds the optic nerve; and, whenever the pressure within the cavity of the skull is increased, as by the growth of a brain tumour, or even by excess of secretion from the membranes themselves, a superabundance of fluid is apt to find its way down the nerve sheath to the level of the eye, to subject the optic nerve to injurious pressure, and, in many cases, to destroy the sight. It not infrequently happens that the pressure within the brain cavity may be increased by temporary or curable causes, which, nevertheless, continue in action sufficiently long to produce permanent blindness, even although the patient may, in other respects, recover. In view of these conditions it was suggested by Dr. de Wecker, of Paris, 16 or 17 years ago, that it might be possible to open the optic nerve sheath, and thus not only to relieve the nerve from pressure and to preserve it from injury, but also, on account of the position of the eye relatively to the brain cavity, to drain the latter by gravitation, and to relieve the brain as well as the eye. Dr. de Wecker made two endeavours to accomplish this object, but he tried to feel his way to the optic nerve without the aid of sight, and to incise the sheath by means of an instrument carrying a concealed knife, capable of being projected by means of a spring. The risks of failure, and, still more, the risks of inflicting irreparable injury upon the nerve, were such that he only attempted his operation in two well-nigh hopeless cases, and only one attempt to follow his example has been recorded. Mr. Carter's attention was called to the matter last year by a case in which the diminution of pressure within the optic nerve sheath was manifestly desirable; and he devised a method of operating by which the sheath could be exposed to view, and the object attained with certainty, under the guidance of sight at every step of the process. He read before the Medical Society of London last year an account of the first case in which he operated, which was successful; and he read an account of three more cases at Glasgow, in one of which the result was negative as far as sight was concerned; while in the other two the patients were not only quickly restored to useful vision, in one instance from complete, in the other from nearly complete; blindness, but were at the same time relieved or cured of other symptoms, such as headache and sickness, arising from direct pressure on the brain. In his paper at Glasgow, Mr. Carter claimed for the new operation that it could be performed with certainty and without risk either to life or to any important structure, and that it afforded a reasonable prospect of the preservation of sight in many forms of disease in which it is now habitually or frequently lost.

THE TREATMENT OF SLEEPLESSNESS.

RECIPES for sleeplessness continue to present themselves. A fortnight ago we discussed the suggestion of a sufferer from this uncomfortable symptom who relied upon a species of artificial dreaming as a means of relief. Another of the same unfortunate class has found the following to be an effectual remedy in his own case. After taking a deep inspiration he holds his breath till discomfort is felt, then repeats the process a second and a third time. As a rule, this is enough to procure sleep. A slight degree of asphyxia is thus relied on as a soporific agent, but the theoretical correctness of this method is somewhat open to question. Certainly there is proof to show that the daily expenditure of oxygen is most active during the waking period, and that nightly sleep appears to coincide with a period of deficient tissue oxygenation. It is as least as probable, however, that other influences are associated with the production and timely recurrence of sleep besides that just referred to. This plan, moreover, however effectual and beneficial in the case of its author, is not without its disadvantages. The tendency of deficient oxygenation is to increase blood pressure and to slow the heart's action. With a normal organ, as an occasional occurrence this might not be of much consequence. If, however, the impeded heart should also be enfeebled by disease, the experiment might be repeated once too often. Another combatant in the struggle with insomnia lays down a series of rules, for the most part very sensible, to which he pins his faith. Considering that the chief causes of sleeplessness are mental worry and the want of a due amount of exercise and fresh air, he advises his fellow sufferers to observe the ordinary rules of hygiene relating to such matters, to take food and drink in moderation, and to avoid of an evening the use of tea, coffee, and tobacco. In dealing with severe nervous irritation from mental or physical work he has found a daily rest an almost essential prelude to sleep at night. Thus, he treats of sleeplessness rather as a tendency requiring constitutional remedies than a symptom of mere brain excitation. There is much to be said for his theory and means *of treatment.—Lancet.*

SCIENTIFIC NEWS.

A NEW comet was, we learn from Dun Echt Circular No. 158, discovered by Mr. W. R. Brooks, of the Smith Observatory, Geneva, N.Y., on August 7 at 8h. 46m., its position being R.A. 10h. 5m., N. Dec. 44° 30′, moving eastwards. Mr. P. F. Duke, of Hendon, writes:—"What is probably the comet discovered by Mr. Brooks on the 7th inst. was seen here last night [Aug. 13] at 9h. 38m. very close to ψ Ursæ Majoris, or approximately 10h. 53m. in R.A. and about 45° in N.D."

Encke's periodical comet was sighted at the Cape Observatory on the evening of the 3rd inst., being then in the constellation Corvus. It is now on the borders of Virgo and Hydra, and the southern declination still increasing. The perihelion passage took place on the 28th of June, and the comet made its nearest approach to the earth on the 31st ult., when its distance was 0·71 in terms of the earth's mean distance from the sun. It is not visible in these latitudes.

Dun Echt Circular No. 159 announces the discovery of Faye's comet at Nice, the observed place being Nice M.T. Aug. 9, 15h. 19·5m., R.A. 5h. 0m. 27·6s., N. Dec. 20° 0′ 42″. The time of perihelion passage being increased by 2·6 days, the following is the ephemeris for Berlin noon, as calculated by Dr. Kreutz:—Aug. 20, R.A. 5h. 28·5m., N. Dec. 19° 31′.

The small planet, No. 276, which was discovered by Dr. J. Palisa at Vienna on the 17th of April, has been named by him Adelheid, and No. 278 has been named Paulina.

In a letter to a local paper, Mr. T. Pridgin Teale, of Leeds, referring to some correspondence about "black rain," says that about 7.30 p.m. on July 31 there was a shower of black rain, which is thus described to him by Mrs. Baxendall, of East Keswick:—"About seven in the evening the sky became overcast, a heavy, reddish-brown cloud being overhead, and reaching to the horizon southward. In about half an hour torrents of rain fell, and the remarkable feature was that the rain was perfectly black. Everybody about here noticed it, and the farmers say that their rain tanks of clear water are now filled with this black water. It does not seem to be on account of any substance which will settle like any sediment, for in the tanks it still (Thursday) remains black. Next morning, as we drove to Collingham, three miles distant, we saw by the roads and the pools that there had been the same at that distance; but we learn that at Thorner, Harwick, and other places immediately surrounding there was no rain." In a second letter the lady "tells me that the shower of black rain extended as far at least as Wetherby, five miles distant, and that her husband has given a bottle of the water to Mr. Branson, of Leeds, for analysis. The explanation I would suggest for the remarkable phenomenon is this, that the colouring matter of the rain is meteoric dust from the breaking up of the meteor, for the meteor was seen against the bank of cloud described by Mrs. Baxendall, which from my house seemed to hang over a district extending from Wetherby to Harewood. The meteor appeared to break up into sparks and mingle with the north-western or Harewood extremity of this cloud, from which in about half an hour descended the black rain. Surely this letter will induce others to contribute information on this interesting subject."

M. Trouvelot has submitted to the Paris Academy of Sciences a photograph of a flash of lightning which he secured during a storm on June 24. This flash, which seemed to connect the earth to a cloud, subtended an angle of 40°. It appears divided in four main branches, brilliant and strongly marked. But there were others less visible, some so faint that they could not be seen in the negative without the help of a lens. The total number of the branches, large and small, is 37. A microscopic examination of the image of the flash shows that it is like a long ribbon, taking all the forms which a ribbon might present if plunged into a slowly moving liquid. This ribbon seemed to be traversed vertically by a multitude of rays more or less close together, and more or less brilliant. They are seen almost everywhere upon the flash, even upon its faintest ramifications. They correspond in general with the fracture of the zigzags which seem to make up the flash.

The Organising Committees of sections A and G of the British Association have arranged a joint discussion on lightning conductors, to be held at the Bath meeting in September. Mr. W. H. Preece, F.R.S., will open the discussion, and Prof. Oliver J. Lodge, F.R.S., will defend the position he laid down recently before the Society of Arts.

Mr. G. J. Symons reports that, notwithstanding the "rainy" season we have had, the fall has not generally sufficed to make up for the previous deficiency. It has done so over the south-east of England, where stations can be found which at the end of July had had one, two, or even three inches more than their average; but that is a small matter, and all that July can be said to have done is to have generally made up for the deficiency in the previous months, except in the north-west of Yorkshire, in Wales, in the English Lake District, and in the south-west of Scotland. In all these districts there was still a deficiency of from 3in. to 18in. at the end of July. It is not for him, he says, to appraise the pecuniary results of these irregularities of rainfall; but, much as we may grieve over acres of spoiled hay, we must not forget that those July rains were of almost priceless value for the water supply of Northern towns.

An extraordinary fall of rain is recorded from North Ockendon, Essex, on August 1, when a gauge carefully attended to registered 4·56in. The returns from several gauges were useless, as no provision had been made for "overflow"; but, as Mr. Symons says, "these falls are very rare, and observers will not believe in their possibility until they have themselves seen them, and, as they rarely (as far as I can trace) happen twice in a century in any one spot, no observer gets a second chance."

An "aggrieved amateur photographer" has a just cause of complaint, for the obstinacy of a Customs officer has spoilt over six dozen negatives he had taken during a trip in Norway. In spite of expostulations and remonstrances this intelligent official not only insisted on opening the boxes, but was not satisfied until he actually touched the plates. As the case is not a solitary instance of devotion to duty, it is suggested that the Customs ought to provide a dark room in which the plates can be examined, and a small fee levied on the owner to pay the expenses. The alternative is to develop the plates abroad; but that would often be very inconvenient.

It is curious to note that the demand for chemical preparations containing the rare metals zirconium and thorium, for use in the Welsbach incandescent light, has led to a remarkably successful search for minerals yielding these substances. Mr. G. F. Kunz has lately stated to the New York Microscopical Society that in the United States exploration for these mineralogical rarities has been so successful that the collectors have procured the extraordinary quantities of twenty-five tons of zircon, ten tons of monazite, six tons of cerite, thousands of pounds of samarskite, and tons of allanite.

The story of the maggot which bored into the metals on the German railways is recalled by the following paragraph, which we find in a Liverpool paper:—Down at Leasowe, at the mouth of the Mersey, there are soft, muddy banks left uncovered at low tide, which are full of boring molluscs of a most peculiar appearance. On Hilbre Island there is a large shell-fish which bores into the sandstone, while the limestone rocks at Puffin Island and the Great Ormeshead are almost riddled by the curious borers. It used to be thought that they made their dwelling-place in the rocks by means of a chemical secretion, and many students still hold to that idea, in spite of the existence of such borers in mud and sandstone; but a note published in *Indian Engineering* casts a new light on the subject. A bridge built in India scarcely a year ago has been attacked by these shell-fish, and all the bricks between high and low water have been bored to a depth of 1½in. from their exposed surface. A specimen brick shows 45 small holes of about $\frac{1}{16}$in. diameter; but if the inside of the brick is on *through* infinity they come back again (because, I presume, the circles of immense radius with which they appear to coincide within certain limits do so), and as they meet and cross at infinity, each comes back along the other, so that all parallel lines are, in fact, the same line passing I know not how many times through the same point at infinity. Such theories seem to me to carry their own refutation with them.

One of your correspondents illustrated four-dimensionism by the case of a two-dimensionist imagining that a point could not be taken out of a triangle without crossing the sides. Of course, the two-dimensionist could only deal with a purely superficial triangle having no thickness at all. Could anything be taken out of such a triangle, whether by passing over the sides or otherwise? But when thickness is once introduced, we have not two dimensions, but three dimensions. Some writers introduce the three dimensions more directly by substituting for a plane surface a curved surface, which could not possibly exist in two dimensions of space. Then we are treated to the supposed speculations of beings without thickness capable of moving along such surfaces only, and whose perceptions are supposed to be strictly limited to their own motions. When we discover thinking beings extended in two dimensions of space only, it will be time enough to inquire whether they are capable of imagining anything beyond the limits of their experience.

Dublin, August 6th. **W. H. S. Monck.**

PROBLEM.

[29098.]—PERHAPS the following solution to equation on page 499, in letter No. 29053, would suit Mr. Wm. J. Grey:—

$$(1)\qquad x^2 + y^2 + x - y = 182$$
$$(2)\qquad x^3 - y^3 - yx^2 + xy^2 = 1220$$
$$\therefore \text{ from (1)}\quad x^2 + y^2 = 132 - x + y$$
$$\text{from (2)}\quad (x - y)^2 + 2xy(x - y) = 1220$$
$$\text{or}\quad x - y(x^2 - 2xy + y^2 + 2xy) = 1220$$

substituting for $x^2 + y^2$

$$x - y(132 - x + y) = 1220$$
$$\text{or}\quad x - y[182 - (x - y)] = 1220$$
$$\therefore\quad (x - y)^2 - 182(x - y) = 1220$$

solving this quadratic we get—

$$x - y = \pm 56 + 66 = 122 \text{ or } 10.$$

Taking $x - y = 10$, we have from (2)

$$(10)^3 + 2xy \times 10 = 1220$$
$$\therefore\quad xy = 11$$
$$\text{But}\quad x^2 - 2xy + y^2 = 100$$
$$\text{and}\quad 4xy = 44$$
$$x + y = 12$$
$$\text{Now,}\quad x - y = 10$$
$$x + y = 12$$
$$\text{adding}\quad x = 11$$
$$\text{subtracting,}\quad y = 1$$
$$\text{Answer,}\quad x = 11 \text{ and } y = 1.$$

The other value of $x - y$ comes out fractionally.

Dublin. **R. B. G.**

["Vanduara," "Lyons," "M.," "A. G. R. P.," "A. Lloyd, F.C.S.," and others have sent solutions, and most express their wonder what Mr. Grey can have found difficult in the problem.—ED.]

EQUATIONS.

[29099.]—MR. GREY'S equations (letter 29053) can be solved by putting $x^2 + y^2 = z$, and $x - y = v$, when they become, after converting the second into factors,

$$\left.\begin{aligned} z + v &= 132 \\ zv &= 1220 \end{aligned}\right\}$$

These equations give us $z = 122$ and $v = 10$. We now have

$$\left.\begin{aligned} x^2 + y^2 &= 122 \\ x - y &= 10 \end{aligned}\right\}$$

the solution of which presents no difficulty. The values of x are 11 and −1, corresponding to the values of 1 and −11 of y.

Charing. **J. R. C.**

MATHEMATICS AND THE FINE ARTS.

[29100.]—I THINK the discussion on space of four dimensions has been productive of some good. This extraordinary speculative idea has been vehemently assailed both by "F.R.A.S." (in "E.M.," June 1st) and by Mr. W. H. S. Monck (in "E.M.," June 22nd), while, on the other hand, it has received support from Mr. Wm. J. Grey, analytical chemist, and a member of the Elswick Science School. The subject was argued at considerable length by Mr. Monck, who, being a science scholar and first gold medallist in logics and ethics, T.C.D., as well as the author of a treatise on Locke, is no doubt upon his own vantage ground in discussing the metaphysical aspect of the question. In the Report of the Brit. Assoc., 1878, already mentioned in connection with this *matter*, the president for the year, the late Dr. *Spottiswoode*, *endeavoured to* show, from historical evidence, that the advancement of the fine arts in past times was largely due to the cultivation of mathematics. The history of art opens a very wide field of inquiry in itself, and the president must have been heavily taxed in searching for arguments—supposing he did not take his historical statements on trust—to have to review the history of a subject quite unconnected with his pursuits. Now in my vocation in life it was necessary for me to have undergone a regular course of study in the history of the fine arts, and my conviction is that these pretensions of Dr. Spottiswoode are quite unwarranted. Just as "M.I.C.E., Bath," has stated in his replies that practical engineering does not depend much on the advanced mathematics, so, in the same manner, I would consider that the practical advancement of the fine arts is essentially unconnected with mathematical cultivation, except in so far as regards the principles of perspective, which, of course, are required to be thoroughly understood.

I think it well, therefore, to protest against a growing tendency of placing obstacles in the way of aspirants to art and other attainments by requiring of them a knowledge of subjects which are really quite foreign to their pursuits, and for which generally they have little natural talent. Dr. Spottiswoode in his address said:—"I might confidently point to the accuracy of measurement, to the truth of curve, which, according to modern investigation, is the key to the perfection of Classic art. I might triumphantly cite not only the architects of all ages, whose art so manifestly rests upon mathematical principles, but I might cite also the literary as well as the artistic remains of the great artists of Cinquecento."

When he speaks here of "the truth of curve" he might seem to argue that artistic curves may be deduced from analytical formulas somewhat as mathematical curves are traced from their equations, but alas, with one or two cases of exceptions, this could no more be thought of than drawing them *liberâ manu*. He has very wisely confined his arguments to the cause of Classic art: it would have been a terrible mistake to have associated accuracy of measurement with Gothic art, that is the peculiar form of it—hideously deformed as it is, and abominable in the extreme—which has seemed to be in such favour with the English clerical and collegiate authorities during the late Gothic Revival. With regard to the great artists, the Cinquecentists, whose works were produced in the Renaissance style, against which Ruskin has bellowed forth such idiotic ravings, we have no grounds for believing that they were mathematicians in the regular sense of the word, or that the principles of mathematics, beyond the mere rudiments, ever served them as a basis for their artistic productions.

The fact is that the *Homo Artisticus* (with apologies to Prof. Owen for the term) is quite another individual from the *Homo Mathematicus*, whom this same professor once said he would like to see constituted into a distinct sub-class. The latter of these species, whose subtlety of reasoning makes his mind generally ill-suited to the material realities of life, is not perhaps after all so distinct from other sublunary mortals; and I might instance the late Aug. de Morgan as a man of exceedingly quaint humour, while yet he could make the Calculus, with all its perplexities, blossom like the rose, his work on that subject being the largest in the English language. It is recorded that the Marquis de L'Hôpital being visited by a friend of Newton, inquired from him whether that great philosopher actually ate, drank, and slept; but, nevertheless, mathematicians do not cease to be men, nor can they live on etherial sustenance alone.

"Plato's" definition of the beautiful is that it consists in harmony, but he has not given us any systematic theory regarding it. By philosophers in art we are told that the theory of the beautiful is one of the deepest questions in metaphysics; and, moreover, that it is only in the systems of the Transcendental Idealists—Hegel and Schelling—that we can find any such theory at once profound and systematic. What a pity, indeed, that the nature of the beautiful is so completely locked up in metaphysical systems, and such purely technical language; for, be it known, Hegel himself has declared that his philosophical views are incomprehensible in anything like a brief exposition. Perhaps it might have made Hegel turn in his grave to have heard Dr. Spottiswoode identifying the æsthetic arts with mathematical science, while he himself had identified them with metaphysical science. But even philosophical inquirers into art shrink from the task of facing the unfathomable depths and endless mazes of the German Transcendentalists, and are obliged to content themselves with the more practical, if less philosophical, expositions, such as are afforded them in Jouffroy's "Cours d'Esthetique."

I may supplement my letter on "What is Infinity?" (p. 459) by remarking with regard to infinity of time, how very few people reflect that there are really two eternities—the past as well as the future—and not the future alone. Indeed, such a thoughtful writer as Victor Hugo has aptly told us that science interrogates in vain these two eternities. The immensity which is so concisely expressed by the mathematical symbol ∞ extends backwards into the abyss of time equally as much as it does forwards, so that this symbol, expressing time, can be taken like the radical with two opposite signs. For believers in another world it is only the future time expressed by + ∞ that is either brimful of never-ending joys, or else laden with the odour of brimstone and sulphur. Nothing of this kind appertains to the opposite time − ∞. However, as such an eminent ecclesiastical authority as Canon Farrar has disclaimed a belief in eternal punishments, perhaps this view of the case requires some modification.

Dublin, Aug. 13. **H. T. R.**

ARSENICAL PIGMENTS IN HOUSEHOLD DECORATION.

[29101.]—ABOUT three years ago my gardener ran into my house in a very excited state, crying out that both his children were dying of some sudden and dreadful disease. On hearing his account of the symptoms, I said they have swallowed a poison—probably they have dug up and eaten some of the many bulbs growing in the flower-beds near their cottage, as they are in the habit of uprooting them. The elder child, a girl of four or five years, appeared to be in great agony, with distorted features and livid complexion; the younger one, a boy of two or three, was not suffering so much. Emetics were speedily administered, with the result of giving us a clue to the pernicious substance they had procured. It was *mineral*, not *vegetable*, poison, for the vomit exhibited abundance of verdigris green streaks and spots, heavy and opaque. The gardener's wife seemed to get a sudden thought, for she went into a room and returned with a gaudily-labelled ginger-wine bottle, empty, a portion of the emerald-hued capsule adhering to the mouth; the cork and remainder of the said capsule she picked up and brought to us. The children had drained the bottle of a trifling amount of wine, and had sucked the capsule repeatedly, as we could see on examination of the same. The glistening paint was composed of those deadly substances—either Scheele's green or Schweinfurth green. The first is a combination of arsenious acid (11 parts) with sulphate of copper (32 parts), carbonate of potass (32 parts), with water. The second consists of arsenious acid (16 parts), verdigris (19 parts), and water. It is also prepared by mixing acetate of copper and arsenious acid in equal parts, allowing the precipitate to rest until it has acquired the proper colour. I think anxious mothers will shun such alluring ornamentation. The little girl was in some danger twenty-four hours, and slowly recovered on a pure milk diet. An artificial rose, from which the colour was scraped to make toilet rouge suddenly required, has poisoned a lady's skin. An obstinate sore is the result of such folly. **Ess.**

ADJUSTMENT OF BAROMETERS.

[29102.]—I SHOULD be glad to gain through your columns some information regarding the adjustment of the ordinary mercurial barometer or weather-glass. Having lately come into possession of one, I set about its adjustment on what I thought a true principle—that is, I took a foot-rule and measured the height of the column of mercury balanced by the atmosphere, or, in other words, I measured the distance between the surface of the mercury in the short tube and the surface of the mercury in the long tube. This distance was at the time of measurement 29½in. I then put the pointer to midway between 29 and 30, and thought I was right. But when neighbours called who had weather-glasses of their own, they said that ours was too high, and they even remained sceptical when the principle of its adjustment was explained to them. The worst sceptic was a gentleman who regarded weather-glasses as a part of his trade, and for whom in vain I exposed the tube and measured the mercury. He decisively pronounced the indication as being too high, and was prepared to prove it by half-a-dozen weather-glasses at his own establishment; but when I asked him on what principle he adjusted them, he had to confess that he always took some particular instrument as a standard of correctness, and knew of no principle of adjustment, although he had an idea that some sort of scale or table existed, and that the adjustment varied with the district. Is this so? Is it a fact that the majority of these mercurial instruments are not set so as to register the actual atmospheric pressure, but rather to indicate the kind of weather that may be expected in any particular district?

S.

WEST COAST SCOTCH EXPRESS.

[29103.]—THE further acceleration of the 10 a.m. express, Euston-square, was yesterday (the 6th inst.) proved an accomplished fact. At Carlisle has been brought down to a reasonable and scientific dimension. The only risk is that from some entanglement the parachute may not become properly inflated by its first unchecked fall. When once fairly spread out the descent is quite a safe one—more so than when a balloon lands, for this, if even half-inflated, has an immense bulk, and sometimes drags the car and its occupants with terrible speed and force over the ground in even a moderate breeze, whereas the parachute, as soon as the weight and consequent motion of descent ceases, instantly collapses and falls flat.

The parachute by which Garnerin made his first descent in this country was of the preposterous diameter of 30ft., giving an area sufficient for the safe descent of 700lb.; consequently the thing, not being adequately ballasted, was top-heavy, and very nearly turned over, as any toy parachute will show when not sufficiently weighted.

Admitting that there is but little danger in Mr. Baldwin's feat, still, beyond a mere daring acrobatic performance, it is difficult to say whether it demonstrates anything novel in the way of aërostation. Mdlle. Garnerin repeated the feat of her father by making 39 descents in a parachute, and became so confident and dexterous that by hauling some of the suspension cords she was enabled, by thus giving a scoop form to the web, to skim down, in an oblique direction, "to a place determined and remote. By the combined inclinations which could be given to her parachute she was seen, in fact, very distinctly to manœuvre and tend towards the place designated." ("Astra Castra," page 348.) This served to illustrate a principle in aërial flight, though any shape that could be given to the ever-concave and unsuitable form of the supporting fabric was ill-adapted for the demonstration.

F. H. Wenham.

EFFECT OF LIGHTNING.

[29113.]—REFERRING to Mr. Wenham's interesting account (letter 29079) of the effect of lightning on the two fir trees, a very similar case occurred in Kensington Gardens, about the year 1875, to two sweet-chestnut trees in a grove near the Albert Memorial, where, I believe, they still stand with the marks remaining on them. I examined them immediately after the storm, and found the effect very much as Mr. Wenham states, a strip of bark peeled off the full height of the bole, widening at the base. They are about 15ft. apart, and the northern had at top a large amount of bristling twigs; the other some small branches. Neither had any spread of branches—rather more like pollard trees. The northern appeared to be less injured than the other.

As to two trees near together being affected by the one discharge of electricity, we must recollect that in the interchange of currents there is as much goes from the earth to the cloud as from cloud to earth, and the roots of the trees extending far and wide afford the readiest conductors for the current, so that the fir tree's spinous leaves and the chestnut's bristling head served more as distributors than collectors, thus forming a temptation for the cloud to strike in that spot, as well as for the earth to send its superabundance of electricity to the cloud. These trees are in a grove, immediately on the right hand, as you pass the turnstile in the fence to the north of the Memorial.

I fancy that the disruptive force of the lightning stroke is occasioned in most, if not in all, cases by the instantaneous creation of immensely condensed heat, caused by the current passing through conductors having considerable electric resistance (or by the conductors not being of sufficient capacity for the current, as in the case of copper bell wires), thereby decomposing fluids and any solid substance capable of decomposition, and expanding the contained air and gases, the violent effects being produced by the suddenness of the action, as is the case with all the well-known explosives.

At this time last year a fine old elm tree, near Waterford, situated in low ground by the side of a small stream, then dry, and surrounded with wooded hills, was struck, the bark being blown off, with one of the branches, to a distance of 50 yards, and two deep holes were burst up in the ground close to the base of the tree. The bark was stripped off for 20ft. of the bole, from 20in. to 2ft. wide. I exhibited a sketch of this tree and specimens of the bark at the last exhibition of the Royal Meteorological Society, together with a lithograph of a church steeple, near Cork, which was burst open through two-thirds of its height. In these cases the effect of the stroke is easily attributable to the instantaneous action of intense heat.

R. J. Lecky.

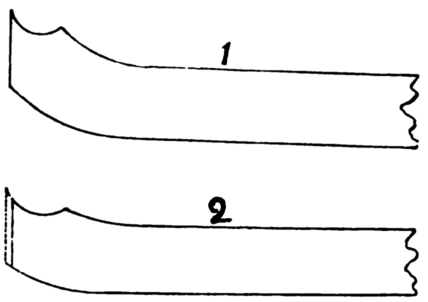
PHOTOGRAPHS OF LIGHTNING.

[29114.]—IN corroboration of Mr. Williams's letter (29080), allow me to say that, on three or four occasions, I happened to be looking at the exact spot where the flash issued from the cloud, and the impression left on my eye was that of a well-defined zigzag. Once I was situated between *two thunderstorms distant* from each other (as I afterwards learned) not less than sixteen miles, with a considerable tract of tolerably clear sky between them. A flash, leaving one mass of thundercloud, traversed the whole distance to the other, making two distinct zigzags in its course. If this be an optical illusion, may I ask to what is it owing?

J. A. F.

LATHE TOOLS.

[29115.]—UNQUESTIONABLY the test of a slide-rest tool lies in its efficiency, and a tool that cuts a long, clean shaving is a good tool, if it also leaves a good and true face upon the work, this being the ultimate object in every case. Hence, F. Carre's is a good tool when it first leaves the grindstone; but if I understand it rightly, the effect of every fresh grind must be to alter its cutting edge, thus,



the dotted line showing the original edge. I have made and used similar tools, and have often filed out such a groove to give out in a tool meant for cast iron in order to fit it in a hurry for wrought-iron; but for the reason stated it is not satisfactory as a permanent form of tool. An emery wheel with rounded edge soon sets them right when the edge is worn; but at each grinding they need to be packed up, which is a drawback. Still, in all such matters the theory need not be too prominently insisted on. The lowering of the cutting edge is a fact; but not, for a time, a fatal one.

O. J. L.

JEWSBURY'S GEAR, &c.

[29116.]—"J. L. D's" (letter 29088 p. 525) ideas of the differential gear for lathes are more imaginary than real. He is quite right with regard to his objection to the shape of the teeth in the wheels, as shown in *Design and Work* (preferably each wheel should have had double quantity of teeth) ten years ago. Nevertheless, they would work, as I have proved in driving machines doing heavy work, the eccentric running 300rev. a minute continually day after day, seldom stopping, and after two years' work, the wear of the eccentric and teeth of the wheels was found to be scarcely perceptible. As to the size of the eccentric, I always contrived to make as small as possible; an eccentric 2in. diam. would be quite large enough for "J. L. D.s" 1⅜in. spindle, not 2½in. diam., as he says. But why have the spindle so large in diam? There is no trouble at all in the working of the oscillating lever holders, which "J. L. D." seems to doubt. I am quite sure, if he could but see this gear at work, he would pronounce its superiority to the ordinary gear. At the Birmingham industrial exhibition, 23 years ago, I was awarded a medal and certificate of merit for exhibits of lathe and pulley blocks, fitted with this gear. If "J. L. D." will turn back to one of the numbers of the "E.M." (I don't know which—I cannot just lay my hand on it) of the latter end of Feb., 1878, he will see an illustration of a peculiar motion, as applied to blocks for raising weights, which motion may well be applied to lathes; but more of this anon. May I be allowed to offer an opinion of Holtzapffel's internal gear? I think it is more complicated, would cause more friction, would make more noise, and have considerably greater tremor than the ordinary gear, and perhaps not so durable. I wish it to be understood that I have not the least interest in the differential gear, other than for the benefit of the readers of the ENGLISH MECHANIC who seek information.

Joseph Jewsbury.

Birmingham, August 13th.

[29117.]—I should like to ask "J. H." to tell us what he would consider the proper shape for the teeth of this gear, the pinion which works into the internally geared ring to be as large as may be, so that when the teeth are "in" one side their points shall clear at the opposite; ring might have, say, 16 teeth, and pinion 14, so as to pass two teeth at each revolution, and give a ratio of 8 to 1. I think the shape of the teeth, as shown by Mr. Jewsbury, cannot be intended to show their real working shape; I take them to be merely conventional teeth. Were I making them they would be quite short, having almost straight radial sides.

I think "J. L. D." has not noticed that the eccentric and pinion will not create friction at the quick speed, since then the whole of the parts revolve together. At slow motion the grooved pulley must of course run freely on the mandrel, and will tg in the pinion. I think this of no consequence; the arms have but the smallest possible movement, and that only at the slow speed. I think their friction would be imperceptible.

Could not our friend "J. L. D." get a look at some back volumes? The questions he asks have been discussed several times: the vertical slide applied upon the top of the rest, on the quadrant, on the front slide, and on the right-hand standard (see Vols. X., XI., XII.); also description of the London Lathe and Tool Co.'s lathe in recent volumes, and discussion which followed. "J.L.D." could easily bore out collars of a new headstock with a bar, by fixing it between the present heads and feeding it along with a hammer; he will find it troublesome to lift on and off the two heads, and he has not told us whether he wishes for a traversing mandrel. I went with a friend to Homerton, by appointment, to see the Watt gas-engines, as advertised in the "Sixpenny Sale Column," but we were not allowed to go in, or see anything.

F. A. H.

THE ORGAN.

[29118.]—IN your issue of August 10th I notice that Mr. Chas. F. Owen, of Chicago (letter 29078), in speaking of, or rather alluding to, my experiments with a pressure gauge in the swell, states that "my suggestion of a funnel leading off from the swell-box to relieve the pressure is wrong." I beg to say that I never suggested any such thing: what I stated was, that there is no alteration of pressure in any part of the box, either top or bottom. I expect Mr. Owen has mixed my communication with that of another correspondent who suggested such an addition as a "tube" to close automatically when the swell front is open, and to be open when the swell is shut. I think a Mr. Clarke wrote about it afterwards as forming a joint patent with another inventor; but I never saw anything about it since. Anyway, it is as old as the hills, and anyone could apply it without infringement. However, as the subject is alluded to, I merely wish to correct the error that has crept in; but as Mr. Owen states in the early part of his letter that he has not the various letters at hand referring to the matter, I assume that the error may be attributed to such.

I know, from actual practice, that the various errors attributed to the swell-box exist only in the distorted imagination and want of skill in the persons who put forth such.

If in a great organ one pipe be shaded at the mouth by another, and it softens the tone and flattens the pitch and takes the quality of the voicing away, is it unreasonable to expect that the same close arrangement must do the same in the swell? And the fault is multiplied by the trying to squeeze the basses into a very small and, in some cases, an impossible area.

Mr. Owen is perfectly right when he states that when the wind has impinged on the lip of the pipe it is lost amongst the existing air in the box; others hold the erroneous view that the wind still carries its pressure in some shape or form with it, and creates currents both horizontal, vertical, and oblique—in fact, a regular forked lightning arrangement. The cause of the speech going off flue pipes is simply this: In the smoke experiments alluded to, and which I had the advanced presumption to try when an apprentice, the results are as follows:—In a flue pipe, either stopped or open, the smoke struck the lip, but none entered the pipe, the column of air in the pipe vibrated, and the smoke glided off and lost itself in the atmosphere; but when any object was placed in front of the pipe so as to obstruct it, the direct stream of smoke was attracted by it and diverted from the lip. I then pushed up the cap so as to throw the smoke on to the lip, and the pipe spoke as before; but on removing the obstruction the pipe was off its speech, which of course was due to the alteration I allude to.

I found that the best results were got by keeping the pipes away from each other equal to the diameters of themselves; thus, if two pipes of 4in. were placed opposite each other, there should be 4in. between them. In the reeds the smoke showed itself above the tops of the bodies equal to the diameters of the bodies, and as long as the pipes were speaking the smoke had the tremulous appearance that heated air will exhibit over the top of a lamp chimney, or the funnel of a steamer.

Therefore, the top of a swell-box should not be jammed down on the tops of the pipes, and plenty of room should be given to the basses, or, to speak plainly, the box should be made as large as it possibly can be over and above the requirements I allude to. I don't mean to go to absurd extravagance by this statement. Those who know nothing practically of the matter, and who hold unproved and fanciful theories, say the box should be made as small as it can be; but they are entirely wrong, and, what is worse, they are so ignorantly and stubbornly opposed to any correct view that they *won't* accept truth, because it infringes upon their "hoity toity" manner. Such men are of the degraded money-loving class, who would do the most absurd thing to please a client, and who have not a spark of moral courage left to oppose the view of a mistaken client or help him through. The degradation of this class of man may be inferred from the following fact. I applied to four shops in London (since I came from the country) for employment, and was refused when they knew who I was. One gentleman (?) said "We don't want men of your class; we can get on *well enough* as we are—you had better seek work amongst those who write articles and give information to outsiders, to the ruin of the trade and the enlightenment of an already too exacting public. We can't make a job pay these days through parties out of the trade poking their noses where they have no right to do so."

Well, it is gratifying to have such an acknowledgment as this. The days of blinding people are fast passing away, and it is not to be regretted. I shall in my spare moments continue to write for the readers of the "E. M."—with the Editor's permission—in spite of the boycotting that my advanced views have received.

Wm. Robinson.

COIL BOILER.

[29119.]—AS one of "Ours" that has a great interest in this subject from the fact that I think of building a coil boiler, I must thank Mr. Cam (letter 29085) for description of one made and used by himself. In his letter he says that "they have their advantages and also their drawbacks"; but though he gives the former, he has omitted the latter.

May I, therefore, ask him if he will give us these, and also, if it would not be trespassing too much on his kindness, if he will favour us with a drawing and full dimensions of his boiler and fittings? If he can do this I am sure our Editor will be good enough to engrave it, seeing that several of "Ours" are interested in the subject.

Would boiler be as effective if inner end of heater coil was connected to bottom of main coil, and top of main coil to steam-chest?

Will Mr. Cam kindly say what arrangement he used in the case of stoppage of launch to prevent overheating of coil or undue steam waste? Information on these, or any other points, will be greatly esteemed by no doubt many others besides

Ponto.

"KITE BALLOONS AND KITE TANDEMS."—The paper on this subject which appeared on p. 494 should have had a note appended to the effect that it was a paper read at a meeting of the Aëronautical Society of Great Britain.

ONE of the new applications of a waste product to a useful purpose is the manufacture of paper out of cedar-wood pulp, for underlaying carpets, wrapping of wool, furs, &c. The paper-makers procure the cedar chips of pencil manufacturers, and the paper made of this material will, it is claimed, preserve articles wrapped in it from the moths.

AN interesting excursion train will leave Paris on September 11 for Central Asia. Upon that day the International Sleeping Car Company will, by arrangement with General Annenkoff, the constructor of the Trans-Caspian Railway, start a train made up of dining-room, drawing-room, and sleeping cars, &c., for Vienna, where there will be a stoppage of 24 hours. The next halt will be made at Kieff, where two days will be allowed, and the same at Odessa. From Odessa the excursionists will be conveyed by water to the Crimea, and, after a stay of five days in that peninsula, they will embark for Novrossick, going on by rail to Vladikavkas, in the north of the Caucasus, and thence to Tiflis. After a stay of two days at Tiflis, they will visit Baku and its oil wells, crossing the Caspian to gain the new railway to Samarkand, where they are due to arrive on September 30. They will visit Merv and Bokhara, returning by the south of the Black Sea—that is to say, they will proceed from Baku to Batoum, by way of Tiflis, and thence to Constantinople, putting in at Trebizond, Sansoun, &c. Five days will be allowed at Constantinople, the return journey being completed by the new lines through Bulgaria and Servia, with 24 hours at Sofia, Belgrade, and Pesth. The excursionists will reach Paris on October 30, and the cost of the excursion, including railway fares, carriage hire, interpreters, food, &c., will be £200 for each person. A doctor will accompany the train, and the issue of tickets will be limited to members of certain leading clubs in France and England.

REPLIES TO QUERIES.

**** In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[65381.]—**Link Motion.**—You do not give any dimensions of engine. Make eccentric rods as long as possible, with centre of crank shaft as centre, and centre of link as radius. Describe part of a circle as large as rods will allow this to be—centre of block, which works in slot of link; make link to this curve. The length of link will depend on travel of valve, and space from bedplate, say, from three to four times the travel. You will find sketch of link in "E.M." for April 23, 1886, with other details.

W. W. C.

[65478.]—**Ice-Cream Tubs.**—I don't know of any "scientific" objection to making these of zinc, except that zinc is liable to be acted upon by the ingredients of the "cream," and would certainly wear out quicker than the pewter at present employed. I suppose by "tubs" the querist means the "freezers," or vessels in which the "cream" is frozen. Anything will do for the "tubs" in which the freezers are placed, and surrounded by a mixture of salt and ice. It should be remembered that in these matters the cost of the raw material, though it may be a consideration, is not the most important, and as much labour must be expended on inferior as on superior materials.

NUN. DOR.

[65704.]—**Emigration.**—"X. Y. Z." should get a little book called "From Britain to British Columbia," by Prof. Sheldon, of Downton College. This may be had from the High Commissioner for the Dominion of Canada, 9, Victoria Chambers, London, S.W., from whom all information concerning the colony may be obtained.

J. A. HOGG.

[65725.]—**Formic Acid in Honey.**—I may tell "S. R." that I have not tried formic acid in new cider, as at this time of year I am not able to get any; but what I wanted was the benefit of others' knowledge and experience, if I could get it, so that I could put it to practical account in the autumn, as I am ready to give anyone the benefit of what little knowledge I possess, if it is of any use to them. So I again ask, Can any of "Ours" recommend an anti-ferment that could be added to new cider or other fruit juices that will not spoil the flavour, or be injurious to persons taking it in moderate quantities; in fact, what I want is a good wholesome, non-alcoholic drink, and I am not alone in that.

F. W.

[65736.]—**Watchmaker's Apprentices.**—A course of instruction in watchmaking is, I believe, given at the school in connection with the British Horological Institute.

L. G. H.

[65757.] — **Metal - Turning Tools.** — Has "H. M. E." ever heard of the ENGLISH MECHANIC, and is he aware that there are now forty-six back volumes, and that up to the present day experts argue as to the best form of tools and tool-holders? Or is his query a grim joke? If he means merely that he (personally) cannot make a tool that will take a good shaving off and leave a smooth surface, I can only suggest that he gets his tools made and ground for him; but certainly he can find plenty of diagrams and innumerable hints in back volumes, and even in recent numbers.

O. I. SAY.

[65772.]—**Giffard's Injector.**—Why use water which spoils the injector? The remedy is to purify the water before passing it through injector into the boiler, where it also does much injury.

G. M.

[65775.]—**Secondary of Vertical Coils.**—I do not think the method of winding these section coils has been described in the last six volumes; but if "Sodium" can see No. 793, on p. 310 he will find an illustrated description of the method of winding the wire discs for induction coils, from the pen of Mr. J. Brown, Belfast. I cannot tell him much from practical experience, but I am sure that in back volumes he can find all the information needed. The rings or discs are soldered together by the inside ends of the wires.

T. M.

[65778.]—**Indicator.**—This query cannot well be answered without seeing the indicator; but if "Perplexed" cannot get over his difficulty after consulting the articles on electric bell-fitting and the many replies to similar questions which have appeared recently, I am afraid he will have to call in a practical electrician.

E. M. F.

[65782.]—**Lithographing.** — See indices for Anastatic Printing. It is work requiring much special skill.

J. T.

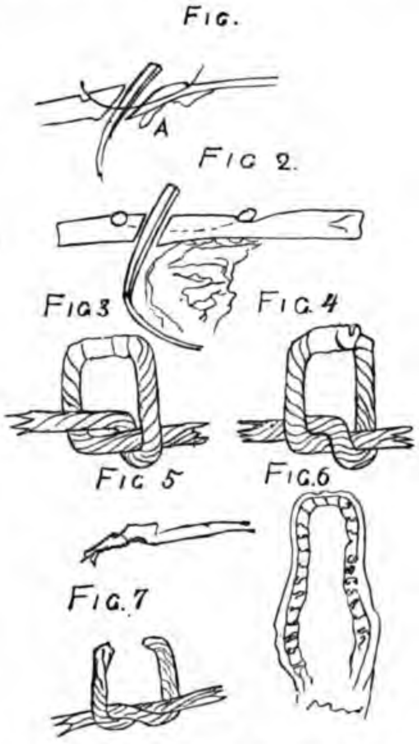
[65784.]—**English and Foreign Meat.**—English-fed beef of the Scotch kind is the best, but the American is very good; Belgian and Australian inferior. I daresay a butcher could distinguish between superior and inferior beef; but as to analysis, that must be the same. What is meant by "synthesis" in the last sentence I do not know.

OXTAIL.

[65789.]—**S.E. Locos.**—I think the following belong to the 7ft. class:—Nos. 201 to 206, and 208 to 214. No. 205's date is 1884. No. 207 is a goods engine. Nos. 198 and 199 are bogie expresses; but whether this class or not I don't know. I have not seen 215 or 216. No. 203 is a T.K.

G. L.

[65808.]—**Boots.**—It is all very well to talk of making boots, or lasts being made to the feet for boots to be made off of. If lasts are ever so well fitted, misfits and very uncomfortable boots can be made off them if the maker is not up to his work—the which, I am sorry to say, that there are many that are not. For instance, the uppers should be cut properly—i.e., that they may fall into their place without pinching. If the uppers want severe treatment to bring them into shape, they will, in spite of everything you can do, go back again when exposed to wet, or worn by a person with a damp foot. A boot thus treated, in many cases will—although going on quite easy when first put on—be very difficult to get on a second time. Let those who have a preference for leather have them made of French calf; or, if light, made of sealskin, Cordovan dressed. Another source of very severe punishment to those troubled with tender feet is the putting bad inner-soles into them, which, when bad (i.e., thin or too loose), pucker up with the sewing, and the man, aware that he cannot get sound work on such a foundation, in sewing he has to resort to the process of over-casting his thread upon the inside—that is, he hauls the right-hand into the position he requires, and casting the thread over upon the inside, ties a knot in his thread, slapping that down to keep it in its place. Now, in this process, the outside chamfer of the inner sole rises and forms a sharp ridge, and then a little further in, just where your ball of big toe and little toe come, there is a trench with every stitch set up in it like a lot of peas. I have heard talk of doing penance with a shoe full of peas; but no one but those who have worn such shoes can tell the fearful punishment and agony such shoes cause, independent of the corns that are produced by such. The following sketch will illustrate. The chamfer should be very slight both for inner sole and welt, and the seam about $\frac{3}{8}$in. wide; the inner sole should be firm, well lasted, and not too wet, and not less than $\frac{1}{8}$in. thick—if $\frac{3}{16}$in., all the better. The thread should not be too stout, and it should be sewn with a good round awl, and not too crooked, that you should have to dig for your work; and the welt sewn thus, butting up against the upper, should form a good flat seam. By these means, the inner sole will lie flat, with no perceptible unevenness, and the last may be drawn easily. The fittings-up should be firm and the surface rounding. A great deal of the comfort of the boots and shoes will depend upon this. The flatter the seam the better the work; the less filling-up required the sounder the work, and good



work is a credit to anyone; about 12-cord of flax. I always cast off half and wax, and then add the other three stitches to the inch. Good wax made of Swedish pitch resin and linseed-oil, and the shoes made in the height of the season, when no tallow is required for the thread—such will produce work that will stand and give satisfaction. This is not given as a standard for navvies' tights or double-deckers. When I have had to work 20 and 30 cord of fine brown hemp, these I have had to make warranting them for twelve months, or if they failed, do all repairs free. Fig. 1 shows how you more generally find stuff fitted to much chamfer, with very light inner sole. Consequently, it is puckered up at A, and when the over-casting is resorted to, as Fig. 3 and Fig. 4, it sets up these peas and trenches, as spoken of and shown at Figs. 5 and 6; because there is not sound width of seam to pull the over-casting in its place—if there was any necessity for the same (see Fig. 7). The whole Fig. 2 shows how it ought to lay, and if there is a good inner sole, there is no necessity for the over-casting; and if used, the stitches can be pulled into position without punishment, and lay snug. JACK OF ALL TRADES.

[65859.]—**A Fallacious Equation.**—I should like to add a few remarks on this subject to those that have appeared. Algebraists of course know the reason of the absurd conclusion; but when called upon suddenly to explain it to a beginner it is quite possible they may fail to make it quite clear to him. "Tyro's" equations proceed quite correctly until he divides by $a - x$. This is, as all your correspondents have pointed out, because $a - x = 0$. Now, when an algebraical expression is divisible by another which is equal to zero, it is an indication that it is itself equivalent to zero. For, whatever zero may be multiplied by, the product will be zero. As a consequence of this it follows that if an expression equal to zero be divided by another expression equal to zero, the quotient may be anything from zero upwards. It, therefore, follows that when both sides of an equation, each equal to zero, are divided by what is equal to zero, the quotients will be either alike or different in value. One may be zero, the other may be something; or they may both be something but different in value; or they may both be zero; or they may both be something and have the same value. Now, it is when the two quotients happen to differ in value that the resulting equation is fallacious. When they chance to be of the same value, then there is no error, even though a factor equal to zero may have been struck out. The "moral" is: Take care that neither side of your equation becomes equal to zero. Or, if it must be, keep your eye on it, remembering that many operations become fallacious when performed with zero, which would be all right if performed on something of real value. T. S. B.

[65912.]—**Wheels.**—To "W. W. C."—Sorry to have kept you waiting so long; but I sent a reply a fortnight ago, and as it has not appeared in print it must have miscarried. The reply by me to a former query to which you refer will not apply to your case, for this reason: you cannot divide both the wheels by any number without a remainder. As you ask for example, here is a simple one. Say driver 100 teeth, and driven 50. Now you can divide both these numbers by 50, and the ratio will be 2 to 1, and it is evident that the driven will make two revs. to one of the driver before the same teeth will gear again. But in your case the driver will make as many revs. as there are teeth in the driven wheel, and the driven as many as there are teeth in the driver before the same teeth will engage again. Hope this will be clear to you. W. W. C.

[65923.]—**Electric Light.**—The ingredients are for a 4-pint cell, with a pint porous pot, 2½ pints water, 17oz. of sulphuric acid, 10oz. of bichromate of soda, well mixed together, same in porous pot as in outer cell. The brass is screwed on the inside of the front piece of wood; the first screw is put at the end, the next 3in. from it, a third one 3½in. from the first, and so on to the end; then between the screws, which are ½in. apart, cut with a saw or a file the brass through, so as to divide it into 5 pieces; next fix 2 binding-screws into the wood at each end, so that they touch the pieces of brass; then solder them together. The carbons are ⅛in. apart, so that there may be as much carbon surface as possible; the zinc is ½in. from carbon to allow it to go into the porous pot. The two pieces of carbon are placed on the first segment of brass as near as possible to the division; the zinc is placed on the second segment about ⅛in. from the carbon; or, if there is not a porous pot, put them as close as you can without touching. The zincs and carbons must be filled up true at the top, so that when the nuts are screwed up there will be good connection as well as being held in their places.

Haslemere. F. S. FOWLER.

[65928.]—**Mangold.**—In reference to this query and Mr. Bottone's reply on p. 505, we may mention that that gentleman sent us a parcel of the midribs of the silver beet, which, when served in the same way as asparagus, were highly appreciated by those who tasted them. ED.

[65930.]—**Photo. Negatives.**—Will J. Bean be good enough to say what advantage the sal-ammoniac has over a plain saturated solution of chloride of mercury? M. P. M. S.

[65952.]—**Ancient Coin.**—The coin that is known as a "small brass" of the Roman Emperor Claudius, A.D. 41-54, if in fairly good condition, its value is about sixpence, as they are quite common. F. W.

[65961.]—**Infinite Series.**—The second term of the general expression found in my reply should be $(-1)^{n-1}.\left(\frac{\sqrt{5}-1}{2}\right)^n.$ This is the same thing as $-\left(\frac{1-\sqrt{5}}{2}\right)^n,$ so that the result is the same as that obtained by "J. R. C." by the calculus of finite differences.

Bath. M.I.C.E.

[65999.]—**Filtering Papers.**—"B.Sc., Plymouth," is quite wrong when he says that Swedish and Rhenish filter papers are used on the Continent, and English paper in England. English filter paper is no more nor less than thin blotting paper of the common form, and contains a good deal more mineral matter than either Swedish or Rhenish filter paper. Now the great points in a good filter paper for quantitative work are these: Absence of mineral matter, and a power of filtering rapidly, and, at the same time, not allowing a precipitate to pass through its pores. These qualities are obtained to the highest degree of perfection in the Swedish paper. While at college (in England) I used this sort of paper, which I washed with dilute hydrocloric acid—the ash of 4in. diameter paper weighed rather less than 1 milligram, and its filtering qualities were excellent. Since leaving college, and entering a works laboratory, I have used nothing else but Rhenish, which varies (according to my experience) in quality a good deal. At its best, it is as good as the Swedish; and at its worst—well, I would almost as soon use common red blotting-paper. But then, of course, Rhenish filter paper is cheaper than Swedish, and this seems to me the great point in the laboratory (at least, ours). English filter paper is always used for qualitative work, as there is no need in this case to pay any particular attention to the ash, and, as far as filtering qualities go, a good quality of paper filters very well. I have heard of cases where even common thick blotting paper is used for quantitative work. For example, a chemist was making an assay of sulphur in pyrites. The way he reasoned was thus: Certainly a little barium sulphate does go through; but it does not matter, the ash of the filter paper will make up for it. But I hope that cases such as these are few and far between. CHEMIST.

[66008.]—**Blowing-off Boilers.**—The reason there is no decrease in pressure when you increase the steam space (under a constant fire) is, the thinner the sheet of water above the fire the more rapid the ebullition, and the thicker the water above the fire the more retarded the ebullition, so you will see from the above the reason the gauge does not fall when blowing off water under constant fire is because the fire generates more steam in the same time when acting on a thinner sheet of water. STOKER.

[66012.]—**Turbine and Electricity.**—Your dynamo has an output, it appears, of about 25H.P. You would get 15H.P. from a fairly good electro-motor; do not expect more. H. R.

[66023.]—**Boiler Priming.**—A friend of mine (an oil refiner) assures me for a positive fact that he never has any corrosion in his boiler whatever—nothing more than he can wipe off with his hands. His boiler often gets well oiled through the carelessness of his workmen, who leave the steam-taps on the oil-tubs at night, so when steam goes down, it sucks the oil in the boiler. Of course, it blows out again when steam is up. If any of our steam-users like to try oiling their boiler, I should like them to report the result for the benefit of others. E. T.

[66025.]—**Portable Railways.**—Having had considerable experience in the construction of light railways, I have much pleasure in sending "J. N. G." a few particulars. The permanent way for 16in. gauge straight line, ½ mile long, would cost approximately £125; switches and turntables, say about £4 each extra. If the line is intended to be permanent, proper formation should be made, and above the level of the ground if liable to floods. As to the economical working, it is uncertain, and in this case, without further particulars, 15 tons per week is not a very large quantity, unless this is the average all the year round. Curved portions would add to the expense, so it would be as well to have the line laid out as straight as possible. The above price does not include rolling stock. If "J. O. G." will send me his address I shall no doubt be able to help him.

4, Queen-street Chambers, Exeter. C. E.

[66029.]—**Electric Wiring.**—A 3-wire system is the same from whatever source, and is one positive and one negative, or flow and return from separate generators connected to one wire, which is thus both flow and return from two sources at the same time, the other two wires + and − being separated; the same for any number, as with 4 machines, 5 wires, and so on. H. R.

[66029.]—**Electric Wiring.**—Electrical engineers in England and America have given the name of "three-wire system" to the special arrangement initiated by Dr. J. Hopkinson. It allows of the use of two lamps in series. Similarly, that used by Mr. Crompton at Vienna, which allows of four lamps in series, is called a "five-wire system." It would be impossible to describe in an intelligible manner either of these systems in the space here available. Most of the large central stations where direct supply is used in America and on the Continent have their mains laid on the three-wire system. The latter has been very fully described by many writers in England and America. Prof. George Forbes described it very fully in his Cantor Lectures on "Electrical Distribution" delivered before the Society of Arts in 1884 or 1885. If your correspondent will read Prof. Forbes's description he will not require any further information on Mr. Crompton's sentence, which, although unintelligible to him, is quite plain in its meaning to those who understand the systems dealt with. M. H. R.

[66030.]—**Silver Solder** to suit "Warwickshire's" requirements. Standard silver would be best, only see that is clean—no solder about it (I do not mean pewter solder)—as anyone in the line knows pewter solder would certainly ruin it. I mean old silver articles—such as watchcases; there is a lot of silver solder about them, and if melted up and made into solder the zinc in the old silver solder gets burned, and your solder will not run nicely. Take 1oz. clean standard silver and put it into a clean crucible; now take ½oz. of thin brass wire, and cut it in lengths about 1in.; tie these lengths together with a piece of thread; now place the crucible in the furnace, and melt the silver first; when the silver is melted, drop the brass wire into it, then a small piece of borax; in a minute or two the solder will be ready to pour into the ingot (that is, if you have not let the heat of the furnace down). The great secret in making good silver solder is to melt your silver first, then drop the brass into it, and not to give it much heat after—"just heat enough." Pure tin would spoil the lot if added to it; but if you wish the solder to run very easy, add a small piece of zinc, about the size of a pea, to the 1½oz. of silver solder when melted; but the second you put the zinc into the pot, the next second you must take the pot from the furnace and pour; but for your work I would not advise you to add zinc. German silver, being a hard metal to melt, you do not require it; but if you wanted to solder an article made of very common silver or gold, you would find the addition of zinc to the solder a boon.

47, Alexandra-road, Richmond. PERKS.

[66040.]—**Hydraulic Pumping Ram.**—I have recently had my house and covered yards supplied with water under somewhat similar conditions to those named by "Yorks"—viz., fall 4ft. 6in., lift 90ft., a splendid supply of surface water with a fair allowance of spring water. I was advised that a pumping waterwheel would be preferable to a ram, and now that it has been at work for nearly eight months I am quite satisfied that I was well advised. I believe that a wheel of the same pattern as mine is at work with a lift of 165ft. I shall be glad to give "Yorks" particulars of cost, &c., and to show him my wheel at work if he will communicate directly with me. I should have mentioned that the stream water is used for motive power, and the spring water is pumped.

Staniwells, Brigg. J. O. NICHOLSON.

[66048.]—**Rouge.**—I think if "No Sig." would gloss the pebbles with putty powder he would get a better polish and have less difficulty in getting rid of it; but it may be best to use rouge. If so, I would get the rouge out of the pores and crevices in this way:—Take 1 pint of hot water and add to it about 20 drops of liquor ammoniæ; take a tooth-brush, dip in the water, then rub on soap, and dab the brush on the pebble. I have never had any difficulty in removing rouge out of anything in this way, but I do not believe in boiling anything that has rouge about it. I have always found that by boiling the article it makes the rouge stick firmer. If this does not do it, send me one, and I will soon put you right.

47, Alexandra-road, Richmond. PERKS.

[66052.]—**Telescopes.**—In my reply last week 360 should be 36. ARTHUR MEE.

[66055.]—**Spring Motor.**—You will not be able to make a spring or other motor that shall do work without power being applied or stored in it, as weights or springs would require "winding up." H. R.

[66056.]—**Gas-Engine.**—Try air port 2½in. by ½in., and gas port ⅜ round hole. Is the diameter ¼ that of the cylinder end, or of the valve?

St. Mary Church, Torquay. ENGINEER.

[66057.]—**Silver Soldering.**—"D. P." does not say what metal the scissors are made of. If they are silver, German silver, or brass handles, it is a simple matter. Make the handle red hot; let it get cold; then file or scrape the parts to be soldered bright; take a piece of thin iron wire, and bind them in position; then get a piece of slate, put a few drops of water on it, then take a piece of borax, and rub it down until it is the thickness of cream; take a small camel's-hair brush, dip it in the borax, then apply it to the break; then take small pieces of silver solder, and lay them on to the parts you are to solder; now heat the article gently over the gas. When the borax has dried and the solder adhered to the article, put the article on to a piece of charcoal, and blow on it with a blowpipe until the solder flows; when cold put them in pickle, one part vitriol, six parts water; this will remove the borax. If the scissors are made of steel it is not such an easy job, unless you go the right way about it. The following, I think, will be the easiest for you:—File the parts bright, touch with borax, lay a small piece of brass on it (or gold is better, for this reason—it runs easier), run it on the ends to be soldered. This is the most important part, and is done by the quickness of the blast; if you don't use a strong, sharp blast, a black crust will come on the surface, and the solder will not adhere. When you have run solder on the ends you will have no difficulty in soldering. Touch the solder with a file; bind them together in position; borax well; put a little more solder on them, and heat. The whole art in soldering steel is a strong sharp heat, to prevent the black crust coming on the break. If this black crust comes it is no good; stop at once, file the parts bright, and try again.

47, Alexandra-road, Richmond. PERKS.

[66060.]—**Fumigating Pastilles.**—The following recipes are from the "Techno-Chemical Receipt Book":—(1) Convert the following ingredients into a fine powder: Charcoal 60 parts, benzoin 2, storax 2, frankincense and mastic each 4, anime resin 1; mix the powders intimately with the charcoal, and then stir them into a paste with the necessary quantity of solution of gum-tragacanth. (2) Pulverise and mix: Charcoal 2 parts, cascarilla bark and sandarac each four, anime resin and liquid storax each 1, cinnamon and cloves each 2, musk and ambergris each $\frac{1}{25}$ part, with sufficient solution of gum-tragacanth, and form the paste into cones. The solution of gum-tragacanth is made by adding 60 parts warm water to 10 parts gum, letting stand for a few days, then pressing through a coarse cloth. The charcoal (willow) must be thoroughly calcined and contain no ill-smelling constituents. A cheaper recipe: Charcoal 6 parts, frankincense ½, juniper wood ¼, liquid storax ⅓, formed into cones with starch paste. This work contains many more recipes. XL.

[66066.]—**Bank Token, 1812.**—If in fine condition, the value is about 5s., as they are not at all rare. F. W.

[66066.]—**Bank Token, 1812.**—There are lots of them. I question very much if you would get more than 8s. for it—I mean from a dealer in old coins.

47, Alexandra-road, Richmond. PERKS.

[66070.]—**Navy-Cut Tobacco.**—Tobacco is issued in the Navy to the bluejacket in the following manner—viz., for use afloat, home service, 1lb.; foreign service, 2lb. (per month), at the rate of 1s. per pound. It is the natural tobacco in the whole leaf, packed in casks, and preserved with saltpetre. When it is first issued the tobacco is dry, so it is generally made moist by sprinkling it with water before taking the main stems out of the leaves. The stemless leaves are then rolled in a piece of duck or canvas and marled down, care being taken not to roll the edge of the canvas between the leaves, because when you come to cut the prick or plug you would have shreds of canvas with it. The tobacco having been marled down ready for heaving up or serving over, the end of a length of spun yarn is timber-hitched round the middle of the prick. The other end is secured to a hammock hook; the sailor sits astride the spun yarn, and with his weight heaves up and serves the tobacco. When made up, tobacco is very solid and hard; it is cut in shavings with a knife as required and rubbed with the hands, and is then ready for smoking. The stems are used for snuff-making. The duty on tobacco is 3s. 6d. per pound. One pound of genuine tobacco is made into from 1lb. to 14lb. of a saleable article classed as "tobacco." GENTLEMAN JOHN.

[66072.]—**Calibrating Ammeter.**—To S. BOTTONE.—Rig up one or two large Daniells, say, about one gallon capacity; couple them in parallel; prepare a copper anode and cathode; carefully weigh the cathode, make a saturated solution of sulphate of copper, acidulate slightly. Place anode and cathode in the bath in circuit with ammeter and the Daniell's battery. Have a bar across the depositing cell, so as to be able to regulate the distance between anode and cathode so that copper shall be deposited exactly at the rate of 0·309 grains per minute, or 18·5 per hour. The ammeter will then indicate one ampère. Every multiple of 18·5 grains per hour will correspond to as many ampères. No. 36 copper wire runs about 5ft. to the ohm. See also my book, "Elect. Inst. for Amateurs." S. BOTTONE.

[66074.]—**Mullein Plant.**—Verbascum Thapsus, or the "great mullein," has long ago disappeared from the British Materia Medica, its properties having been pronounced "insignificant." The herbalists no doubt still stick to its use. It was supposed to be narcotic, and the seeds were used to stupefy fish; but I know of no officinal preparation in modern medicine. EOS.

[66074.]—**Mullein Plant.**—Mullein plants are made into an infusion or decoction in some parts of Italy, 1½oz. to 1 pint of water, and it is said to be useful for a cough, inflamed bowels, diseases of kidneys and bladder, and is used as an injection to allay tenesmus. The flowers, when dried in the sun, give out a kind of fatty matter, used in Alsace as a cataplasm in hæmorrhoidal complaints. ("Floragraphia Britannica," 1857.) J. A. HOGG.

[66074.]—**Mullein Plant.**—There are five species of Mullein plants; but the true medicinal one is Verbascum Thapsus, natural order Scrophulariaceæ. In its young state it very much resembles the purple foxglove, but the leaves of Verbascum Thapsus are hairy on both sides, whereas the digitalis is hairy on its under surface only. Verbascum is a hardy biennial, plants growing about 4ft. high, with mucilaginous leaves and a yellow flower. The leaves should be gathered in early autumn, just previous to the plant flowering. The most simple and pleasant means of taking its virtues is the old Irish method of boiling in milk: four ounces of the fresh or dried leaves to a pint of cow's milk, boil for ten minutes, strain and sweeten with sugar, and drink while warm. A juice or extract may also be prepared in a similar manner to the directions given in the British Pharmacopœia; but the juice is very unpleasant to take, and the extract requires great technical care in its preparation. Mullein is now being used for diarrhœa, coughs, and consumptive patients with marked beneficial results.

FREDERICK DAVIS.

[66077.]—**Canvas for Canoe.**—The canvas can be got at most ship chandlers or sailmakers. For dressing, get 2oz. of pure rubber and cut up small, and dissolve in a pint of good benzoline without heating. Mix this with half-gallon of boiled linseed oil—i.e., paint oil. You can mix any colour with this, and apply according to fancy. JACK OF ALL TRADES.

[66077.]—**Canvas for Canoe.**—Cover with crash (strong and close) to be obtained from any linen draper. Seven yards, 5ft. wide, will cover a 12ft. canoe. Before putting on the deck, give the lower part outside a good coating of boiled linseed oil. The same may be done afterwards with the top. Three days after, give top and bottom outside another coat. Then paint the canoe according to taste, giving second coat of oil time to dry. Two coats will be advisable, and paint which will stand water well should be used. Frame should be painted before covered. ATLAS.

[66078.]—**Champagne Corks.**—"W. H. M." has probably expected the cork to take its final shape too soon. It will not finally set for at least three months. The cork must be softened by squeezing and lying in water. After it is in the bottle, with about ½in. or ⅝in. projecting, tie it with string. Tie the string firmly round the collar of the bottle so as to have the two ends of string opposite one another. Knot very tightly on top of the cork. Repeat the process at right-angles to first knot. This will be sufficient to give the cork the proper form in time. Wiring can be done after the stringing, or a month or two later, if required.

F. R. S. E.

[66078.]—**Champagne Corks.**—In the first place, "W. H. M." must use really first-class corks. Those used by the champagne manufacturers—such as Moet—are about 2in. long, 1¼in. in diam., and cost them something like 25s. a gross, in bales; they are obtained principally from Catalonia. Then he must have a machine which compresses the cork small enough to enter the neck of the bottle, which is ¾in. diam, and at the same time driving it in about half its length. The corks are steamed and dipped in wine, and used while warm. "W. H. M." will see that the inch inside the neck is compressed to about half its original size, while what is left outside expands again. Then the cork is secured with string drawn tightly across it, which has a tendency to draw the opposite sides of the top of the cork together, which is also helped over with the thumb; then comes the wire, which does the same thing. There is also the pressure inside the bottle, which is over five atmospheres in a good wine, and of course makes the wire and string still tighter, and brings the opposite sides of the top of the cork still closer together, and gives it the rounded appearance usual with champagne corks. The gist of the whole is, have plenty of cork, and tie tight enough. F. W.

[66080.]—**Electrical: Calculating Windings for Bobbins.**—The resistance of different qualities of wire, their lengths, and diameters in hundredths and thousands of an inch, can be seen in any electrical wire merchant's price lists. Having decided on the wire to be used, the following formula will give the required answer as to length of wire to be used, of given diameter, on bobbins of stated sizes—viz., "multiply the length of the bobbin in inches by the number of turns of the chosen wire required to make 1in. Multiply this by the mean between the inner and outer diameters of bobbin in inches. (The mean is got by adding together the core diameter and the flange diameter in inches, and dividing by two.) Now multiply the number thus obtained by 3·14. The answer will be length of wire in inches." S. BOTTONE.

[66081.]—**Guttapercha Moulds for Electrotyping.**—You will get into a mess if you go boiling them. Mix some of Nixey's black lead, in powder, with the 'percha. Do not make too hot when taking impressions, and keep weight on and in position until cold.

JACK OF ALL TRADES.

[66082.]—**Indian Sauce.**—The favourite extempore sauce used in India, from the prince to the beggar, by European and native alike, is made by the following simple recipe:—Pound one or two green chillies in a mortar (according to size and pungency) to a paste; add thereto a handful of soft, fresh mint shoots without stalks. Reduce this to a fluid paste, stirring well into the first ingredient; then add a saltspoonful of salt. Rub all well together; add the juice of one lemon, strained through gauze, with one small teaspoonful of white sugar. Mix intimately, and it is then ready. It does not keep well in summer, so making a little at a time is best. EOS.

[66086.]—**Recovering Bichromate.**—The salt observed is chrome alum; it is a double sulphate of chromium and potassium, having the formula $K_2Cr_24SO_4$, 24 H_2O. The salt may be precipitated by ammonia, which throws down chromic hydrate; this, when heated with nitre, forms potassium chromate which, by adding nitric acid, is converted into bichromate. It would be out of the question to work this economically. PRINCIPIA.

[66089.]—**Refrigerator.**—If "Traveller" will refer to "E. M.," No. 1215, July 6, 1888, middle column, he will see sketch of refrigerator and table. If he does not understand it, I will give him more minute details if he will give me his address. H. M. WARD.

Whitefield Vicarage, Glossop.

[66091.]—**Muzzle Energy of Guns.**—Muzzle energy = $\frac{W \cdot V^2}{2 \cdot G}$ where W = weight of projectile in pounds, V velocity in *f.s.* at muzzle, G = acceleration due to gravity. The following is an example: 10in. R.M.L. gun, weight of shell, 410lb.; muzzle velocity, 1,379*f.s.* Then—

$$\frac{W\ V^2}{2 \cdot G} = \frac{410 \times (1{,}379)^2}{2 \times 32{\cdot}19 \times 2{,}240} = 5{,}160 \text{ tons.}$$

MR.GR.R.A.

[66093.]—**Chromic-Acid Cell.**—To S. BOTTONE.—The red deposit is not the cement, but a chromic salt. To fasten on your carbon, soak it in boiling water; dry in an oven. When quite dry place the end you wish to join, for the depth of about ½in., in a bath of strong sulphate of copper solution; place a copper anode in the same bath. Couple up to a Daniell cell; deposit copper on the carbon to the thickness of a sheet of writing paper; remove from bath, wash well in several changes of boiling water, till the water comes away quite free from sulphate of copper. Dry quickly on a cloth. Now clean the copper flange on the head of the bottle cap. Pin both that and the coppered carbon with a plumber's bit. Hold them both together over the spirit lamp till the solder runs and makes a good joint. When cold, varnish with good Brunswick black over the join.

S. BOTTONE.

[66095.]—**Tobacco.**—Nicotine ($C_{10}H_{14}N_2$) when pure is an oily, colourless fluid. Various methods for its preparation have been devised by Wittstein, Schloesing, and others. The method generally followed is this. The leaves are exhausted with acidulated water, and the infusion concentrated, then rendered alkaline with caustic potash, and agitated with ether, which removes the nicotine, the ethereal layer is decanted, and the ether allowed to evaporate. The residue is neutralised with oxalic acid, the nicotine oxalate removed by alcohol and distilled with caustic potash, and the alkaloid purified by redistillation in a current of hydrogen or carbonic oxide. A simpler method is to extract with dilute sulphuric acid, and distil the concentrated extract with soda-lye. Nicotine is highly poisonous, and must be very carefully used. J. A. HOGG.

[66097.]—**Annuity.**—The present value of an annuity of £100 per annum to continue 90 years, calculated at 3 per cent., is £3,100. F. W.

[66097.]—**Annuity.**—Present value at 2¾ equal £3,353 19s. 4d.; at 3, equal £3,134 18s. 3d. ENOCH EVANS.

[66099.]—**Electrical Sparks from the Body.**—If C. F. Fowler has one of the old frictional machines (cylinder or plate), this result is easily obtained. Let him take six tumblers, wipe them out thoroughly dry, and place them, inverted, on the carpet, away from the walls and furniture. A dry board must be placed in these tumblers, and C. F. Fowler must then stand on the board, holding a chain connected to the prime conductor while his friend works the machine. Anyone standing on the ground can, by touching C. F. Fowler with a finger or any conductor, draw sparks from any part of your correspondent's body. B. HARCOURT.

[66099.]—**Electrical Sparks from the Body.**—There are two ways of doing this. First, place the person on a stool with glass legs. Connect him by a chain to a good electrical machine; let someone turn the handle. Anyone presenting the knuckle to the person on the stool will draw sparks from him. Secondly, place the individual on a glass-legged stool, as before, and let him be connected by a chain or wire (not touching elsewhere) to the positive terminal of a shocking coil. Let a wire be brought from the negative terminal to a metal plate put in front of the person on the stool. Anyone treading on this plate, and touching the person on the stool, will receive sparks and shocks. S. BOTTONE.

[66100.]—**Frictional Electricity.**—All metals will give rise to electricity on friction; but both they and the rubber must be insulated. Read Guthrie's or Thompson's "Electricity" before you do anything else in the way of storing electricity obtained by the continuous friction of metals. S. BOTTONE.

[66101.] — **Midland Locos.** — The outside cylinder locos. working the Midland metropolitan traffic are Nos. 204 to 209, built by Beyer, Peacock, and Co., 1868; cylinders, 17in. by 24in.; four-coupled driving-wheels, 5ft. 9½in., bogies and side tanks. DUBLIN.

[66101.]—**Midland Engines.**—The six tank engines to which Mr. A. M. Bushell refers were built by Messrs. Beyer, Peacock, and Co., Manchester, 1868, as part of an order from the Metropolitan Railway Company. The Midland Company at the time requiring engines to work its new traffic between Kentish Town and Moorgate-street, purchased six engines from the "Metropolitan" during the time when they were being built, and they are numbered from 204 to 209 inclusive. CLEMENT E. STRETTON.

[66101.]—**Midland Metropolitan Locos.**—Nos. 204 to 209, built in 1868 by Beyer, Peacock, and Co.—driving wheels, 5ft. 9½in.; cylinders, 17in. by 24in.; outside bearings. Nos. 690 to 695, built in 1869 by same makers—driving wheels, 5ft. 2in.; cylinders, 17in. by 24in.; double frames. Nos. 780 to 799, built in 1870 by Dübs and Co.—same dimensions as preceding. These last have no very striking resemblance to the Metropolitan single; the Midland have trailing bogie, inside cylinders, and outside bearings for coupled wheels; while the Met. have leading bogie, outside cylinders, and inside bearings. Dimensions of 690 class:—Cylinders, 17in. by 24in.; coupled wheels, 5ft. 2in.; bogie wheels, 3ft.; wheel base, L. to D., 8ft.; D. to bogie-pin, 12ft. 3in.; bogie, 5ft.; boiler, 11ft. long, 4ft. 3in. diam.; firebox—length, 4ft. 7in.; height, 5ft. 3¾in.; width, 3ft. 6in.; tubes, 167, 2in. diam. REYMOND.

[66102.]—**Old Westminster Bridge.**—It is quite true that if a person whispered in one of the alcoves on Westminster Bridge it could be heard in the opposite one; but I don't know if it was so when the traffic was going on; but on a still evening you could hear quite distinctly. The reason is that the alcoves were so truly constructed in architectural proportions that the sound was concentrated in one point. H. M. WARD.

[66102.]—**Old Westminster Bridge.**—This is due to the fact that when a wave of sound meets an obstacle in its path it is reflected; if the obstacles are placed in a favourable position the sounds are reflected in such a manner as to be heard plainly at a distance. Among the ancients a notorious instance of a sound-collecting surface was the "Ear of Dionysius" in the dungeons of Syracuse. The roof of the prison was so constructed as to transmit the words and even the whispers of *the unhappy victims* there confined, to the ear of *the tyrant, through* a narrow passage cut through the solid rock. The whispering gallery of St. Paul's Cathedral is another instance of this kind. PRINCIPIA.

[66102.]—**Old Westminster Bridge.**—The alcoves were similar to four upon Essex Bridge, Dublin; but, whereas the latter has never had, I believe, but four, on the two chief piers, Westminster had originally two upon every pier. Of these, however, several had, before I knew it, been removed. None had been designed with any acoustic view, and it is wonderful that any had the whispering property that they certainly had (by night, at least), as the plan of each recess was merely a half-octagon, and its roof an angular half-dome, composed of five bits of cylindric surface externally, and I am pretty sure the same internally. There was not an inch of spherical or doubly curved surface without, nor, I think, within. Yet a whisper was audible the 50ft. from each to the opposite one, as if they had been elliptic or parabolic reflectors. There were two pair, I think, larger than the rest, but nowise differently shaped. E. L. G.

[66104.]—**Thunderstorms.**—These questions are fully discussed in a paper by Prof. Lodge in No. 1,214 "E. M." J. A. HOGG.

[66105.]—**Moist Water-Colours.**—Put one drop of glycerine on the top of the paint, and leave it for a day or two, and it will become quite moist. Don't put water on them for moistening them. H. M. WARD.

[66106.]—**Moist Water-Colours.**—Use honey and water with a little gum-arabic dissolved in it. JACK OF ALL TRADES.

[66106.]—**Moist Water-Colours.**—If "R. G. J." will place one drop of glycerine on each of his moist colour cakes, and keep his box containing them in a damp place, I think he will find them keep moist enough. PHOTUS.

[66106.]—**Moist Water-Colours.**—Water, glycerine, and a drop of honey is the "mixture used in making moist water colours." A drop of ox-gall is an improvement to these colours, which do not "sour" under it.

Plymouth. B.Sc.

[66106.]—**Moist Water-Colours.**—You can keep your colours moist by simply giving each a drop or two of glycerine, or if the pans are full, saturate a small piece of paper and lay it on the top of each. Do not put much water on your brush when taking up colour. If a quantity be required, rather lift the colour with the point of your penknife and rub down on your palette. AVICULA.

[66108.]—**Legal.**—The general rule is that all chattels and personal effects may be distrained for rent. Among other exceptions, tools and whatever else is in actual use in the hands of a person at the time cannot be distrained. But if they be not in actual use, and if there be no other sufficient distress on the premises, then they may be distrained for rent ("Simpson *v.* Hartopp," "Smith's Leading Cases," 450).

Plymouth. B.Sc.

[66108.]—**Legal.**—Clothing actually being worn is privileged from distress for rent, but not if it is taken off. A workman's tools in actual use are privileged; but as regards tools not absolutely being used when the distress is made, they are only privileged in the event of there being other sufficient distress on the premises. The object of the legislature in protecting these articles in use is to avoid a row, which would be highly probable if a broker attempted to pull off a man's coat or take an axe out of his hand. B. H.

[66110.]—**Steaming Hay.**—Get some lengths of ¾ iron barrel the length you require, then have the one end plugged up and drawn to a sharp point. In these, about 3ft. of their length, get three lines of ⅛ holes drilled about 2½in. apart, these are thrust into the stack, and connected up to lines upon the outside, which consist of a series of short lengths of 1in., or, better, 1¼in. pipes, and tees with ¾ outlets. You had better have two caps for large pipe, two for ¾ pipes, and the same number of plugs; these do to stop ends, and to insert to. Drive the pipes into stack with a wood maul to protect the screw ends. JACK OF ALL TRADES.

[66111.]—**Cutting Glass.**—I know nothing about the process; but Chemnitz (pronounced Kemnitz) is the principal manufacturing town of Saxony, and is on the Dresden-Hof Railway.

Plymouth. B.Sc.

[66112.]—**Clockwork Blower.**—Would not an aspirator be much cheaper and better for so small a tube? S. BOTTONE.

[66113.]—**Hydraulic Cup Leathers.**—Gelatine size is used, or water diluted with sulphuric acid. J. G. HAWKES.

[66119.] — **Grandfather Clock.** — In the "London Directory" of 1816 there is a Thomas Martin, of 245, Tooley-street, silversmith and jeweller? Would this be the maker? J. J. R.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

65502. Eyepieces, 336.
65510. Hot-air Engine, 336.
65520. Blast Furnaces, 337.
65526. Normandy s.s., 337.
65528. Solid Drawn Tubing, 337.
65540. Worm Wheel-Cutting in Lathe, 337.
65542. Line-Preparing Machinery, 337.

65750. Lemon Squeezer, p. 423.
65751. Telephone Appliance, 423.
65755. Pig Iron, 423.
65774. Formula for Solar Heat, 423.
65788. Carpet-beating Machine, 424.
65789. S.E. Locomotives, 424.
65790. Channel Steamers, 424.

QUERIES.

[66123.]—**Differential Co-efficient.**—Will some mathematical reader, who understands the differential calculus, tell me what is the differential co-efficient of $\underline{|x}$ with respect to x? Also the differential co-efficient of $\underline{|x-a}$ (a being a constant)? By $\underline{|x}$ I mean the "factorial" of x—viz., 1, 2, 3, 4 . . . . x, and so on. In other words, if $y = \underline{|x}$, what is $\frac{dy}{dx}$, and if $y = \underline{|x-a}$, what is $\frac{dy}{dx}$?—TYRO.

[66124.]—**Factorial of Zero.**—Will some one, more learned in mathematics than I am, confirm or contradict the following statement (which I think is true, though it seems paradoxical at first sight)—viz., that the factorial of zero is not 0, but 1? If we put a series of their factorials over that of the natural numbers, thus:—

$$\begin{array}{cccccc} 1 & 2 & 6 & 24 & 120 & 720 \\ 1 & 2 & 3 & 4 & 5 & 6 \end{array}$$

we may observe that (putting a for any number in the second row, and u_x for the number above it, and so on)—

$$u_x = xu_{x-1}$$

or, in other words, any number in the first row is the product of the number preceding it and the number beneath it. If we make this the definition of a factoral, and if we prefix to the series the terms 0 and u_0, thus:—

$$\begin{array}{cccccc} 1 & 1 & 2 & 6 & 24 & \&c. \\ 0 & 1 & 2 & 3 & 4 & \&c. \end{array}$$

we evidently get $u_0 = 1$. The same result might be shown arithmetically, and less technically, by successive divisions. Thus beginning with 120 as the factorial of 5:

$$\begin{array}{rcl} 5)\underline{120} & = & \text{factorial of } 5 \\ 4)\underline{24} & = & \text{,, \quad ,, } 4 \\ 3)\underline{6} & = & \text{,, \quad ,, } 3 \\ 2)\underline{2} & = & \text{,, \quad ,, } 2 \\ 1)\underline{1} & = & \text{,, \quad ,, } 1 \\ 1 & = & \text{,, \quad ,, } 0 \end{array}$$

—F. S. S.

[66125.]—**Effervescing Hop Bitters.**—Would any kind reader kindly give me a recipe for making the above refreshing drink, similar to the kind sold in small bottles in our large towns?—HOPS.

[66126.]—**Silver Soldering.**—What pickle is used after the soldering to cleanse it from the borax and tarnish? Is it dipped in or left to lie in?—S. T.

[66127.]—**Bending Hard Wood.**—Will any of your readers inform me if there is any good method of bending hard wood, about ½in. thick, or a little thicker, and about 5in. or 6in. wide?—COCO.

[66128.]—**Glass - Engraving.**—Would any reader kindly inform me how to engrave on round glass bottles from a steel plate by acid?—MILLBANK.

[66129.]—**Byrne's Dual Arithmetic.**—At the Patent Office Library I lately came across the above book. It professes to be a calculus of great power and utility. Does any reader understand it, and if so, is it really meritorious, and worthy of study?—CALCULATOR.

[66130.]—**Linear Associative Algebra.**—What is this? It was invented by a Prof. Benj. Peirce (of America). Does any reader know its principles and objects and the reason for its name?—M. A. I.

[66131.]—**Turning Small Granite Columns.**—Will some reader please inform me the best tool to use for turning small granite columns or pillars and the best material to use to polish them with?—WM. JOHNSON.

[66132.]—**Polishing Sticks.**—Can any reader give me a recipe for polishing hard or soft wood, like walking and umbrella sticks?—EALING, W.

[66133.]—**Faded Furniture.**—I possess fine pieces of furniture in mahogany, the blooming colour of which is daily fading, being gradually destroyed by light and turning greyish. Could any kind reader give me the means of reviving the furniture colour?—CH. RABACHE.

[66134.]—**Dynamo for Gas-Engine.**—I have just completed a 3 man-power gas-engine from a set of Watt's castings which runs very well, and I should be pleased to have particulars of a dynamo suitable for it. I want to light direct from dynamo, as engine seems to run very steady.—J. H. F.

[66135.]—**Shooting.**—Can anyone, having a good experience in the above, give me hints as to the best and easiest position in kneeling, lying down, and standing, and also in holding, pulling, and sighting the (M.H.) rifle? I am practising shooting with the V. Is it better than the plain bar?—WIMBLEDON.

[66136.]—**Communication Cords on Railways.**—In view of the accident at Hyde Junction is it considered that it is safe for passenger trains to run for 20 miles without passenger communication cords?—PASSENGER.

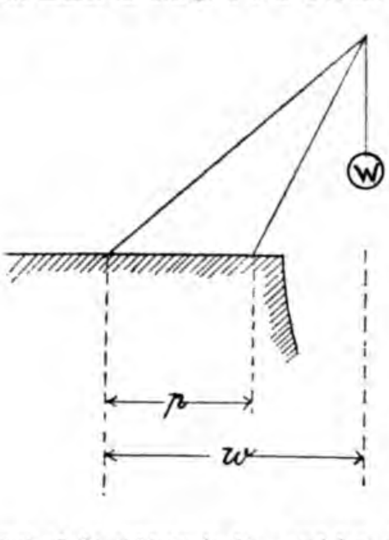
[66137.]—**White Metal for Brass.**—Having a thrashing machine under my care, I have heard that brass is sometimes lined with white metal. Will some reader inform me how it is done and how to make the metal?—JOHNNY RAW.

[66138.]—**Dynamo.**—Will Mr. Bottone kindly give me the size and dimensions of a 20c.p. Gramme dynamo, of the same form of construction as that in his pamphlet "The Gramme Dynamo," which I have got? I intend using a soft iron ring armature. How many sections should there be in it, and what size and quantity of wire to wind the same? Also what diameter should field magnets be, and size and quantity of wire to wind on? What size of base and standards. I intend connecting up as a series machine to light a small arc lamp for a small workshop or house?—A NOVICE.

[66139.]—**Weaving.**—I would esteem myself much favoured if some experienced loom maker would assist me with the following idea, and also give me an opinion on the practicability of it. I want to cause the weft, instead of going across the warp in a straight line, to take a half-circular direction, so that the middle of each shot would be, say, 4in. or 5in. nearer the beam than the sides or selvages. That this idea is feasible I believe, but have been wondering whether to try and come at the desired ends by means of a curved reed, shuttle race, and shuttle, or to have a picking motion instead. If some of our ingenious readers would give me a hint, I would be greatly obliged.—S. G. N.

[66140.]—**Outboard Condenser.**—Kindly inform me of the best arrangement (with dimensions) of outboard condenser, air, and force pumps, for a compound launch engine, cylinders 2in. and 3½in. by 3in., pressure 100lb., with sketch, if possible.—R. G. SCOTT.

[66141.]—**Shear Legs.**—In calculating the shearing stress upon the joint pins at the bottom joints of front legs, for a given position of the legs, for example, thus, I have assumed the leverage of W to be *w*, and the leverage of the resistance to be *p*, and have proceeded somewhat as though the pins were lumps of sugar, with the shears as the cutter, and W the force exerted by grocer. I am informed that this is wrong, and that shearing stress upon pins can only be $\frac{W}{2}$, leaving mechanical advantage out of the question. Will some brother-mechanic confirm or demolish this latter theory?—SHINY BOOTS.



[66142.]—**To "Principia" or "Chemist."**—I thank you very much for your replies of the 3rd inst; but would be glad if you would explain the following. As I said before, the HNO_3 would not distil over, so I poured the solution back again into a bottle of which three parts of it crystallised and the $2HSO_4$ (which seemed to take up the HNO_3) remained on the top. I poured some of the solution into a vial, then added some scraps of zinc and then poured about the same quantity of HCl on it. Of course it effervesced, but while it was dissolving I happened to put my nose against it, and I can tell you I went away pretty quick. Chlorine is bad enough, but it beat that hollow. What I want to know is, What gas was it that was given off? Also almost immediately it crystallised, leaving a little solution on the top which possessed an extremely sweet taste. The feature of it was its crystallising so quick—much quicker than Glaubers salts.—A. H.

[66143.]—**To Mr. Bottone.**—Could you tell me whether there are any electro-magnets that will take as much current as you can put on, and will go at any speed, provided you have the current? By electro-magnets I mean rotating magnets to be used instead of motors. I have made a battery which gives a large current and large E.M.F. What I want is an electro-magnet to take a big current without heating; and if there is none, could he tell me how to make one to answer my purposes?—A. H.

[66144.]—**Propelling Ships.**—I made a model on the pumping system. It is 4ft. by 11in. by 5in., to be driven by two sets of pumps having two engines of 1in. diam. Owing to causes the details being too long to go into, I have only once been able to try the model, and then only one engine working. She went at a good two miles an hour. I am now trying it in a larger boat, 21ft. by 4ft. 6in., with one set of pumps, two cylinders 5in. by. 5in. (I have made them square so as to get them under water), having a 3in. stroke. The engine to work them is 2½in. by 4in. The boiler, I fear, is rather too small—only 1ft. outside diam. with drop tubes. I have also wheels to double the rate of the engine, so I hope to get about 300 strokes a minute in the pumping cylinders. As this will prove that water will come in quick enough and the size of the engine will show the gain there, I should much prefer a quick engine and no wheels, only I have to work with what I have and prove as much as I can. I could have made more of it, if I could have built a boat. Hope in a short time to try it in the sea.—W. B. CHAMBERLIN.

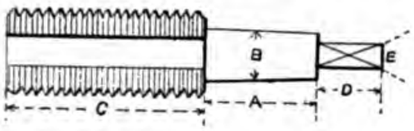
[66145.]—**Scent for Grease.**—What can I add to grease to make it smell like the bark-tanned leather used for boot soles?—DELTA.

[66146.]—**Modified Bunsen Cells.**—Can any reader recommend either of the following, (described by "Eveline" some time ago? Inner cell:—Nitric 1pt., HCl 1pt., dilute H_2SO_4 (1 : 20) 2pt. Outer cell:—Aq. 20, H_2SO_4 1, HCl 1pt. He stated that it is not necessary to remove zincs. Does the Fe_2Cl_6—(i.e., Bunsen type, only inner cell filled with ferric chloride) give a good and constant current?—BUNSENITE.

[66147.]—**Fuller's Battery.**—I should be much obliged if Mr. Perren Maycock or some other competent reader would help me. I have been using for some time past 30 cells of a nitrate of soda battery, but find that it is a very great nuisance to keep it filled. Seven of the cells are nearly twice the size of the rest, and they have the porous pot surrounded by the zinc, whilst the others have simply a zinc column. The carbons of the large ones are 8 by 1½ corrugated, of the small 5½ by 1½. Now I propose to change the battery into Fuller's cells. Will you kindly tell me (1) the E.M.F. I shall get; (2) time it will last on and off (there is no lifting arrangement and the battery is outside)? The battery is to be used for incandescent lighting, and I want, if possible, to light a 10c.p. lamp and two 5c.p. If you could supply these details I should be very much obliged.—ONE IN DOUBT.

[66148.]—**Rats.**—On the ceiling of the workshop where I am employed there has lately appeared a large number of impressions as of rats' feet, with which the shop is infested. We never find any but rats in the place, besides we are sure they are rats' marks, as we are so familiar with them, but not on the ceiling. I may say the ceiling is very dark for want of whitewashing, so that the impressions are very distinct, and there are no marks on the wall, nor on the ceiling nearest the walls. They all seem to be in the centre, where they are very thick, so how they get there is a mystery. If any reader will explain the mystery as to whether rats can walk on ceilings I should feel greatly obliged.—MECHANIC.

[66149.]—**Gas Taps.**—Will some fellow-mechanic help an anxious turner how to come at the sizes of Whitworth's gas taps? I have spent a lot of money in books for the information, but all to no purpose; these books only give the diameters. I should like the sizes of from ⅛in. up to 2in. diam. *c* = length of thread, *a* = length on shank, *b* = diam. of shank, *d* = length of square, *e* = size of square.—BONUM.



[66150.]—**Azimuth and Altitude v. R.A. and Declination.**—Thanking our esteemed contributor, "F.R.A.S.," for his replies on p. 476, to my queries on p. 444, I would now like to direct his attention to his reply on p. 229 of Vol. XLVI. showing how to convert declination and hour angle into altitude and azimuth, and to ask him to be so obliging as to work out in a similar manner the data applicable to Jupiter and Saturn on or about the 19th inst. for noon at Greenwich. I choose these because one is S. and the other N. in decl., and Jupiter east and Saturn west of the meridian. Also for Mercury on any day in November next.—J. C. L.

[66151.]—**Weight of Live Fish.**—On p. 436, in the first column, "E. L. G." says—"A live fish put into a vessel of water adds no weight!" If this be true, can "E. L. G." prove and explain it?—J. C. L.

[66152.]—**Solar Eclipse.**—Can any of your readers indicate where I might find the method of projecting the track of visibility of a solar eclipse on the earth's disc? I am familiar with the projection for a parallel of latitude by Loomis. If no book can be quoted, a hint as to the method of ascertaining this trace would oblige.—W. S.

[66153.]—**Electric Glass Plate Machine.**—After having this machine a while in use, the glass plate commenced to crack from the centre in two places, almost opposite each other, and continued almost to the outer edge. I procured a new one, trued up the wooden bosses on glass spindle and fixed it all right. I used transparent cement and plaster of Paris mixed up for fixing. I left it by to set, and on the second day I observed the new plate to be cracked a ¼in., exactly as the last, and on the next day 1in., and so on, gradually extending. Would anyone who has experience of fixing plates kindly tell me the cause of this, and say the best way I should fix another? I thought of a plan without cement—that is, to make a wooden boss with screw and nut and fix plate between two leather or indiarubber washers, and then tighten up. How would this do?—GLASS.

[66154.]—**To Mr. Wimshurst.**—I am making a 17in. plate machine in accordance with your directions in the "E. M.," No. 1,073. Would you kindly explain how to fix the glass discs to the bosses? Please explain whether the vulcanised fibre should be between the glass and the boss or between the plates, and if cemented to both bosses and vulcanised fibre, and also what cement would be best to use? Would hollow brass balls do as well as solid ones for terminals?—A. W. R.

[66155.]—**The Race to Edinburgh.**—What engines are being used on the West Coast route for the 10a.m. race to Edinburgh? Marmion, which ran from Euston to Crewe without a stop, seems to be one of the old "Lady-of-the-Lake" class of singles. To what class does 275 engine belong? Is it not somewhat strange that when fast running is wanted the Compound engines, with their 180lb. steam pressure, have to give place to the old engines with 120lb.? What was the cause of the serious breakdown of the North Western engine at Shap, on Thursday, the 9th inst., causing some 45 minutes' delay to the West Coast train?—PASSENGER.

[66156.]—**Scotch Expresses.**—What is the real timing, according to working book, of 10a.m. expresses of the West and East Coast routes respectively, right through from London to Edinburgh? The recent accelerations have been effected too late to appear in the August time tables. Of course I want the latest fastest timing at 8 and 7¾ hours, or under, if they again quicken this week. Any instances of good running by these trains would also be very interesting to readers if published in the "E. M."—N. S. R.

[66157.]—**Magnetism.**—Would some reader answer the following? What is it that causes the mariner's compass to point north and south? The stronger the needle is magnetised has it the greater affinity for the poles? Would a powerfully electro-magnetised bar balanced on a pivot resist considerable force, and would such a bar be of any use as the keel of a balloon cage to keep it from turning on its axis, and for use in propelling the balloon by sails?—LOCK STIVE.

[66158.]—**Battery for Electric Clock.**—Will some reader kindly inform me how to make a battery for above? I want something that will be constant in working, as the clock requires the circuit to be closed 30 times in one minute, just while the pendulum is swinging ⅛ of its stroke. I want something that will last, say, for nine or twelve months. I have tried several kinds of battery; but all have failed to meet my requirements. The Daniell cell seems very good, but copper is deposited on the porous pots, which seems to set up a local action. Would it be better to wind the bobbins so as to have a high resistance?—MC. S.

[66159.]—**New Elements.**—Will any reader give a list of new elements discovered since vanadium, together with date of discovery and name of discoverer? Does anyone know anything about davyum and pelopium? I take this opportunity to heartily thank Mr. Hardy, F.C.S., for his useful tables on specific gravity on p. 483?—PRINCIPIA.

[66160.]—**Barometer.**—Would some reader kindly afford me information as to how mercury can be introduced into the tube of a Fitzroy barometer which reads 1·5in. less than it ought? What would be the amount of mercury required to be introduced to make it read correctly? The barometer hangs about 40ft. immediately above sea level.—E. V. H.

[66161.]—**Calculus of Finite Differences.**—If it would not take up too much space in the "E. M.," I should like to see the steps in the process by means of which "J. R. C." find the general term of the series from the equation (65961, p. 506)—

$$u_{x+2} = u_{x+1} + u_x$$

I have looked through the treatise on the "Calculus of Finite Differences" in the *Encyclopædia Metropolitana*, but cannot find anything of a similar equation.—PHILOMATH.

[66162.]—**Multiple Thread Screw-Cutting.**—Will some kind reader give me a description of a double- or treble-threaded screw and the mode of cutting it? I can put the wheels on and cut single-threaded screws, but I have not the slightest idea how to commence with a double- or treble-threaded screw. Is the pitch of a double-threaded screw twice the pitch of a single one? Is the pitch given, and should I have to arrange the wheels by the same rule as for single threads? I want to know how to get size of tool and depth of thread, and anything a novice should know before commencing to cut these screws. I have learned what I know about screw-cutting from the "E. M.," and hope kind readers will further assist me.—POOR SCREW-CUTTER.

[66163.]—**Gums, Gum Resins, Venice Turpentine, Sealing Wax.**—Is the Venice turpentine in the market always manufactured? What is crude turpentine? What is gallipot (used in the manufacture of sealing wax)? What is Canada balsam? Can it be bought cheap in quantities? Is there a kind of copal gum that will melt at a lower temperature than shellac? What is the chemical action of calcined magnesia upon gum lac? When added to it it seems to stiffen and is used, I am informed, by sealing-wax makers—for that purpose. Perhaps some of our American or Scotch readers in the trade will answer and say what gum is used as well as shellac in making sealing-wax.—X. L.

[66164.]—**Rainfall and Sunspots.**—Can "F.R.A.S. suggest any hypothesis to explain the extraordinary weather lately experienced over the northern hemisphere, and just now we have a telegram from Valparaiso, stating that in consequence of the great floods there a reservoir has burst, causing great damage to property and loss of life. I understand that the advocate of the sunspot theory undertakes to show that the greatest rainfall is coincident with the maximum period of sunspots; but it is well known that they are now at the minimum period. I have examined the sun several times lately with a 4¼in. telescope without detecting a single spot on its surface. Can this abnormal weather have an electric origin? I believe I have read somewhere that Lord Rayleigh experimented with electric discharges in invisible aqueous vapour, converting it into water, but I am open to carrection in this. Scientific men generally fight shy of this subject of meteorology.—ELECTROSIS.

[66165.]—**Music Notation.**—I shall be glad if any reader will kindly tell me if there are any systems of music notation in use besides the old notation and the tonic sol-fa, or give information as to any schemes which have been contrived for easy acquirement of the old notation. Also whether there is any movable-doh scheme for the old notation, and what are the weak points in the old notation and the tonic sol-fa, and the advantages which each has compared with the other.—PYTHAGORAS.

[66166.]—**Ammeter.**—To "ELECTRICIAN, DUBLIN."—I should be much obliged if you would give the material and length of the light pointer C from centre to upper end in the drawing of ammeter which you gave on p. 62, No. 991 of "E. M." for March 21st, 1884, and roughly, about how many degrees it should deflect with a C of 10 ampères? I have made one to drawing, but fail to get a movement of needle (which is well magnetised, and works freely with pivots on jewels) with a current which lights up seven 45-volt Edison-Swan lamps. Strip of copper is 1in. wide, and needle oval, ⅜in. long by ⅛in. wide, and plays about ⅛in. in front of strip of copper.—SHUNT.

[66167.]—**Colouring Cement.**—I have some slabs of coloured Keen's cement to make. I have tried ordinary colours from the paint shops, which either killed the cement or made it so porous that subsequent polishing was impossible. Will some one kindly suggest a few colours that will combine without injuring Keen's? Red, green, and violet wanted. A hint on polishing would also be acceptable.—KEEN.

[66168.]—**Dissolving-View Lantern.**—Can any of "ours" who possess, or have access to a good brass fronted Bi-unial dissolving-view lantern, with 4 or 4½ condensers, supply me with rough working drawings and accurate dimensions of telescopic draw fronts, &c.? I want to make a first-class instrument for my own use only. The lantern known as the "Luke Bi-unial," manufactured by Steward, is the one of which I am most anxious to get a sketch.—IREX.

[66169.]—**Chain Belting.**—Would any reader give a method of calculating strength and H.P. of chain (leather link) belting? Will "T. C., Bristol" give the pull of above as per formula given in replies, p. 215, No. 1,179, Vol. XLVI.?—J. G. HAWKES.

[66170.]—**Cement.**—I am wanting a cement for combing machine leathers. I have consulted all back numbers, but find nothing that meets all the requirements. It must be strong and pliable and able to stand strain and pressure of fluted cones.—J. G. HAWKES.

[66171.]—**Polishing Cedar Cabinet.**—What is a quick way of darkening and putting a slight polish on a cedar-wood cabinet? French polish is difficult as there are many corners, and I am not practical at it. Varnish is too bright, and, to my mind, gives a common appearance to the article. I want it a rich dark mahogany colour.—E. A. B.

[66172.]—**Governor for Gas-Engine.**—Can any of "ours" advise me as to what kind of governor is most suitable for a small gas-engine (Watts, 1¾ bore, 5in. stroke)? Engine runs all right except when extra pressure of gas is turned on of an evening, and then it goes very fast, which I want to prevent. I want to make governor myself, which I think I could manage. I made engine up except boring cylinder.—J. C.

[66173.]—**Brass Casting.**—Can any of "ours" inform me of any plan to cast brass in metal moulds, so as to bring it up as sharp as type? Also whether the mould should be of cast iron or steel. Have tried sand, but it is not sharp enough.—CHILL.

[66174.]—**Aristotype.**—Can any photographic reader recommend me a suitable substance for squeezing aristotype prints on to? Vulcanite is objectionable because it so easily gets scratched, and each scratch shows upon the gelatine surface. I have tried glass, but my prints refuse to come off at all.—P. E. B.

[66175.]—**Estimation of Ammonia.**—Would some practical chemist tell me how to estimate the amount of ammonia in sulphate of ammonia, as made in a work like a gas-work, &c. I think it stands about 24 to 25 per cent. R. B. H. NOSMOHT.

[66176.]—**Midland Engines, 1810 Class.**—Can any reader oblige with the particulars of the new Midland express engines, 1810 class, specially built to work over the Lancashire and Yorkshire line between Marple, Manchester, and Hellifield, and what is the speed of the trains?—LOCO.

[66177.]—**Engines in Hampton-Wick Collision.**—Can any reader kindly tell me the numbers of the two engines in this collision, and also their description. Are they entirely disabled, or will they be able to be used again?—G. L.

[66178.]—**Solder.**—Can anyone tell me if a solder melting at 700° or 800° Fahr.? The ordinary solder has too low a melting point and silver solder too high. There is some risk of spoiling the work if the solder has too high a melting point.—ELAG.

[66179.]—**Curve.**—A cord 50ft., long, pulled tight and each end pressed against a curved wall, is 5in. from the wall in the middle of curve, or the middle of cord. By what rule could I find the sine or distance of any suitable length of cord from the wall in the centre? Please show simplest way of working it out.—J. B.

[66180.]—**Ventilation.**—What is the best way to learn the action of the air in regard to ventilators and chimney cowls, so as to attempt to manufacture such on an efficient basis? Any hints will be much esteemed.—G. JOHNSON.

[66181.]—**Photographs, to Mount and Varnish.**—Will some of "ours" furnish me with well tested practical recipes for the above? Some photos. that I have seen look as if they had a very thin plate of glass in front. How is this accomplished? I do not think it was glass?—YOUNG ANALYST.

[66182.] — **Instantaneous Shutter.**—Can any of "ours" oblige with sketch and particulars for making above for camera? Also have there been instructions in "E. M." for making good camera (either ½ or whole plate) for amateur? If not, I should be very glad of same. I have only been a reader three moths, but find something interesting and useful every week.—PHOTUS.

[66183.]—**Brass Castings.**—Will some reader inform me the best way to produce a clean smooth casting in brass? I have done several of different sizes, but they have all come out very unsatisfactory. Will some kind friend help me?—H. C. D.

[66184.]—**Electric Depilatory.**—Would any of our electrical friends oblige by giving the rough outlines of an electrical apparatus (cautery) for removing superfluous hair by electricity? I am a mechanic and can make it myself if some one would oblige.—M. G.

[66185.]—**Grease Cup.**—Will anyone tell me how the grease gets out of the cup when placed on the slide valve, as I understand there is always a pressure of steam against it?—BRASSFINISHER.

[66186.]—**Methyl Orange Indicator.**—How long has this been employed in volumetric analysis? I can find no mention of it in the 1887 edition of Thorpe's "Quantitative Analysis."—YOUNG ANALYST.

[66187.]—**Etching on Glass.**—Will any of "ours" be good enough to give the practical details of the above as done with hydrofluoric acid or fluorides?—PRINCIPIA.

[66188.] — **Boring Lathe Heads.**—Will any of "ours" kindly help me in boring loose heads? A rough sketch of boring bar would be a good help to me, as I never saw one in our district.—AN OLD SUBSCRIBER.

[66189.]—**Condensers.**—When using water for condensing, which requires the most water, a surface or a jet condenser, to condense the same quantity of steam?—STOKER.

ANSWERS TO CORRESPONDENTS.

⁂ *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustration on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

⁂ Attention is especially drawn to Hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, Aug. 15, and unacknowledged elsewhere:—

COOPER COOPER AND CO.—Birmingham Small Arms Co.—H. Milnes.—W. Higman.—Monte Christo.—A Young Fitter.—A Reader of the Mechanic.—G. H. P.—G. G.—H. S. C.—Ixion.—W. P. Maycock.—Green.—L. E. E.—E. M. Richards.—Principia.—C. E. Stretton.—A Fellow of the Royal Astronomical Society.

GLENTANA. (The querist asked for instructions how to make a water-motor, and as replies might be useful to other readers, the query was inserted. Your reply must appear as an advertisement, as you simply offer to supply the querist with one on trial.)—H. T. F. S. (Surely you know that we published a series of articles on Pattern-making in the numbers mentioned on p. 511. They were afterwards collated, revised, and enlarged, and published by Crosby Lockwood and Son, Stationers' Hall-court, E.C., under the title of "Pattern-Making.")—AN INQUIRER. (You will find a lot about Dentistry in Vol. XLII., pp. 17, 39, 63, 85, 127, 145, 166, 500, 522. As to the qualification, see the Act, 41 and 42 Vict cap. 33.)—WOULD-BE STUDENT. (See indices or recent back numbers.)—A. W. J. (Surely you do not imagine the sun is "a cold, invisible body"! At any rate, we have no space to debate such a question. See indices of back volumes, or Proctor's work on "The Sun," published by Longmans.)—AMETUER. (What is your query? If it is in general terms, "How to Make a Medical Coil," see p. 52, No. 1121, and the indices of back volumes, as medical coils have been frequently illustrated.)—HARRY. (It is impossible to answer such a question, as it depends entirely on the ability of the individual. If in London, attend the classes at the Finsbury Technical College, and you will soon find out what you are capable of doing.)—ALALAS. (Depends on facts not stated. 2. Yes, at the town hall at certain times, which you can learn on inquiry. 3. It is impossible to say what a Corporation can be compelled to do.)—LIGHTHOUSE SERVICE. (Someone who has forgotten to sign his letter is informed that all posts in the lighthouse service are under the control of the Trinity House. He should address his inquiry to the Secretary of the Corporation of the Trinity House, Tower Hill, London.)—W. JOHNSON. (After it is tooled into shape or turned in the lathe, it is polished with sharp sand and water, the glaze being brought up with the finest "mud" and the hand, using putty powder if necessary. In the lathe a slow speed is used, and plenty of water with the sand after the tools have roughed the granite into shape. It is a peculiar question to put, because no one can turn and polish granite columns without rather extensive plant.) — J. G. DUTTON. (Ink marks are removed from paper in the ordinary way—by means of oxalic acid and subsequent bleaching.)—HY. COX. (The only way to find out whether an article is or is not patented is to search the records at the Patent Office. If you can give name and date, nature of article, &c., any of the patent agents advertising in our columns will make a search for a comparatively small fee.)—LAURENCE RUSSELL. (We do not know of a work devoted to the subject, which, however, has a chapter in many books, and many articles in our back volumes. Almost any work on steel or tools would have something about it.)—F. W. (The articles on Electric Bell-Fitting are not yet obtainable in book form, but probably will be.)—CARBON. (What can anyone say without details of the construction of the dynamo? If it gets sensibly hot after five hours' run, of course there is a fall of E.M.F. An expert should be called in. You do not give the slightest idea of how the dynamo is made.)—POOR SUBSCRIBER. (See many recent replies.)—A
TEUR. (See previous answer, or p. 377, this vol
H. HOMMELL. (Peroxide of hydrogen is
bleaching hair.)—CONSTANT READER. (We
the swivels can be obtained from an ironmo
Anoint the dog's leg with a mixture of sulphur
or vaseline.)—J. S. K. (The vapour of a
hydrocarbons when mixed with air is highly ex
—W. P. W.—(Don't understand you. A baro
a tube with an open end, which, as a rule, di
cistern of mercury, and the pressure of the ai
is indicated by the height to which the merc
in the tube. Your tube seems to have a bul
therefore more like a thermometer tube. Re
subject in some textbook, and then put a
query.)—ONE ASTHMATIC. (Procure the gu
issued by the Emigrants' Information Office,
way, Westminster. Wages are attractively
some colonies and other places; but the qu
how many days' work in the year is to be ob
those wages?)—GLENDALL. (Not a very old s
—or else a careless reader. Tanmer's "Elec
the Treatment of Disease," published by A
Maria Lane, E.C., may suit.)—J. H. BEST. (Y
must be mixed up. *Twice* in your letter yo
night, *Nov.* 13.)—AMATEUR. (Stephens' stain
best. How *can* any stain *wear* without varnish

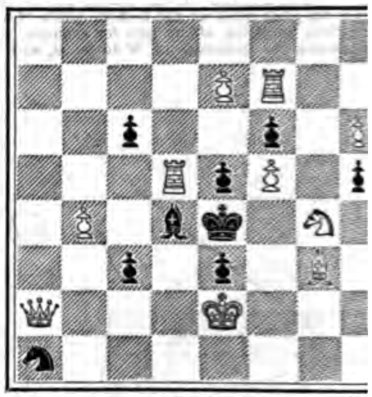
Advice and Pamphlet Free.—Mr. C. B.
Consulting Medical Electrician, gives advice, either per
by letter, free of charge. He has positively and permanen
by his Electropathic Treatment thousands of cases of nerv
tion, brain fag, rheumatism, sciatica, indigestion, sle
liver and kidney diseases, ladies' ailments, &c. Suffer
write at once. Note only address: Harness' Electropath
lishment, 52, Oxford-street, London, W. (corner of Rathbo
Pamphlet containing copies of hundreds of testimonials
on application.

CHESS.

ALL communications for this department
addressed "CHESS EDITOR, ENGLISH MECHA
Strand."

PROBLEM MCX.

Black.



White. [10

White to play and mate in three moves.

SOLUTION TO 1,108.

White.	*Black*
1. P to K B 8 (B).	1. Anything.
2. Kt mates.	

(Two variations.)

NOTICES TO CORRESPONDENTS.

CORRECT solutions to 1,108 by Black Paw
trickery—not even clever), A. Wheeler, J. Kistro
Hankin, G. W. Middleton, and J. Palmer; to 1,1
Palmer, R. G. Briscoe, G. W. Middleton, and A.
to 1,105 A Wheeler. Answers to other corre
unavoidably deferred.

BLACK PAWN.—We presume that the object M
has in view in offering prizes for second solutions
there be any) is in order that the problems may
the severest scrutiny. We are unable to furnish
any further particulars respecting the Wil
Tourney. Your best plan will be to apply to the

THE Problem Tourney to be held in connect
the forthcoming Melbourne Chess Congress wil
to the world. Each competitor to enter a set
direct-mate problems, two in three moves and e
moves. Any competitor may enter more tha
Sealed envelopes and mottoes. Address Mr. F.
69, Temple-court, Melbourne. All problems to b
before Sept. 15, 1888. A first prize of five guine
for the best set. Other prizes will be announced

A MATCH between the Manchester and Glasg
has been arranged to take place on Sept. 15 at

MR. B. G. LAWS has been appointed to the
which has occurred in the editorship of the *Ches*
through the death of Dr. Zukertort. Mr. Laws
duct the Problem department, Mr. L. Hoffer b
sponsible for the games and other contents of th
zine.

A NEW Chess Column is about to commence
Rawtenstall *Free Press*, to be conducted by Mr.
late chess editor of the *Bacup Times*.

Holloway's Pills cleanse the blood f
contaminations, and by that means strengthen and invig
whole system, healthily stimulate the sluggish organs
over-excited action, and establish order of circulation and
throughout every part of the body. The balsamic nature
way's Pills exercises marvellous power in giving tone to de
and nervous constitutions.

The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, AUGUST 24, 1888.

NOTES ON THE CONCERT-ROOM ORGAN.*—V.

By George Ashdown Audsley, F.R.I.B.A.

IN speaking of the "Number and Compass of Claviers" in my second article of the present series of Notes, I alluded to the difficulty there was in adhering to the old and well-known nomenclature of the manual departments for the class of Concert-room instrument now being touched upon. I there remarked that while I am reluctant to upset the old-established nomenclature of the departments and their controlling claviers, I can hardly see how it can be retained for the departments of an instrument in which so much that is old-fashioned is swept away, and in which the very conditions that gave rise and reason to that nomenclature no longer obtain. The term Swell Organ, for instance, has no definite significance in an instrument which has every one of its departments wholly or partly inclosed in swell-boxes. No department is specially a Swell Organ, while the entire instrument, under certain conditions, may, correctly speaking, be designated one grand Swell Organ. This term, therefore, must be disused in the nomenclature of our new Concert-room Organ. Two other terms must also drop out of use—namely, Choir Organ and Echo Organ. The former is essentially meaningless in connection with the Concert-room Organ, whilst the latter is simply absurd, and has no *raison d'être* in relation to the modern Organ. There may not be the same objection to the retention of the terms Great Organ and Solo Organ; but even these are not altogether applicable to any departments of the class of instrument now under consideration.

Such being the case, I have, for my present purpose, decided to employ the simple and easily understood terms First Organ (lowest clavier), Second Organ (second clavier), Third Organ (third clavier), Fourth Organ (fourth clavier, and highest in four-manualled instruments), and Fifth Organ (fifth clavier, and highest in five-manualled instruments). The term Pedal Organ being perfectly applicable to the department controlled by the feet of the player, is retained. With these few explanatory words, I come to the consideration of the appointment of the First Organ.

First Organ—Lowest Clavier.

In necessarily brief articles like the present, I must confine myself to the elucidation of general principles of appointment, and not indulge in the verbosity which would attend the giving of even the smallest number of explanatory examples of appointment.

The First Organ must be looked upon as the true foundation of all the manual departments, as forming, in conjunction with a certain portion of the Pedal Organ, the grand Organ or Organ proper. Its tonal structure should be as complete as science can direct and skill accomplish. After the requisite preponderating amount of unison (8ft. pitch) tone is secured, both the 16ft. and 8ft. harmonic structures should be introduced, the former in all cases being subordinate to the latter; for while it is desirable, in this department at least, to have a due amount of 16ft. tone and its upper partials, it must be borne in mind that the true manual pitch is that of 8ft., and that nothing is gained by lowering the pitch an octave, and so assimilating it with the Pedal Organ unison pitch. Whatever stops of 16ft. pitch are introduced in the First Organ department, they must be both in strength and penetrating quality of tone strictly subordinate to the fundamental unison stops.

Notwithstanding the practice (of certain German masters in organ-building) of adding a stop to the chief manual department of 32ft. pitch, I boldly question the wisdom and utility of its introduction, and fail to discover a single reason, scientific or æsthetic, for the introduction of so grave a pitch in the manual division of any organ, however large, and I dispute its utility and appropriateness in any department save the Pedal of the Concert-room instrument. I am glad to say that none of our great builders have inserted such a stop, whole or half, in any of their Concert-room Organs. I may just mention that one Organ in this country possesses a stop of 32ft. pitch (from tenor C to top) in the Great department. The instrument alluded to is the Organ in the parish church of Doncaster, constructed by E. Schulze, of Paulenzelle.

I have said that whatever stops of 16ft. pitch are introduced in the department under consideration, they must be strictly subordinated to those of the unison pitch in the same department; and still more must those stops which strictly belong to the 16ft. harmonic structure, and corroborate certain upper partial tones of the fundamental 16ft. tone, be subordinated to all stops near them in pitch which belong to the 8ft. harmonic series. It may be mentioned that the only stops which will have to be considered, belonging to the 16ft. series, are the *Quint*, 5⅓ft., and the *Tierce*, 3⅕ft. These stand in the relations of the twelfth and seventeenth to the fundamental 16ft. tone. The other intervals of the harmonic series, represented by stops of 8ft., 4ft., 2⅔ft., and 2ft., are all likewise intervals belonging to the more important unison or 8ft. harmonic structure, and the respective stops are provided and proportioned with reference to the foundation unisons, without special regard to the 16ft. stop or stops. These are rules which must be strictly observed if a well-defined unison pitch and a perfect balance of tone is to be secured. There is one question which may arise at this point in the reader's mind—What character or quality of tone should the chief 16ft. stop have in comparison with the fundamental unisons, or *Open Diapasons*, 8ft.? I think there can be little doubt that the quality of tone should be similar, but considerably softer, so as to secure due subordination to the chief unison, when drawn with it. If a second stop of 16ft. pitch be added, it should be in the shape of a small-scaled open stop, of a soft string-toned character. Such a stop would be very useful.

In all the manual departments of the Organ the 8ft. fundamental tone should assert itself with overwhelming predominance, but in no department more so than in that under consideration. The fundamental unison tone of the First Organ should be yielded by at least two *Open Diapasons* of metal, one of very large scale and strong intonation, with a voice full, round, and sonorous; the other of contrasting quality, smaller in scale, and with a voice of rich and somewhat penetrating character. This decided contrast of tone is to prevent sympathy between the stops, and a consequent loss of power and volume in the combined sound. In instruments of the first magnitude a third *Diapason* should be added, formed of open wood pipes, voiced on the Schulze model. This, again, with the view of materially increasing the volume of unison tone, and avoiding any tendency towards sympathy. The next unison should be a covered stop of great body and filling-up power. No better stop than the *Doppel Flöte* can be adopted in this case, for its tone is characterised, when it is voiced by a master-hand, by great volume, dignity, and sonorousness. With the four unisons already mentioned, the true foundation tone of the department is secured; but, leaving reed and other inclosed stops out of consideration for the moment, at least one other open metal stop of 8ft. ought to be added, uninclosed: and this, to secure the necessary contrast, should be of a full, string-toned quality, capable of asserting itself through the whole volume of *Diapason* tone.

We now enter on the important question of the harmonic structure, based on the fundamental unison or *Diapason* tone. There can be no doubt that the First Organ—the true *Organ*—should be characterised by absolute completeness in its tonal structure; and all the facts the science of Acoustics has revealed to us must be carefully studied and skilfully applied in its development. In the 8ft. harmonic series, the first element, after the fundamental tone, is the *Octave*, which represents the first and most important upper partial tone. The stops which represent this are 4ft. pitch, and should, to some extent, be under control, so that the octave tone may be graduated in intensity to suit the strength of the fundamental tone. All the stops which represent or corroborate the higher upper partials should be under absolute control for the similar end. This fact, however, has never been recognised in a practical manner by any European organ builder. One *Octave* formed of open metal pipes of about the same scale and strength of tone as the second or lesser *Open Diapason*, may with advantage be planted along with the *Diapasons*, in an unenclosed condition; but all the other stops of 4ft. pitch, the two stops already named as belonging specially to the 16ft. harmonic series, and all the stops of higher pitch than 4ft., which belong to the 8ft. harmonic series, should unquestionably be inclosed and under control.

Much has been written against the increased use of the swell-box since I first advocated its multiplication, in connection with the Chamber Organ, in these pages in the year 1886, and subsequently in my "Notes on the Church Organ," in the following year; but my advocacy in favour of the introduction of the swell-box in connection with every department of the Organ, and of the Concert-room Organ in particular, is based on too thorough a scientific and practical investigation of the subject to be shaken by such arguments as have been advanced by persons who are, for reasons best known to themselves, perfectly satisfied with old-fashioned ways of doing things. But things will not stand still on their account; and the pebbles they throw will not dam up the river of progress, sluggish though it is in matters of organ building, at least, on this side of the Atlantic.

Let it be understood at this point that I advocate, in relation to the department of the Concert-room Organ now under review, the planting of the stops of 16ft. pitch, the *Diapasons* and others of 8ft., as already described, and one open metal *Octave* on an *uninclosed* windchest; and that *every other stop* introduced in the department be *inclosed in a swell-box*.

The additional stops required to complete the 8ft. harmonic series are as follows:—1. A small-scaled open metal *Octave*, having a bright voice of medium power. 2. A *Twelfth*, 2⅔ft., representing the second upper partial tone. This must be slightly softer than No. 1. 3. A *Super-octave* or *Fifteenth*, 2ft., representing the third upper partial tone. To be a trifle softer than No. 2. 4. A *Tierce* or *Seventeenth*, 1⅗ft., representing the fourth upper partial tone. This must be considerably softer than No. 3. 5. A *Larigot* or *Nineteenth*, 1⅓ft., representing the fifth upper partial tone. This may be about the same strength of tone as No. 4. 6. A *Septieme*, 1⅐ft., representing the sixth upper partial tone. This must be voiced the softest of all the harmonic-corroborating ranks. 7. A *Twenty-second*, 1ft., representing the seventh upper partial tone. This stop should be equal in strength of tone to No. 5. Of course these remarks anent the relative strengths of tone must be accepted as general hints only; after all is said and done, the cultivated ear and artistic judgment of the musician must be called in as the only guides in so delicate a question. It may be objected by some organ builders that it is inexpedient to introduce stops of so high a pitch as the *Nineteenth*, *Septieme*, and *Twenty second*, especially in an instrument which ascends to c^4, on account of the great difficulty of carrying such small stops up to the top. But this need be no barrier to their introduction, for they may all three be discontinued in the top octave. The *Nineteenth* may stop at g^3, whilst both the *Septieme* and *Twenty-second* need not go beyond c^3. It will generally be expedient to place these three stops together as a three-rank *Mixture*, or, if it is thought desirable to keep the octave rank free, the *Tierce*, *Nineteenth*, and *Septieme* may be put together as one stop of three ranks.

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* Continued from p. 126, Vol. XLVI.

Notwithstanding the unusual completeness of above scheme, the general harmonic structure of the department will not be satisfactory without the addition of one or more compound stops, formed of several ranks of pipes, which carry the harmonic series still further throughout the bass and tenor octaves, and materially enrich the higher octaves of the manual compass. Such *Mixtures*, if carefully schemed, and scientifically proportioned in strength of tone, are of the greatest value, imparting a mysterious richness of colouring and a fascinating complexity of structure to the compound unison tones which no other class of stops can impart.

Space will not permit me to do more than touch on the somewhat complicated question of the *Mixtures*, but, by way of conveying some clear idea of what would be suitable for such a department as that under discussion, the following full compositions may be cited :—

MIXTURE—VI. AND V. RANKS.

CC to B	15	19	22	24	26	29
c^1 to b^1	8	12	15	17	19	22
c^2 to b^2		8	12	17	19	22
c^3 to c^4		1	8	10	12	15

MIXTURE—V. RANKS.

CC to e^1	15	19	22	26	29
f^1 to b^2	8	12	15	19	22
c^3 to c^4	1	5	8	12	15

The former *Mixture* comprises a third-sounding rank throughout, placed in the most favourable position for such an interval. From C C to b^1 = 36 notes, there are, in addition to the *Tierce* rank, three octave and two fifth-sounding ranks ; and in the treble there are from c_2 to b^2, in addition to the continued *Tierce*, two octaves and two fifths ; and from c^3 to c^4 there are one unison, two octaves, one third, and one fifth-sounding rank. This latter break theoretically belongs to the 16ft. harmonic series, and on this account imparts fulness to this acute portion of the manual compass. The latter *Mixture* has no third-sounding rank, octaves and fifths alternating throughout. In both compositions I have made the higher ranks octave-sounding, for that interval is unquestionably the best, musically, in such a position, although it is not imperative. In scaling and voicing such *Mixtures*, and indeed every *Mixture* in the Organ, the organ builder must recognise the teaching of the natural laws of sound, which clearly point out that as the upper partial tones of any compound sound decrease in power as they ascend in pitch, so must every rank of pipes, inserted in the Organ with the view of corroborating or introducing such upper partial tones, be similarly graduated in strength of speech. Probably no law of sound has been more pertinaciously ignored by the organ builders of all periods than this. They probably first blundered through imperfect knowledge, and afterwards accepted the condition without further question. The inartistic character, to use no harsher term, of the old harmonic-corroborating stops has gradually led to the present restricted introduction of such stops ; now, however, with our more perfect knowledge of acoustics and the composition of musical sound, it is to be hoped that all those stops, which so materially add to the glory of the Organ, will be reinstated in the tonal structure of all instruments which lay claim to be considered worthy of the name of Organ.

One more word with reference to all the harmonic series of stops above enumerated. It is understood that they are to be inclosed in a swell-box—say swell-box No. 1—and so placed under control as to be capable of having any desirable degree of softness given to them. Now comes the obvious question, What should their strength of tone be when heard at their *full power* with the swell *open ?* The question is very easily answered. Let all the stops which produce the fundamental unison tone, which are *outside* the swell-box, be drawn ; then let all the stops which represent the 8ft. harmonic series be voiced and so regulated as to complete the desirable unison *compound* tone in a manner consistent with scientific teaching and a true and refined musical sense. Let there be no undue pulling upwards of the unison tone, no scream and crash, like broken glass, as each note is put down by the fingers : on the contrary, let the whole complex structure combine in one grand flood of rich and refined sound, of which the ear feels assured it could never tire. When such an end is attained, the Organ, in its true and proper form, is safe ; and the modifying effect of the swell may enter on its mission—to throw upon the numerous varieties of unison tone varied garments of a mysterious and almost fascinating beauty of texture. Effects such as these must be known to the ear before they can be realised to their full value by the musician.

Such an Organ—call it a Great Organ if you will—is no longer the loud intractable thing we too often find it to be, but a sympathetic instrument, bending itself to the will and impulses of the musician, and lending itself to requirements of tonal structure unknown and scarcely foreshadowed in the present all but brutal European system of organ appointment.

To conclude these brief and necessarily very imperfect Notes on the First Organ department, I have only to allude to the few remaining stops which are required to complete it, and which must be inclosed in the swell-box. Another flue stop of 8ft. pitch should be inserted, and this may assume the form of a large-scaled covered and half-covered metal stop, similar to the "*Bourdon*" 8ft., in the Great department of the Organ, erected by M. Cavaillé-Coll, in the Town-hall, Manchester. Another stop of 4ft. pitch should be added, preferably in the form of a *Harmonic Flute* of large scale. Two reed stops are essential, both of which should be of broad intonation and great dignity. The first, a *Trumpet*, 8ft. of large scale ; and the second, a *Clarion*, 4ft., of rather smaller scale.

As regards the wind pressures required for this department, I may mention that the last four stops named might, with advantage, be on wind of 5in. ; while all the rest of the department need not speak on wind of above 3½in. All the foundation work must be copiously winded, and voiced to yield the purest possible quality of sound.

I must leave the thoughtful musician to work out in his own mind the almost countless effects a single department, schemed as I have described, is capable of producing; it would take quite an article, as long as this, for my pen to give an outline of them. In my next article I shall enter upon the consideration of the other important departments of the Concert-room Organ.

(*To be continued.*)

A SUBSTITUTE FOR GLASS.

GLASS is so cheap that it seems scarcely worth while to invent a substitute; but if the substitute is equally transparent, and at the same time unbreakable, we have an invention that is worth attention. M. L. C. A. Marguerie, of the Boulevard St. Denis, Paris, has obtained a patent in this country for what he calls a novel vitreo-metallic material, suitable for glazing and for other purposes in place of glass, which material is said to be unbreakable and transparent. It is made by immersing wire gauze or metallic cloth—that formed of galvanised iron wire being preferred—in a heated state in a thin paste or liquor formed of soluble glass, gelatine, or isinglass, and glycerine, or glucose in proportions which will vary according to the use to which the sheets or panes of the material are to be applied—say, for example, 10 to 15 per cent. of glycerine or glucose, and the remaining 90 to 85 per cent. being two-thirds gelatine and one-third soluble glass. The sheets or pieces of wire gauze are afterwards hung in a drying room, and before they are quite dry they are dipped in a concentrated solution of chrome-alum or bichromate of potash, after which they are again dried, when they will be ready for use. Colouring matters in any suitable proportions may be incorporated with the gelatine so as to produce sheets or panes of any desired colour or shade; or by applying coloured pastes or liquids with a brush transparent mosaics can be produced. The vitreo-metallic sheets or panes can be coated with a protective varnish of any suitable kind—such, for example, as a copal varnish.

VIVIAN'S IMPROVEMENTS IN ALLOYS.

THERE is no end to the improvements which can apparently be made in alloying metals, and in spite of what has been done, it is not at all unlikely that some persistent workers may find an alloy or two yet which will be of so much utility as to be commercially valuable. Mr. A. P. Vivian, of Port Talbot, Glamorgan, has recently patented an improvement in the manufacture of alloys of copper, zinc, and iron or steel, which consists in first producing an alloy of copper and iron or of copper and steel, or of copper, iron, and steel, and then adding to this the requisite proportion of zinc, such addition being effected either while the alloy of copper and steel or of copper and iron or of copper, iron, and steel is still in a molten condition, or after a solidified alloy of copper and iron or steel has been remelted. The proportions in which the preliminary alloys of copper and iron or steel and the final alloy of copper, iron, or steel and zinc are prepared may be varied considerably according to the purposes for which the alloy is required. Thus the alloy of copper and iron or steel may consist of from 48 to 62 parts by weight of copper, with from 1 to 10 parts of iron or steel, or of both mixed, and to this alloy may be afterwards added from 35 to 55 parts of zinc. The alloy thus obtained is highly malleable at a red heat, and is applicable for sheathing, bearings, &c.; but for forgings less zinc can be employed for the former than for the latter application. In carrying out this invention, the patentee prefers to proceed as follows :—According to one mode of proceeding, he melts in a reverberatory or other suitable furnace 100 parts by weight of metallic copper with, say, from 5 to 15 parts by weight of iron or steel, by preference using wrought iron or wrought steel. When thoroughly melted and well mixed the alloy is tapped into moulds of convenient form and weight. A ferriferous copper is thus obtained which is then alloyed with the zinc in proportions which may vary from 40 to 55 and beautiful results, and, when properly handled, the least outlay in money. As regards the latter all-important point, it is evident that the bulk of the labour being done by the photographer himself or his assistants, and the prices of the material being comparatively low, the cost of the finished prints, particularly when made in quantity, will compare favourably with other processes where the paper has to be bought ready prepared at a high price, and where, only too often, there is no redress in case of failure and loss from causes for which the photographer himself is by no means responsible. As there is a reverse side to everything, however, it may very possibly happen that seasons will arise when the labour and time of paid assistants must be economised to the uttermost, and when the quickness with which large numbers of prints can be turned off by the aid of an article bought ready prepared, will more than make up for the higher price at which the article has to be purchased.

We are not disposed to consume space in the consideration of these more strictly business points, for each photographer will necessarily regulate them for himself. Our province is rather to attempt to compare the values of the different printing processes we have mentioned in their proper photographic sense.

We have already alluded to the great range of tone afforded by the ordinary silver print, but it is even more extensive than many persons suppose, who think only of the conventional portraits of public and private individuals, and of the ordinary landscape and architectural studies seen in exhibitions. We shall only be reiterating the well-known saying among practical printers when we remind our readers that the first factor of tone in the print is the character of the negative. A model printing negative will often afford prints which may be toned to any desired colour, from the rich, warm red—almost cherry-hued, through chocolates, sepias, and browns, to violet, then to pure black, and finally to a steel blue-black just verging on ashiness. To produce these tones at will from such a negative will require no little attention to detail. The strength of light in which the print is made has some influence. A print rapidly made in the full glare of the sun's light will rarely stand the combined action of the toning and fixing baths as well as one that has been made more slowly in a more subdued light. Exceptions to this may sometimes be found in the case of negatives that have been over-developed or over-intensified, so that the brightest sun will be required to penetrate them, and give a proper gradation of shades in the print. A proper toning bath must be selected, and the reddening, which always takes place in the hypo fixing bath and the final wash waters, be noted and calculated for, as well as the remarkable return of colour which occurs when the print is dried. Beginners and inexperienced printers are very apt to find their work over toned to an ashy blue tint; forgetting that the prints "dry up darker and bluer," they leave them too long in the gold bath, so that they there assume the precise tone wished for in the finished result. But, on the other hand, when we consider that the production of a certain tone or colour in the finished print is really a matter that has to be calculated, and that requires thorough knowledge of the different solutions, it is little short of marvellous how perfectly regular tones can be made upon thousands of prints, even from different negatives, by an experienced man.

So much for the average silver print as usually seen. But this is only the beginning. Those who are not content with the brilliancy and polish of the print when mounted and rolled, can increase them to almost any amount by burnishing, or still more by making the so-called glacé. A better finishing method than either of these, however, is the cementing of the print to glass by means of gelatine; by this, all the beautiful brilliancy of the print as it appears in the wash water is preserved, and the glossy surface of the glass does not convey such a "mock polish" and artificial effect as the former.

Before the introduction of the bromide papers, it was customary to make enlarged prints on albumenised paper by means of special solar cameras, fitted with powerful condensing lenses. Excellent results were obtained, but the loss from uncertain light and bad weather was very great. The tone of the albumen print was, however, preserved, and here we come to the great drawback to the bromide print, either for contact work or enlargements—its limited range of tone. That the fine, brilliant black of a well-timed and skilfully-developed bromide print is very pleasing and good we do not deny; on the contrary, there are certain subjects and certain effects that will be better suited by this than by any other tone; but the point is, that the bromide print, being produced by a process of development, has the main characteristics of developed prints—i.e., less depth of shadow—with a tendency to the veiling of the finer details in the *darks, together* with a cold tone. To make a familiar comparison, we might say that the tones of a bromide and albumen print stand to each other in nearly the relationship of a wet collodion and an albumen lantern slide, where the collodion slide is invariably cold in tone unless specially treated.

Among the greatest beauties of the bromide print is its delicacy and perfection of half tone. Great evenness of quality is another. The most ardent advocate of the albumen print must have often noticed the striking difference in behaviour between the "thick" and the "thin" edges of the sheet. With the bromide papers there is no such drawback; there is perfect uniformity of tone, so that if the opposing corners of the sheet be bent over so as to touch, no difference in tone is perceptible. It is by no means every albumen print that will stand this simple test. The chemical character of the bromide print affords the strongest grounds for the belief that the image will be permanent, and not fade in the disastrous manner common to all albumen prints. In this connection we may mention the fact that recent authorities advise the addition of some alkali—say, carbonate of soda—to the fixing bath for bromide print. When it is remembered that the developer is removed by means of an *acid wash*, and the print afterwards immersed in the hyposulphite, common caution would call for the presence of the alkali. A point that will always be in favour of the bromide print is the ease with which it may be worked upon with the pencil or crayon, and other retouching articles. In this respect it is *facile princeps*.

Interest has recently been revived in the old method of silver printing on *plain salted paper*. That beautiful results can be produced in this manner will be attested by all who have seen the work shown at the Photographic Society by Dr. Charles L. Mitchell, of Philadelphia. The process is easy to work, and very economical, particularly in the consumption of gold. The tones range from dull brick-red to blue, and the prints are quite without gloss. As in the bromide print, there are certain subjects that will be admirably suited by just these qualities.

ON SOME POSSIBLE METHODS FOR THE PREPARATION OF GRAMMOPHONE AND TELEPHONE RECORDS.

By Prof. Edwin J. Houston.*

PHONOGRAPH records, of the type employed by Mr. Berliner in his grammophone—i.e., those obtained by causing the point or stylus attached to the vibrating diaphragm to move parallel to the recording surface instead of perpendicular thereto, can be prepared more readily, and by a greater variety of methods, than is possible with record surfaces of the old forms.

In a study of the later forms of phonographic apparatus, several methods of preparing grammophone plates have suggested themselves to the author, which he hopes soon to be able to put to the test of actual trial. These methods, though particularly applicable to records horizontally traced, may, in certain cases, by slight modifications, be applied also to those vertically traced.

In order to place some of these methods on record, a brief description will be given of a few of the most promising. At the same time, the author admits that serious difficulties may lie in the way of practically carrying out some of the methods proposed.

Mr. Berliner, as is well known, prepares his record surfaces by moving the tracing point over the surface of a plate of inked glass or metal, covered with a uniform deposit of lampblack. The record thus obtained is either mechanically copied on a metal surface, or is reproduced thereon by the process of photo-engraving or etching. I would suggest the following methods, viz.:—

1. After the record on smoked glass is obtained in the usual manner, expose the plate to the action of a regulated sand-blast so as to obtain cuttings or groovings on the surface of the plate, suitable for the movements of the reproducing diaphragm. Roughness in the edges of the lines so obtained would probably cause screaming sounds in the words reproduced, which might be removed by a few applications of an emery-covered tracing point.

2. The phonogram record surface is composed of a smooth surface of hardened wax, on a composition of wax and resin which is *locally heated* so as to *slightly soften the surface* directly under the tracing point or stylus.

In order to insure the rapid cooling and hardening of the surface, immediately after the impression has been impressed thereon, the heating must be local and not general. To more thoroughly insure local cooling, a light blast of cool air might be directed on the surface almost immediately after the tracing has been made.

3. Instead of heating the record surface itself, a local source of heat may be used to heat the tracing point or stylus. This heat may be either ordinary heat or that of electrical origin. When the stylus, instead of the recording surface, is heated, the latter may be made of much harder material.

4. The record-surface consists of a glass plate covered with a thin layer of wax. Either the record-surface itself, or the marking stylus, is locally heated as before, only the layer of wax is so thin as to leave the glass exposed after the passage of the tracing-point. A permanent record is then etched in the surface of the plate so prepared either by the sand-blast process, or, preferably, by the action of hydro-fluoric acid.

5. Instead of employing the records of the lamp-blackened glass surface as a photographic negative for the purpose of reproducing them by photo-engraving or etching, they may be used for transferring the record to a glass surface covered with a film of sensitised gelatine. The portions of the glass that are left uncovered after the plate is fixed are then deeply cut or etched by treatment with either gaseous or diluted liquid hydro-fluoric acid. I have treated a gelatine-covered glass plate printed from a photograph by means of this process, and find that it produces a very fair and permanent picture on the glass. It is evident that this process will leave the design either in relief or intaglio, according as a photographic negative or positive is used.

6. The recording diaphragm, in its movements to and fro, is caused to deposit on the surface of the record-plate a uniformly thick line or layer of some rapidly hardening substance. This substance is contained in a vessel provided with a pointed outlet tube, and attached to the diaphragm. The material either runs out by its weight and is deposited on the record surface, or is forced out by the movements of the diaphragm itself. A record, thus prepared, would consist of a uniformly thick, sinuous ridge of the hardened material. The reproducing stylus, or that giving motion to the diaphragm that reproduces the speech, could, it is evident, be operated either from the upper or lower surfaces of the sinuous ridge independently, or from both simultaneously.

7. If the movements of the receiving diaphragm of a telephone be sufficiently amplified or intensified to permit it to trace or cut a sinuous record on a suitably prepared record surface by any of the methods proposed in this article, or by any other method, then there would be produced a simple yet effective method for obtaining not only a permanent record of a telephone despatch, but as well a means of reproducing it as often as might be desired.

It should be carefully borne in mind that a telephone record may be made of very small dimensions. Indeed, in the case of any phonographic apparatus, where it is not intended that the record should reproduce the sounds by direct mechanical movements of the diaphragm large records are not always necessary, nor are they desirable; for such reproductions may be effected electrically.

Where the telephone record-surface has been prepared, no effort should be made to cause it to reproduce the telephonic despatch mechanically. *An electrical method of reproduction is far the preferable one.*

8. The following method would appear to promise excellent results. Employ the telephone record to act mechanically on a lever or other device; but instead of attempting to cause the movements of such a lever to impart audible, articulate motion to a receiving diaphragm, cause them to act directly on a variable resistance, in the circuit of which is included a voltaic battery and a receiving telephone. Since, for such an operation, very slight movements of the variable resistance contacts are required, it is by no means improbable that some of the methods proposed, or obvious modifications thereof, will, in practice, be found applicable to the production of a permanent telephone record.

9. Before concluding this brief sketch, it might be well to suggest the following plan, which would appear to be particularly suitable for obtaining a telephone record: Mount a concave mirror at the centre of the diaphragm of the receiving telephone; or, better yet, from the entire diaphragm of a concave mirror, shaping the magnet pole of the telephone to conform to the approximated surface thereof. When the telephone is receiving transmitted speech, allow the light reflected from the diaphragm-mirror, and suitably concentrated by a lens, to fall on a sensitised photographic plate placed in a plane at right angles to the plane of the diaphragm, so as to receive the spot of light parallel to its surface. The photographic plate must, of course, be moved mechanically at right angles to the direction of movement of the spot of light. The plate thus acted on is then developed, fixed, and used to reproduce the record by any of the well-known methods of photo-engraving, etching, &c. The record thus obtained may be used either mechanically to reproduce the transmitted speech in an ordinary phonographic apparatus, or, pre-

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* Extracted from a paper read before the American Philosophical Society.

;, in connection with a variable resistance t, electrically in a receiving telephone.

:e can be no doubt, whatever, that this l will be found operative in practice, since graving stylus, a pencil of light, is destitute ght, and therefore offers no resistance to the ovements of the telephone diaphragm.

[nstead of causing the voice, as in the or- form of phonographic or grammophonic tus, to act mechanically on the record- e, cause it to move a suitably focussed pencil t over the surface of a photographic plate. ' complete record could thus be obtained, in it would be possible to impress on the plate) minute peculiarities of the overtones, on the quality of the voice depends. In this r there could be obtained and preserved s of the voice of distinguished individuals.

photographic method just described would ı, among others, the following advantages— -

he ease with which it could accurately re- :e in all their minutiæ the tones involved in oduction of articulate speech.

he readiness with which such a record could gnified to any desired extent, thus rendering le an increase in the amplitude of the repro- vibration.

'he aid such magnified, accurate sound- s would afford in the study of the same, with , not only of ascertaining their peculiarities en with a view of being able to read articu- eech directly from the diaphragm record.

AZE FOR PORCELAIN WARE.

E results of investigations on the red glazes which are produced on porcelain by means of : and its salts have been recently communi- to the French Chemical Society by MM. and Dutailly. The colour produced in this r is of a much more permanent nature and ır superior tint than that which is obtained oxide of iron is used for the same purpose. ed colour, when used for decorative work on t porcelain, is often accompanied with a blue ing matter beneath the surface of the glaze. ears that the secret attached to the produc- of these colours was known only to the se until recently, and that the red, known as ung, or *sang de bœuf*, could not be imitated e French at the Porcelain manufactory at ı. In 1852, MM. Ebelmen and Salvetat voured to reproduce these copper colours in e by making careful analyses of fragments nese porcelain coloured in this manner, and mitating, in the composition of the glaze and mployed, the Chinese specimens. The re- of these earlier experiments are now in the ic museum at Sévres, and are the first les of the kind produced in Europe. Other h chemists have since then attempted to ve on the first trials, and the problem has een attacked by H. Seger, of the Berlin llan Fabrik, and by H. Bunzli, at Kramm- ı Austria. MM. Lauth and Dutailly have ished by their experiments that the maximum rature which the Chinese red glazes can without losing their colour approaches to sed for baking the new Sévres porcelain. By sively associating all the compounds capable tering into the formation of a colourless with oxide of copper, they have come to ollowing conclusions:—That in the same of glazes, those which produce the finest olour with copper compounds have the st amount of silica present, and that in a of glazes of approximately the same degree lity, the best results are obtained when there rger proportion of alkalies and a small per- ge of alumina. They have further noticed f the alkaline metals be increased in relation alkaline earths present, a finer red is pro- , but at the same time the liability to break eased. By employing boracic acid or borates, ıconvenience may, in some measure, be pre- l, Lime, magnesia, various fluorides, and and iron oxides have also been tried; ne results obtained by their use have not l satisfactory. A very good red glaze can be ced when zinc oxide and baryta are the bases ıt in the glaze. The copper can be intro- into the glaze in different ways. Oxalate of r, simply mixed and not fused with the melt, good results; but if previously fused with aze, very satisfactory colours are produced. uantity of copper salt employed depends on me required for baking the porcelain, and n the temperature of the furnace. Five per s the quantity which is recommended as the uitable to use, and the addition of a small ity of tin oxide is advantageous. The glaze has given the best results has the follow- mposition:

matite, 31·17; sand, 36·37; fused borax, dry carbonate of soda, 4·76; barium car- e, 10·39; zinc oxide, 4·38. Corresponding to silica, 61·02; alumina, 5·85; alkaline oxides, 10·72; baryta, 8·42; zinc oxide, 4·51; boric acid, 9·48. This glaze has a degree of acidity represented by the number 5·39, that of the French glaze, No. 1, being 5·14. The bases are in the proportion which corresponds to the formula:

$$Al_2O_3, 3NaKo, BaO, ZnO.$$

By using this glaze with a similar one containing lime, MM. Lauth and Dutailly have succeeded in obtaining a great variety of colours on the same material, and in producing some effects on porcelain which have not hitherto been achieved.

A RUSTLESS COATING FOR IRON.

AT Port Chester, Pa., pipes have been treated by a new process, which is said to have advantages over the Bower-Barff process. Mr. F. Haupt describes the plan as follows: "After the pipes have been lowered into the retorts by means of a traveller, the retorts are closed for about 15 minutes until the contents are heated to the proper temperature. Steam from the boiler at 60lb. pressure is then introduced into the superheater, which it traverses, and from which it escapes at the temperature of the iron upon which it acts for about one hour. A measured quantity of some hydrocarbon is then admitted with a jet of steam, followed again by a fixing bath of superheated steam, which completes the process." The absence of pressure and of explosive gases is a proof that all the operations have been nicely regulated, and that a perfect absorption and union of the carbon, oxygen, and hydrogen with the iron has been effected. The protection is said to be a real conversion of the metal to a certain depth into a new material. There is no coating that cracks or can be destroyed by bending, hammering, rolling, or heating.

IMPROVEMENT IN SACCHARIN.

A GREAT objection to saccharin is its very sparing solubility when pure. The defect is corrected by the addition of an alkaline bicarbonate, but it is often at the expense of the sweetening properties of the chemical, which sometimes acquires almost a bitter taste. Flies, bees, and other insects will not touch saccharin in any shape; but, as man, who is not so good a judge of sweets, likes it, let it at least be cooked up and served to his taste. M. P. Mercier recommends the following process: Take of—

Pure saccharin........................	10 parts
Distilled water........................	5 ,,
Sodium bicarbonate	4-5 ,,
Alcohol (95 per cent.)	20 ,,
Sulphuric ether	sufficient.

The bicarbonate is to be added by small portions to the saccharin mixed with the water, about half an hour being allowed to pass between each addition, and the mixture being stirred occasionally to hasten the combination and the evolution of carbonic-acid gas. It is important to cease adding bicarbonate before the saccharin is entirely saturated. The operation requires ten to fifteen hours. Next the alcohol is added to the mixture, with the effect of throwing down most of the soda saccharinate, and holding in solution the excess of saccharin and impurities; and, finally, the magma is thrown on a vacuum filter, where it is washed, first with more alcohol, and lastly with sulphuric ether. On drying in the open air a white, exceedingly sweet, and soluble crystalline powder is obtained, which possesses all the properties of saccharin. Some of the chemical features of the foregoing processes may be briefly alluded to.

It will be noticed, for instance, that no heat is employed. The reason is that under the influence of heat soda will readily transform saccharin into salicylic acid. Then the use of bicarbonate instead of carbonate of soda is not indifferent, as the presence of caustic soda, always to be feared in carbonate, will turn the saccharin into a *para*-compound possessing no sweetness. Lastly, the use of alcohol as a precipitating agent renders heat unnecessary, and removes many impurities to be found in the purest commercial saccharin.—*Chem. and Druggist.*

SNAKE POISON.

DR. A. E. FEOKTISTOW has published a communication to the Imperial Academy of Sciences of St. Peterburg on the effect of snake poison on the animal organism. His experiments, which numbered some 300, were conducted with the poison of vipera ammodytes, vipera berus, and crotalus durissus, obtained from about 80 of these animals, which were kept in a building suitable for them. No physiological difference could be discovered between the effects of the poison of the three snakes mentioned. The average quantity of poison introduced by a bite was found to be in the case of vipera ammodytes 0·065 gramme, the maximum and minimum being respectively 0·17 and 0·01 gramme, all the bites being after at least three days' abstinence from biting. When the bites were repeated one after another, it was found that from three to five bites were sufficient to use up all the poison. In the case of vipera berus only about 0·03 gramme was delivered per bite. The rattlesnake delivered ten times that amount, or 0·3 gramme. A snake which was first curarised and then injected with muscarin presented no increase in the poison secretion; indeed no means is at present known of increasing or diminishing this secretion. Various monads were apparently unaffected by a 2 per cent. solution of snake poison; spermatozoa also lived for hours in fresh, neutral, or alkaline solutions, but were killed immediately by an old acid solution. Bacilli and bacteria not only lived but multiplied in solutions of snake poison, so that it is evident that this cannot be a general protoplasm poison. A large number of observations on the physiological effects and post-mortem appearances are given, which are well worth attentive study. The paper being published in German is fortunately accessible to most scientific men. Regarding the lethal dose for different animals, the author remarks that it is impossible to give it with any approach to scientific accuracy, for the fresh poison does not always contain the same amount of water, and the inspissated substance contains albumen and other indifferent substances, the percentage of the active principle being entirely unknown. At all events, snake poison is not to be compared with the most toxic alkaloids, as the latter prove much more rapidly fatal even in far smaller doses. It is to be remarked that the young of mammalia during the first four days of life are less affected by snake poison than adults, even amongst animals which are peculiarly susceptible to it; thus while a full-grown rabbit will die in from one to five minutes after a bite from a large rattlesnake, a rabbit a few days old will live for from ten to fifteen minutes after a similar bite, and a very young kitten will survive a bite some three hours. The reason of this difference is probably the undeveloped state of the central nervous system. The best therapeutic means for combating snake-bite are undoubtedly restoratives, especially preparations of ammonia, as they raise the blood pressure, but they are only of service in slight cases; in severe cases these remedies increase the hæmorrhage of the lungs and other organs. The American plan of giving large doses of alcohol is erroneous in principle, because, while it is true that in small doses alcohol stimulates the vaso-motor nerves, in large doses it paralyses them. Lacerda's treatment by permanganate injections into the venous circulation has proved useless in all cases where a really lethal dose of the poison had been given, and appears to rest on an erroneous assumption. Special experiments regarding hypodermic injections of permanganate in the locality of the bite are still required, but its usefulness is very doubtful, for whenever a lethal dose is inserted it is so rapidly absorbed that the permanganate injection is almost sure to be too late to do any good. At present a physiological antidote cannot even be conceived to exist, as we have no means of opposing the paralyses of the spinal cord, the intra-cardiac terminal branches of the vagus, the cardiac ganglia, the splanchnics, the respiratory centre, &c. The treatment must, therefore, be conducted on other lines, and Dr. Feoktistow is about to commence a series of researches in a new direction altogether, the nature of which he does not indicate. It must be remarked that death frequently follows snake bites after a prolonged period, and is due, not to any direct toxic action, but to the morbid changes which have been set up in vital organs. The chronic poisoning, as it may be called, frequently follows doses of smaller amount than those which are immediately lethal.—*Lancet.*

SPECTRO-TELEGRAPHY.[*]

SPECTRO-TELEGRAPHY is the name of a new invention by Paul la Cour, the inventor of the phonic wheel and its synchronism for multiplex telegraphy. The instruments were at work in the Copenhagen Industrial Exhibition, and the invention, which is patented, is based upon quite a new principle. It may be used for several purposes; but I shall here confine myself to pointing out and describing in detail the application of the system to nautical use as a simple means of communication from lighthouse to ship, and *vice versâ*, and between ships themselves.

It is well known that such a signal system exists, but it is only available in the daytime. The first idea was originated in England in 1857; it was taken up by France, and afterwards by nearly all maritime nations, and is known as the international flag system. Generally speaking, the signals are not meant to express words and sentences by spelling, but only to give a limited though very large number of sentences, which are arranged in a signal-book (international code of signals). It has the advantage, however, that each vessel can carry a signal-book in its own language, and two ships of different nationalities are thus enabled to correspond without understanding each other's language.

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[*] Translated from the Danish. Communicated by Mr. P. Chr. Dresing.—*Electrical Review.*

The signalling is accomplished by means of 18 flags and pennants, each of which indicates one of the letters B, C, D, F, G, H, J, K, L, M, N, P, Q, R, S, T, V, W. Of these are then formed two, three, or four flag signals, respectively, in the number of 306, 4,896, and 73,440. All the two and three flag signals and $\frac{2}{18,960}$ $\frac{1}{\text{first}}$ of the four flags are intended for the different communications, queries, and answers. The others are reserved as "distinguishing signals" for ships, 1,440 for man-of-war, and 53,040 for trading vessels

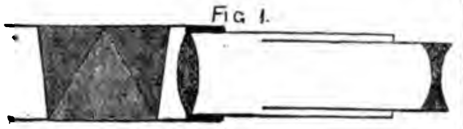
The large extension which this system has attained in a comparatively short period is a proof of its practical arrangement; still it has one disadvantage—namely, it is useless at night, and yet ships sail as much then as in the day. The value of this mode of correspondence is thus reduced one half, and an owner wishing to give final instructions to his captain by this means hesitates in doing so, as he is not certain that his ship may pass the lighthouse in the day.

La Cour's system is not intended to supersede the present flag system; but to supplement it in the night. This invention enables us to utilise a corresponding *modus operandi* at night by means of the same signal book, and in such a way that the night duty becomes as simple as the day duty, and even possesses certain advantages over the latter.

When we observe a distant white light, a star, or the light from a lighthouse through a prism with vertical edge, then such a light, as is well known, appears as a horizontal luminous line, consisting of red, orange, yellow, green, blue, indigo, and violet-coloured rays. Sir Isaac Newton discovered that this was owing to the fact that the white light in reality is a combination of all these colours, with their infinitely many shades, and that they are refracted differently in the prism and thus separated, while they can again be combined and reproduce the white light.

Instead of a simple, a compound prism may be used. The latter separates the colour rays, but does not, on the whole, deflect them much from their original direction, and such a prism fixed on a telescope (Fig. 1) is specially adapted to dissolve the in-going light. When a distant *white* spot of light is observed through this, a luminous line (Fig. 2) is seen in the field of the telescope, *coloured from red to violet.*

FIG. 1.



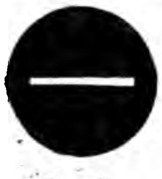


FIG 2.

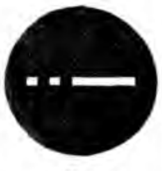
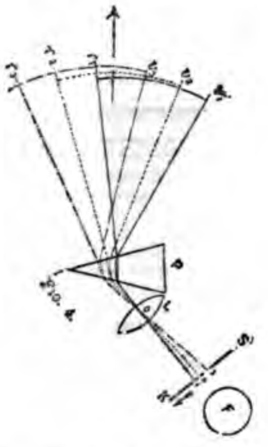


FIG 3

If now the person *who is sending* the light signal is capable of providing, in a simple manner, that all the colour rays are not emitted, but only some, while others are entirely removed, it can be arranged so that the remaining part of the spectrum appears as a distinct signal—for instance, the Morse signal - - —— (Fig. 3). This is exceedingly easy to decipher, and does not even require colour sense, for although it is differently coloured, yet it is only the shape which is of importance (the colours are only the means of providing the conventional shape), and the signal can be made by any one, even the colour blind.

The sending instrument is represented diagramatically in Fig. 4, which shows a horizontal section of the instrument (it is about 1ft. high and long and 8in. wide), together with the rays of light on their road to the horizon. F is the lamp, S, K is the screen, in which openings are cut corresponding to the signals to be sent, for instance, two small openings (1 and 2) and one wide (3), corresponding to the signal - - ——. L is a lens, the distance of which from S K is equal to its focal length. *Therefore* all the rays of light which through the opening, 1, strike the lens, L, will, after passing through it, become parallel with the line, 1—0, from the opening, 1, to the optical centre of the lens (0). The other rays of light are therefore not shown, for they have the same direction as 1—0. This ray of light will then strike the prism, P, and be refracted and spread, so that it forms the coloured, fan-shaped rays of light, $r_1\ v_1$, containing all the colours. In the direction of the distant observer, i, a distinct colour only will be emitted from the opening, 1, say *orange;* from the opening, 2, there will also be rays emitted, which are first made parallel by the lens, and afterwards spread by the prism in the fan-shape, $r_2\ v_2$, of which a single colour only strikes i, say *yellow.* In the same way the opening, 3, produces the fan-shape $r_3\ v_3$, but this opening being wider, i will receive several kinds of *green* and *blue* rays.



To the naked eye, or with an ordinary telescope, the light which issues in the direction i will give shades of colour corresponding to a mixture of the respective colours; but if the spectro-telegraphic telescope is used, the signal appears as in Fig. 3.

When the sender moves the screen, S, K, in the direction indicated by the arrow, opening 3 will take opening 2's place, opening 2 takes 1's place, and in the field of the telescope the receiver will also see the line of light, 3, slide smoothly into 2's place, &c., so that the signals are seen to glide through the field, in at one side and out at the other.

To perfect the present system of signalling, and use La Cour's signals at night, a sending instrument, with the 18 perforated metal pieces, together with the receiving telescope, is only required. Instead of hoisting the four flags in the daytime, signifying, for instance, C, F, G, L, the four corresponding pieces of metal need only be inserted in the sending lantern, and made to move backward and forward several times, so that the receiver had time to read them.

These night signals are in some respects superior to the day signals. They are, for example, not diminished by distance, as their size only depends upon the receiving telescope, so that, however far they are sent, they keep the same dimensions. They are also independent of the direction of the wind, which often disturbs the flag signals by making them turn edgeways to the observer, so that he cannot see them.

The same system has been tried for ordinary telegraphy, by passing a perforated slip (as in the Wheatstone's transmitter) through the sending instrument, and a telegraphist can read these marks so easily that the telegraphing can be performed with the same speed as with the ordinary Morse instrument.

It is well known that a hazy atmosphere first obliterates the violet and blue rays of light; it has, therefore, been supposed by some that spectro-telegraphy would fail under these circumstances. This is, however, not so, for as the signals seem to glide through the whole spectrum, they can always be read in the red, yellow, and green, even if they are lost in the violet and blue.

This principle also appears to be applicable in several different ways. If a lighthouse is supplied with a sending instrument, in which the first letter or letters of the light's name are placed, the mariner will always be able to see in the spectro-telegraphic telescope what light it is, and thus mistakes and loss may often be prevented.

Further, an entrance to a harbour does not need to be indicated by *two* lights, which direct the course, but by *one* only of La Cour's system, with a fixed signal or letter, which is only seen in the middle of one's telescope, if one is exactly on the right track. By steering a little to the one side or the other, the letter or signal will appear to glide in the telescope to either of the two sides, and if the ship passes entirely out of the proper course the signal disappears from the field of the telescope. Another advantage in this method is that the light from the harbour lantern is very easily distinguished from all other lights, for these latter appear in the telescope as a continuous light from red to violet, whereas the former gives its own peculiar signal—for example: - —— - ——.

Finally, ships might be supplied with a fixed lantern of this kind, which throws light forward, and obliquely to the sides. Two ships going in opposite directions will thus in their telescopes immediately see whether their course lies to the starboard or port of each other, and also whether they are in the act of altering their helms, for the letters in the telescope will then appear to glide to one side or the other.

THE LUGO MOTOR.*

IN discussing the various methods by which motion can be obtained with combinations of magnets and wires carrying currents, Faraday, in his "Researches," remarks that "the motion between two poles and two dissimilar wires (helices) is an instance where several powers combine to produce an effect." It is upon this principle that Dr. Orazio Lugo, of this city, has constructed an electric motor which embodies a novel principle which seems destined to a wide application.

The new motor of Dr. Lugo is constructed so as to utilise the maximum effects found in placing moving solenoids in proximity to fixed solenoids in such relation that, as the armature coils move, a maximum number of lines of magnetic forces is cut in the passage of each armature bobbin past each field-magnet bobbin, and these effects are made successive, so that there is a continued application of such successive effects; and, in addition to utilising these effects, due to a specified relation of the solenoids themselves, the combined effects of these solenoids and their cores also are employed.

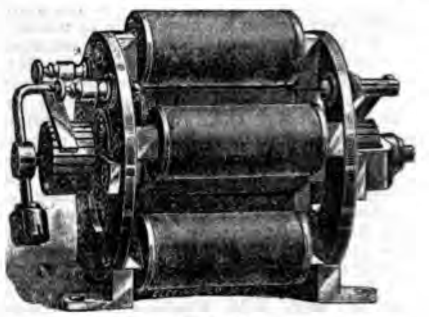


FIG. 1.

By creating successive magnetic circuits through successive armature and field bobbins in pairs until the series has been gone through once in each complete revolution of the armature, each armature bobbin being in circuit at least once in a complete revolution with each field-magnet bobbin, and all of the bobbins, both of the armature and field-magnets, being allowed to rest magnetically by being cut out of circuit during a fraction of each revolution of the armature, the evil effects of Foucault currents are said to be largely avoided.

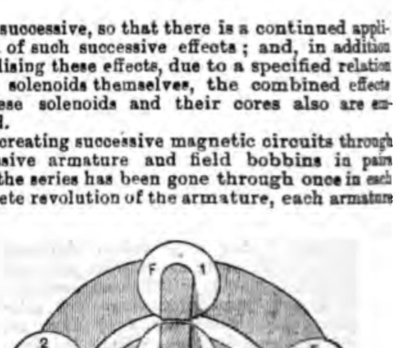


FIG. 2.

The motor, which is of very simple construction, is shown in perspective in Fig. 1, and in cross-section in Fig. 2. As will be seen, it consists of a series of bobbins arranged in a circle to the number of five, and within which there revolve four similar bobbins attached to the shaft of the motor. All the bobbins are provided with cores and short pole-pieces, which revolve in close proximity to each other.

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[*] From the *Electrical World.*

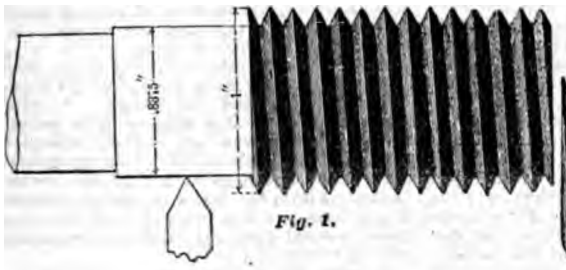

Fig. 1.

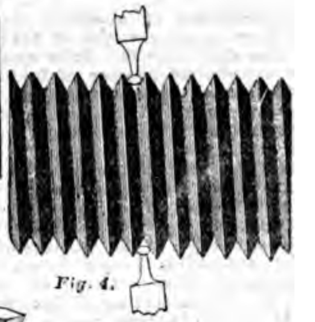

Fig. 4.

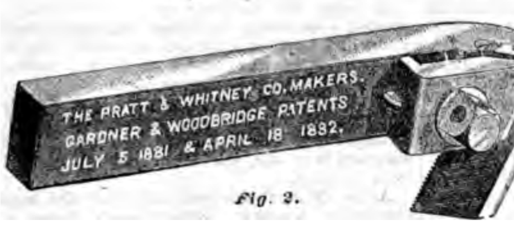
THE PRATT & WHITNEY CO. MAKERS.
GARDNER & WOODBRIDGE PATENTS
JULY 5 1881 & APRIL 18 1882.

Fig. 2.

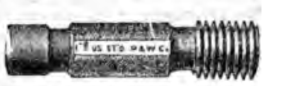
1" US STD P&W Co.

Fig. 5.

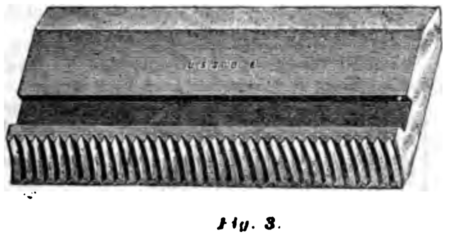

Fig. 3.

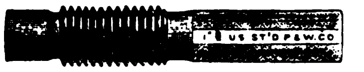

Fig. 6.

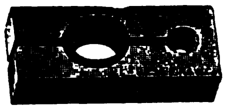

Fig. 7.

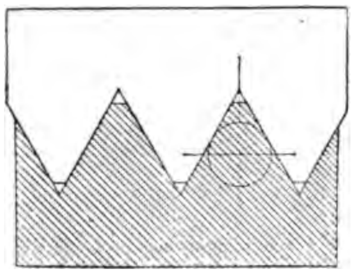

Fig. 8.

purpose, one of which is shown at Fig. 2, with a cutter detached at Fig. 3 (the latter full size). They are ground accurately to shape by special appliances, after hardening, and when care is taken in sharpening them to preserve the original angle of the top face (upon which all the grinding is done), and they are properly set in the lathe, very fair results can be obtained by using them in this way.

A method by which greater accuracy can be secured is by changing the flat contact surfaces of a micrometer caliper into small spheres, and measuring the sides of the thread directly, in the manner shown in Fig. 4. It is very evident, however, that the reading of the micrometer screw, when used in this way, will bear no definite relation to the normal size of the tap, but, nevertheless, it is plain that the reading will be the same upon two screws which are just alike in every respect, and it is upon this latter fact that the value of the method depends. Having a screw, or standard screw plug gauge, such as is shown in Figs. 5 and 6, the caliper having the little spheres can be adjusted until they will just pass easily through between the threads and the reading of micrometer noted; then the tap which is to be made can be chased until the spheres will pass through its threads in the same manner and at the same reading; it is then evident that, if the thread is of precisely the same shape, the two screws (the plug and the tap) are of the same size. It will be noticed that the engraver has apparently taken considerable pains to avoid representing the spheres as such, but the idea will be understood, nevertheless. This method of measuring also originated at the Pratt and Whitney Co.'s, I believe. Of course, any screw may be taken as a standard, and accurately reproduced in this way, but if the actual U. S. standard is aimed at, it is, of course, better to obtain the standard plugs of parties who are equipped for their accurate production. Such plugs as shown in Figs. 5 and 6 are furnished by the makers, accurately ground in the threads to the exact size and pitch after hardening, and where the greatest possible accuracy and uniformity is desired are, of course, indispensable.

In connection with them are used the screw thread receivers, Fig. 7. These are made of a flat piece of steel, having a threaded hole through it, and cut open, as shown. Two pins are put through it, extending from one side to the other, one each side of the hole; the object of the pins being to bring the two sides of the gauge into proper relation with each other after hardening, and to keep them so in use. Then out towards the end there are two screws, by one of which the gauge can be drawn together and made smaller, while by the *other the opp*osite effect can be produced. By means of these screws the gauge can be adjusted to accurately fit its corresponding plug gauge, and can then be used to gauge taps or screws.

No matter what method of gauging may be adopted, it is, of course, of vital importance that the tool should be of the proper shape, and accurately set in the lathe, with its centre line at right angles to the centre line of the tap, and with its top face lying in a line radiating from the centre—not necessarily level with it.

It is important to see to it that in finishing the threads the tool has not become dulled on the point to any appreciable extent, especially if the first-named method of gauging is employed, because it is evident that, if the tool be worn, and the chasing be continued until the point of the tool touches that part of the tap which has been turned to the size of the bottom of the thread, the size in the threads will be too small, by an amount just equal to twice the amount which has been worn from the point of the tool. It is better, on this account, to use the accurately ground cutter for finishing only, and for all but a few finishing cuts to use either an ordinary tool ground by hand, or another form of cutter furnished by the makers for the tool, Fig. 2, which has several cutting teeth like a chaser, but is not ground to shape after hardening. With this the threads can be roughed out much faster than with a single tool.

Usually but little attention need be paid to the outside diameters of taps when made in this way, except to make them large enough. If they are made somewhat larger than the normal size, the only apparent difference will be in the width of the flat at the top, which will be narrower. The actual size of the thread upon the sides will be unaffected by it, and, indeed, it is preferable usually to make taps somewhat larger outside, the effect of which is to tap the holes so as to leave a space at the top of the thread, as shown by Fig. 8, provided the outside diameter of the screw is kept to standard, as it should be; and this space does no harm, but is really beneficial, as it gives room for particles of dirt to lodge without affecting the fit of the screw.

Another advantage of this is, that it has been found in practice to extend the life of the tap to a remarkable degree, because the chief wear upon the tap comes upon the extreme points of the threads, and if left large enough to come tò a sharp point, instead of being flatted, the points must wear off to that extent before the fit of the holes tapped by it will be affected, provided the bolts are kept to standard diameters outside.

Mr. Chas. A. Bauer has applied this to another important feature of this standard screw problem—i.e., the reduction to standard of finished and rough bolts in the same shop, and making them interchangeable one with the other. The establishment of which he is manager makes large quantities of rough bolts for its own use, and at the same time a good deal of tool and special work is done, for which finished bolts and screws are used, besides those made upon screw machines for the regular work. All the rolling mills furnishing round iron for making rough bolts in his shops are furnished by him with limit gauges, by duplicates of which all iron received is tested, and, if the variation exceeds the limit, rejected. This limit falls considerably within the amount necessary to be added to a flat thread to make it sharp, and all taps for tapping nuts to be used on such bolts are left large enough outside to come up sharp when the size measured in the sides of the threads is standard. This leaves sufficient difference between the outside diameter of the taps and the largest admissible size of the rough iron, to allow for some wear upon the former before the fit is affected; and holes tapped by the standard hand taps, which are used for other work, and are of standard diameter outside as well as in the threads, will fit the rough bolts when the tops of the threads are filed off a little; at the same time, nuts tapped for the rough bolts will fit those which are turned and chased in the lathe, or made in the screw machine. In short, the whole system is reduced to a uniform standard, and yet allowance is made for the unavoidable variation in size of rough iron.

Hand taps are usually made standard size, and the character of the fit of the screws determined by varying the size of the screws; but machine taps are ordinarily made somewhat above standard size, to allow for wear of the taps, and for easy fits of the nuts; the excess being, on the different sizes of taps, from two to ten thousandths of an inch, depending also, of course, upon the character of the work.

No fixed rule can be given for allowances to be made for alteration in size by the process of hardening, because it is impossible to foretell just what a piece of steel will do when hardened. About the best that can be done is to select some good brand of steel suitable for the purpose (it don't pay to make taps of poor steel), and test it to find out what it is most apt to do under given treatment in hardening; then, if the same steel is used all the time, and it is given the same treatment, reasonably uniform behaviour may be expected, and its probable variation one way or the other allowed for. Forging is apt to make the results more uncertain than if the steel be cut from an annealed bar, and turned to size without forging, and a tap which has been forged should be thoroughly annealed, then roughed out, and finally annealed again, to take out all strains put into the metal by the hammering before it is finished; and in fact, when the greatest accuracy of size and pitch is desired, it is best to anneal after roughing in all cases, whether the tap has been forged or not.

Food Reform.—One, and that not the least important, of the movements at present operating in the direction of increasing the physical vigour and, correlatively, the mental and moral condition of the people, is that which has for its object the improvement in the kind and the quality—i.e., the purity and the dietetic value—of the food in common use. In this matter, as in other things, prejudice and fashion have had too much sway. To take only one example, that of bread—how difficult it appears to be to persuade people that, as the whiteness of a loaf is increased, so, *pari passu*, is its nutritive value diminished? Then, again, as to the kind of food. The general impression among the poorer and more uninstructed classes is, no doubt, that the heavier and more bulky the mass, the more in weight that can be got for a certain sum of money, the better the bargain; whereas, in fact, bulk is a comparatively unimportant factor in the question of economic dietetics. We have before us the last published report of the Bread and Food Reform League, which we commend to the attention of all who desire to assist in the amelioration of the lot of the struggling poor. This report gives an encouraging statement of the progress of the movement towards awakening a more extended interest in food questions, and its promoters are worthy of all praise for their exertions in diffusing information on a subject which lies at the very root of many of the evils which afflict the lower strata of society.—*Lancet.*

THE American Statistical Association publishes some interesting figures on the amount of water-power employed in the United States. In 1880 there was a total water-power equal to 1,225,379 horse-power used for manufacturing purposes, this being 35·9 per cent. of the total power thus employed in the States. The annual value of the water-power thus utilised is set down at 24,000,000dol. The New England States alone use 34·5 per cent. of the whole water-power of the country, and altogether the Atlantic States use over three-fourths of the whole.

LETTERS TO THE EDITOR.

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[We do not hold ourselves responsible for the opinions of our correspondents. The editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, *332, Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

⁂ *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

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NEBULÆ — THE CHABOT OBSERVATORY—THE "CANALS" IN MARS—LINES AND POINTS — FORMS OF LIGHTNING — VEGETARIANISM — CURVATURE OF IMAGE BY PRISM — SEXTANT GLASSES — THUNDERSTORMS — THE KITE BALLOON — IDEAS — THE SOLAR ECLIPSE OF AUGUST 7—CONVERTING DECLINATION AND HOUR ANGLE INTO ALTITUDE AND AZIMUTH — CALCULATION OF THE DETAILS OF A SOLAR ECLIPSE — RAINFALL AND SUN-SPOTS.

[29120.]—THE latest issued portion of the *Memoirs* of the Royal Astronomical Society (Vol. XLIX., Part I.) is replete with interest for the student of the physical structure of the universe, containing, as it does, a catalogue of no fewer than 7,840 nebulæ, whose positions on the celestial vault have been determined with more or less accuracy. Dr. Dreyer, to whom we are indebted for its compilation, has taken the catalogue of the late Sir John Herschel as the basis of his new one, correcting it by the observations of d'Arrest and others, and supplementing it by the addition of the new nebulæ discovered by d'Arrest, Marth, Stephen, Tempel, and others. Nothing is much more instructive than to trace the growth of our knowledge of the mysterious bodies of which Dr. Dreyer supplies so extensive a list. Imagined at first (and, as we now know, in many cases correctly) to be masses of incandescent or glowing gas, the resolution of a considerable number of them by increased optical power into masses of stars too minute to be individually discernible, gave rise to the belief that a simple increase of telescopic aperture and of magnification must ultimately result in revealing all nebulæ as mere examples of stellar aggregation and compression. In fact, in what I may call the treatises on the picturesque in astronomy of the immediately preceding generation, all irresolvable nebulæ were held to be so from their practically infinite distance, and speculations more poetical than rigidly scientific were indulged in as to the probability of their being systems of suns like those which spangle our night sky, reduced to the semblance of vaporous films by the appalling distance which separates them from us. The first shock that this hypothesis received was administered by the discovery in 1864 (by him who is *facile princeps* among British spectroscopists, Dr. Huggins) that the nebula H. 4374 really gave a gaseous spectrum of three bright lines. Since then I need not say that the spectroscope has shown the same thing to be true of numerous other nebulæ, including one at least, which, it was imagined, showed signs of resolvability in Lord Rosse's giant reflector; and it is now, of course, quite familiar to astronomers that matter in all stages of aggregation and relative age is visible in space, from the filmy streak of glowing vapour, through nebulous stars, to those in the intensely incandescent condition of Sirius, and so, through our own sun, and Jupiter, down to the cooled earth and that dead world the Moon. Perhaps nothing more curious has been effected by celestial photography than the rendering visible nebulous masses which human vision, aided by the telescope, has so far failed to detect. Naturally, among the early discoveries made with the big Lick Telescope, some new nebulæ occupy a prominent place. I learn, by the way, that in that mighty instrument the glorious aspect of such clusters as M. 4 Scorpii and 13 M. Herculis is almost beyond description or even conception.

Although Mr. Burckhalter has been deprived of the services of his colleague, Mr. Chas. B. Hill, at the Chabot Observatory in California, by the transfer of that gentleman to the Observatory on *Mount Hamilton,* it would yet appear from his report that the extent and usefulness of the work at the institution over which he so ably presides have suffered no diminution. It is much to be deplored that that admirable form of patriotism which prompts men to establish and endow such institutions as this, for the free scientific education of their countrymen at large, does not extend to this country. One reason, I gravely fear, why Englishmen are shy of spending their substance to so laudable an end is the manner in which astronomy has been used for the purest cadging purposes by the Ring so intent on their research for endowment at Brompton and elsewhere.

Speaking, by the way, above of the great Lick Telescope suggests to me to remark that I learn from an unimpeachable source that Mars, when examined with that instrument in the pure atmosphere of Mount Hamilton, does *not* exhibit the "Canals" of which we have heard so much since their discovery (?) by Schiaparelli; in fact, I am informed that one of the most skilful planetary observers there who closely scrutinised the planet during its recent opposition, "smiles at the idea of canals," and, in short, regards them as a species of areographical Mrs. Harris.

The idea suggested by Mr. Rendell in letter 29074 (p. 522) has already been carried out by Mr. A. J. Knox, in the frontispiece to his capital little book on the "Differential Calculus," which Macmillans publish.

I am not concerned to deny that Mr. Williams did actually see the sharp zig-zag which he delineates in letter 29080 (p. 523) in one flash of lightning. The forms assumed are almost indefinitely various; but of the hundreds of flashes that I have myself observed, I have never seen one exhibiting such a continuous series of serrations or forks as artists love to depict. The photograph, of which a copy appears on p. 569 of Vol. XLIII. of the ENGLISH MECHANIC, shows one or two much more common forms of lightning. And in connection with this I cannot conceive what Mr. Urquhart is driving at in letter 29093, on p. 526. I am wholly unaware that anyone has ever predicated of lightning flashes that they "can be, practically speaking, parallel either vertically or otherwise." If your correspondent will ask some friend who owns an ordinary cylinder or plate electrical machine to turn it in the dark while he presents his knuckle to the ball of the prime conductor, he will notice that the discharge will take the form of a stout, straight, and continuous thread of blue light when his knuckle is pretty close to the ball. As, however, he withdraws his knuckle, the spark will cease to be continuous, and will strike across at intervals, the resistance of the air to the disruptive discharge and the motes floating in the atmosphere converting the straight line of light into a sinuous or ramified one. It is a similar discharge from a cloud to the earth, from the earth to a cloud, or between two clouds at a sufficient distance which constitutes "chain"—as contradistinguished from "sheet" lightning. As for the question which Mr. Urquhart puts concerning the truthfulness of the photographs of the Thunderstorm Committee, as a matter of course they are absolutely trustworthy. Premising that lightning does not, as Mr. U. seems to conceive, travel like water through a pipe, I may say that so enormous is its velocity that it to all intents and purposes is present at the same absolute instant in every part from end to end of the visible flash, and hence the photographic plate must reproduce its aspect accurately. If some years ago, with the comparatively insensitive plates then in use, Mr. Muybridge could photograph a galloping horse, a jumping man, &c., *à fortiori,* with the extraordinarily rapid plates now employed, a streak of light *unchangeable in form and direction during its brief period of visibility* must be accurately depicted. Messrs. Williams and Urquhart should both procure the Report of the Thunderstorm Committee of the Royal Meteorological Society, and study it for themselves.

I should like to say, in connection with letter 29095 (p. 526), that the overwhelming proportion of people care less than nothing whether Dr. Richardson chooses to graze like an ox, or the lunatic king whose history is to be found in Daniel iv. 33, or whether he eats raw beefsteak three times a day. If he finds a diet of lentils and turnip-tops agree with him, in heaven's name let him adhere to it. Possibly, with the occasional aid of a little ginger (as a strictly vegetable corrective of so flatulent a form of nourishment), he may be able to get on with it. But do not let him attempt to ram this nonsense down other people's throats. Every man has a distinct right to his own opinion, and no one may say him nay in his conscientious endeavours to act up to it; but I do protest against the behaviour of the vegetarians, teetotalers, anti-vaccinators, homœopathists, and other fanatics in this and cognate matters. All the world is wrong, and they alone are right. The Temple of the Lord are they, and outside of their pale there is certainly no temporal salvation, even if it be vouchsafed in eternity, to those who presume to differ from them. You must swallow the whole hog, curl in his tail and all, as poor Dickens said, or you are anathema maranatha. "W. J. R.'s" argument about the giant and the dwarf is simply irrelevant, as he would see had he but the veriest inkling of comparative anatomy. Food, as I have before pointed out in these columns, depends largely upon climate; as we may learn from the bears, which are frugivorous in tropical climates, omnivorous in temperate ones, and exclusively carnivorous in the Arctic and Antarctic regions. Human life may be sustained on dates and bananas with the thermometer at 97° in the shade; but I should be curious to know during how many days — nay, how many hours—a man would be able to sustain life upon a purely vegetable diet in latitude 81° north! Mankind in general have found experimentally that a mixed diet supplies nutriment in a comparatively concentrated form, and one easy of assimilation. Granted that a slaughter-house presents an unpleasing spectacle, people are not (at all events, I am not) in the habit of visiting such places. A great deal that is repulsive enters more or less remotely into all we eat. I have some reason to believe that when a cesspool is emptied here, that my gardener utilises its contents for his vegetables; but I do not stroll into the kitchen garden to inspect the operation. "Sensitive minds" might forswear cabbages and cucumbers for ever after witnessing such a process of manuring them. Perhaps "W. J. R." will kindly furnish your readers with some statistics to support his astonishing assertion that "some nine-tenths of the world's inhabitants have been, are, and seem likely to remain non-flesh-eaters." "You may as well," say schoolboys, "tell a good one while you are about it!" How many of the 285 millions of Europeans —to begin with—are vegetarians? The Hindoos are, we know; but how many of the 450,000,000 Chinese confine themselves to a vegetable diet? Why, they prefer eating rats, mice, and slugs to doing so. Again, how many of the 82,000,000 inhabitants of the United States abstain from flesh-meat? Of the savage and cannibal tribes of Africa? Of the fish-eaters of Polynesia?—and so on. Man seems, *ab initio,* to have been carnivorous. At all events, the Cave men who were contemporary in England with the hippopotamus, cave bear, and reindeer 50,000 to 100,000 years ago were such epicures that they cracked the bones of the animals they ate to extract the marrow! Let me commend the study of the concluding clause of verse 5 of Romans xiv. to "W. J. R.," and assure him, in conclusion, that Dr. Richardson is by no means such a burning and shining light in the scientific world that his dicta are—or will be—accepted without cavil by those best qualified to judge.

The seeming curvature of the image of the window-bar, referred to by "M. O. H." in letter 29091, p. 525, is a quasi-perspective effect, having its origin in the approximately spherical outline of the eye, and the consequent direction in which the lateral rays coming from points so far to the right and left of its axis enter it. With regard to the second question put in the letter to which I am referring, I cannot see that any practical advantage would arise from suppressing the upper or unsilvered half of the horizon glass in the sextant —always supposing that its surfaces are parallel. In fact, as the rays of light must pass through the thickness of the glass twice, before and after reflection, from the silvered portion, the preservation of that glass for the purpose of viewing objects directly through it would rather tend to accuracy, by equalising the conditions under which the two images are viewed. Thirdly, I think that blackened index and horizon glasses might be useful for solar observation, but I greatly doubt their utility for any other purpose; and fourthly, while silvered glass or speculum reflectors might, under certain circumstances, be rather superior to the existing forms, the tenderness of the film, and the liability of speculum metal to tarnish would constitute serious defects in instruments designed to be used in all weathers, and to endure a good deal of roughish usage. Finally, I do not believe that it would be possible to make mirrors interchangeable on a sextant without repeating every single adjustment *de novo* on each occasion on which the instrument was employed.

I am afraid that Comet Sawerthal is by this time hopelessly beyond the power of the 2½in. telescope of "Omicron" (query 66098, p. 532); but as far as its position is concerned, it will be to-night approximately at the right angle of a right-angled triangle, which it will form with α and η Cassiopeiæ. Hence it will travel towards the west with a slight southerly tendency, and on the 29th will be a little more than ½° south of α Cassiopeiæ, and so on.

In reply to "F. R. S. E." (query 66104, p. 532), our knowledge of the cause, or causes, of thunderstorms is in a very inchoate stage indeed. I have myself noted (though I do not remember ever to have seen it mentioned) that high wind is almost invariably followed by more or less electrical atmospheric disturbance. This I have always attributed to the friction between the earth and the air moving so rapidly in contact with it. If difference of opinion. The division seems to occur when the term is extended, so as to include and explain certain geometrical forms otherwise anomalous. Thus, if $C_1 = 0$ and $C_2 = 0$ represent two circles which intersect, it is a general law that $C_1 - \lambda C_2 = 0$ represents a circle through the points of intersection whatever be the value of λ. But when $\lambda = 1$ $C_1 - \lambda C_2 = 0$ becomes a straight line, which is thought of as a circle with an infinite radius. Those who cavil at the mathematical doctrine of infinity, draw the line at the Dog Star or the Milky Way. Of course, a circle with its centre at such an enormous distance would correspond approximately with its tangent for a considerable distance (but would mathematically coincide only in a point). But this has nothing whatever to do with "infinity." The notion of infinity does not express facts, but only certain conditions of thought. We say a straight line is a circle with its radius at infinity, when thinking of a straight line under certain conditions, as one of a family of intersecting circles and of parallel straight lines, as meeting at infinity when considering the relation between straight lines and their points of intersection. But it is obvious that at "infinity" (not an enormous distance be it noticed) our notation breaks down. We can form no conception of a straight line at infinity, for we have no means of distinguishing its extremities. If l be the length of the line, however great l may be, x and $x + l$ only denote coincident points in thought when x is infinite. In fact, there is then no more difference between x and $x + l$ than there is between "Eternity" and "for ever and a day."

Vernon E. Bell.

ADJUSTMENT OF BAROMETERS.

[29126.]—IN your issue of Aug. 17 I see a letter (29102) concerning the adjustment of barometers. "S." is quite right in his method of adjustment, and his advisers were certainly advising him wrongly when they said that his glass was too high. Most aneroid barometers, when purchased from a good establishment, are set by a standard mercury column by the seller which corresponds with the difference between his level and sea-level. But Fitzroy barometers are usually put together in rather a haphazard fashion, and very rarely correspond exactly with any glass. And the old dial glasses are even worse; so that if "S." measures the height of his column between the top of the mercury in the short leg and the top of the mercury in the long leg, and sets his pointer to correspond, he can then snap his fingers at the local glasses, secure in the knowledge that his glass is, in all probability, more correct than any of them. To get at the height of his glass at sea-level "S." will have to add ⅛in. for every 100ft. he is above the sea-level.

Nitram P. T.

[29127.]—THE barometer (29102) falls (speaking generally) one-tenth of an inch for every 100ft. it is above mean sea level. The simplest way for the querist would be to get someone in his neighbourhood, having a standard barometer, to give him the correct weight of the column after the necessary connection for altitude has been made.

F.R.Met.Soc.

[29128.]—IF "S." were on, or near, the sea level, and the temperature 60° Fahr. when he adjusted his barometer, it would be practically correct. The barometer alone cannot foretell the weather; it merely indicates certain facts—viz., the rise and fall of atmospheric pressure, and by taking these into consideration along with some others, such as the direction of the wind, the state of the thermometer, &c., we can draw certain deductions as to what the weather will probably be during the next few hours. The custom of having the words "rain," "much rain," "change," "fair," &c., printed on the scale is both misleading and unscientific. A barometer will give correct readings in different districts so long as the elevation above the sea is the same, and a small allowance be made for temperature. If the elevation be different, we must add an inch to the reading for every thousand feet above the sea-level.

Stephen Stepton.

BALLOONING.

[29129.]—WILL you please allow me to register my protest against "Common Sense's" (p. 547) assertion that weight is essential to aërial navigation? It is unfortunate that he is not the only one who has ventilated this fallacy. The Duke of Argyll, in "The Reign of Law," considers it not only an indispensable, but *the principal*, factor for producing flight.

In my humble judgment it is far otherwise, and although I would not advocate further attempts in the direction of steering, or attempting to steer, balloons, yet I think it possible that the flying machine will be dependent on gas to carry some of its weight. In my opinion the failures which have attended the attempts to steer balloons are the results rather of bad management of the controlling apparatus than of the fact of the balloon being lighter than the air it displaces, the general plan being to attach the screw, fan, or what not to the car instead of to the body of the balloon, which exposes a tremendous surface to the air, and is, therefore, the place where the apparatus would produce the best results. When placed on the car, suspended as this is by ropes, the effect, except in the calmest weather, is completely neutralised by the greater force exerted by the wind on the surface of the balloon above. In fact, it is about as sensible as putting the motive power and screw of a ship into a bucket, hanging it by a rope a fathom or two under the vessel, and expecting the ship to behave as well as if she were under ordinary conditions.

"Common Sense's" comparison of the stone and feather shows he has forgotten that each is heavier than the air it displaces, the difference between them being simply that the weight of the feather is distributed over a very large area. Hence it falls more slowly than the stone, and its large surface allows the wind to play tricks with it (which it would do with the stone if that could be beaten out as thin as paper), but it as certainly falls to the ground as the stone.

The lighter the flying machine can be made the better, provided the apparatus moving it is properly arranged relative to the surface and weight of the machine, and the power applied is strong enough to maintain the way of the machine against the caprices of the wind, which our friend "Simplex" seems to fear so much.

My own notion of the flying machine is that it will be, both as regards the principle of its flight—which is simplicity itself—and in form, very much like a bird. The only really serious obstacle I can see is the chance of getting a motor very light and capable of exerting great power. As to this, I see there is a ray of hope in the Scientific News this week, but it may be nothing more—it is American.

W. J. G.

BALDWIN'S PARACHUTE.

[29130.]—MUCH misapprehension has been caused by newspaper reports of Baldwin's feat as to the distance traversed before opening out. When the balloon rises with Baldwin, it certainly attains an upward velocity of 8ft. per second. When Baldwin "lets go" this upward motion of the balloon is very much increased, and during the next two seconds after separation the balloon would probably rise 100ft. Baldwin's upward motion has then to be reversed by gravitation, which would take half a second, and another three-quarters of a second is required to acquire a downward motion of 32ft. per second, falling 16ft. This gives the appearance of great distance between Baldwin and the balloon when the parachute expands; and this distance has been magnified into hundreds of feet by newspaper writers. Your readers will now see where the mistake lies.

I have twice watched this point very carefully, and I say decidedly that, from the point in space where Baldwin "lets go," he never falls more than 16ft. before the parachute is forcibly opened by the air.

The mouth of the collapsed parachute, when ascending by the side of the balloon, is open to the extent of about 2sq.ft. At 16ft. per second the upward pressure is over 2lb. per square foot. This 2sq.ft. is almost momentarily increased to 254sq.ft., whereby its downward course is immediately reduced to a moderate speed, such as any active man could sustain with safety when alighting.

Probably one useful lesson may be learnt from Baldwin's feat, and that is, that when the resistance of the air is properly utilised, buoyancy is obtained; and, by a scientific use of such buoyancy, aërial navigation without gas bags may be effected, after careful and expensive experiments.

I have not yet measured the parachute, and have assumed its diameter to be 18ft., but it appears to me to be greater. The wind was very light this evening, and the form of the parachute was very perfect, no oscillation taking place.

Thomas Moy.

8, Quality-court, W.C., August 18.

A COBRA'S REVENGE.

[29131.]—THE death of Mr. Andrew Fischer, an employé of the Madras Railway Company at the Pennar Bridge Works on the north-west line of the railway, under most distressing circumstances, is reported. He was employed as a driver of bridge engines at the Pennar Works. While he was seated in the verandah of his bungalow, he observed two large cobras on the barren plain immediately in front of the house. Arming himself with a stout stick he proceeded to the spot and encountered the snakes. He succeeded in killing one of them, while the other, which had been slightly wounded, managed to escape. Mr. Fischer hunted about for the runaway, but could not find it. He then returned to his bungalow, and rested for some time, as he was off duty. Later in the day he prepared to go to his work, and with that object got out his clothes to dress. He sat on his coat, and was about to put on his shirt when he felt something sting him on the back. He turned round, and to his horror found a snake on the cot behind him, which he is said to have recognised as the cobra he had wounded that morning. He immediately sought medical relief, and all kinds of remedies were applied, but to no effect, and he died in the evening, leaving a widow and an infant child, for whom much sympathy is felt.

"Kellayan" writes to a Bombay paper:—"It is commonly believed among the Hindoos that no animal is more revengeful than the cobra, and that if an attempt is made to kill it and it escapes it never gives itself rest until it has wreaked its vengeance upon its assailant. This conviction is very widely shared by intelligent people. A particular friend of mine, now holding a very important position in Vizianagram, an M.A. and a B.L., used solemnly to tell me that this craving for vengeance on the part of cobras and alligators is not a mere figment of the fancy. Taking for granted that the facts about Mr. Fischer's death are as they are stated to be, will any of your scientific readers explain whether there is any truth in the popular belief that cobras trace at all hazards the whereabouts of their assailants, and do nothing until they have revenged the injury done or intended to be done to them? I am also informed that failing in the object of their attempt they cease to live."

The superstitious Hindoo clings to the traditions of the old serpent worship. His reverence for the dangerous creeping enemy is still unabated. After dark any devout person must not call a snake "a snake," but when fleeing in alarm must shout "my uncle!" or mention him as "a string." To kill him at any time, or under any provocation to injure him, is repugnant to the religion of Caste natives. I once met my gardener at early dawn sitting outside his hut. He said he was forced to quit by the sacred intruder under his sleeping mat. I got a stick, searched the bedding, and therein killed a fine cobra. When a man is bitten, incantations and magic potions are the usual practice. The snake is allowed to escape—to kill him would hasten the victim's death! In Bengal the corpses of those dying by snake-bite are not cremated, as the Brahmins say it is only a three days' sleep—nothing more. The body, fastened on a raft decorated with flags, is launched on the nearest river. I was watching the voyage on one occasion, when a river steamer came in collision, and the floating bier went to the bottom in a very rough way.

Very long ago the excessive number of females bitten in their own houses attracted public attention, and raised suspicions of wife murder in an ingenious fashion. It was said by the police that a man wishing to get rid of his partner bought a lively cobra for about a shilling of the professional catchers, and deposited the deadly reptile in the most likely corner of their hut—among the milk pans or cooking utensils. Just after the Mutiny I met a military chaplain, newly arrived from England, who astonished me with an account of a recent snake adventure. He had mounted the pulpit stairs in a Calcutta church, when he came in front of a cobra, and retreated backwards for safety. I believe it was killed. I have little doubt that the venomous intruder was purposely placed there by some vengeful Oriental. When snakes are pairing they seem to be greatly attached, and I believe the so-called "revenge" was merely the snake being in quest of its mate. I have often wounded large cobras, which managed to escape, yet they never returned to my premises.

Eos.

TAPPS' SAUCE.

[29132.]—A THOROUGHLY Oriental condiment, occasionally to be met with in London. In these days of quick steam voyages, mangoes can be brought to English ports in good condition. Green mangoes 4oz., sugar 4oz., salt 4oz., raisins (stoned) 4oz., green ginger 4oz.; garlic to taste. Pound all the above into a paste, then mix with three bottles of good vinegar, and half a bottle of pure lemon-juice. Put in a glass jar exposed daily to the sun for one month (or in this part of the world a hot room or kitchen shelf may do as well). Strain the sauce into half-pint bottles, sealing them down, and keep the thick residue as a "chutney." I have found half-ripe pineapples and green apricots not a bad substitute for green mangoes, using half of each. Still, nothing can imitate the spicy flavour of a mango.

Eos.

SOME LITTLE-KNOWN PLANTS OF THE FLORA MEDICA.

[29133.]—"AMYGDALACEÆ," or almond-bearing tribe, of which *Armeniaca vulgaris*, or apricot, is a member. This tree is so common in Kashmir and the other Trans-Himalayan countries that its timber is much used for making the wooden bowls in which the lower classes of Mahomedans delight to deposit their food when taking a gregarious meal. The fruit is generally small and insipid—is fact, only *once* did I meet with a tree producing specimens equal to European. Tons weight are dried for winter food and exportation, the stones being extracted and reserved for the expression of a valuable oil, chiefly used for their lamps by the primitive villagers. In Kunawur, a remote province, rot-heaps are to be seen, where the fruit is collected to decay for the sake of the oil product. This is clear, of a pale yellow colour, and smells strongly of hydrocyanic acid, of which it contains usually about 4 per cent. This oil is occasionally to be met with in the plains of India under the name of "Hill almonds." As a soothing and healing emollient for the breast sores of wet nurses and nursing mothers, I have not seen its equal. It bears so high a reputation that scarcely an English tourist or sportsman escapes the troublesome commission of procuring a bottle or more of the pure local oil for the use of his friends. **Eos.**

LATHE MATTERS: VERTICAL SLIDE.

[29134.]—In reply to "J. L. D.," p. 525, the milling slide, made by Hines, Norwich, is the tool inquired for, I believe. He makes two or three different attachments of the kind for the ordinary slide-rest, the vertical slide being very effective and much the simplest.

Split chucks, as used on the Whitcombe lathe, if they were characterised in the "E. M." as toys, as stated by "Notogsden," p. 525, it was not far wrong. They may do well for holding watch movements, an escapement, or such small fry; but suppose, for example, we try one at holding the driving-wheel of a locomotive, or, not going so far as this, will it hold securely (i.e., the same construction) a 12in. drum, or a 10in. face-plate chuck while being bored and screw-cut? **X.**

LATHE GEAR.

[29135.]—Replying to letter 29117, page 548, neither radial sides nor cycloidal curves could be obtained in a gear having an internal ring of 16 teeth, and a pinion of 14. This is clear from a glance at Vol. XLVI., p. 247, Fig. 17, in which figure H or I might be supposed to represent flank curves rolled by the pinion circle. Teeth of the forms shown at p. 451, Figs. 53 or 61, would be the proper ones to adopt. **J. H.**

THE FORMULA FOR SPIRAL SPRINGS.

[29136.]—Where can I find the most correct formula for calculating the dimensions of spiral springs? A spiral spring may be considered as a series of concentric rings, and every particle of the spring will therefore be subjected to a twisting moment equal to the load multiplied into the radius or half the mean diameter, with the exception of that part which is not a true circle, and which generally may be left out of consideration or treated as part of a circle. The mathematically correct formulas for the carrying capacity of spiral springs are—

$$W = \cdot 388\,\frac{Sd^3}{D_0} \text{ for round steel,}$$

$$\text{and } W = \cdot 471\,\frac{Sd^3}{D_0} \text{ for square steel,}$$

and for the deflection of one single coil—

$$F = 8\,\frac{P D_0^3}{Ed^4} \text{ for round steel,}$$

$$\text{and } F = 4{\cdot}712\,\frac{P D_0^3}{Ed^4} \text{ for square steel.}$$

Where W = carrying capacity in pounds.
S = greatest tensile strength per square inch of material.
d = diameter of steel.
D_0 = mean diameter of coil.
F = deflection.
E = torsional modulus of elasticity.
P = any load or pressure on the spring, in pounds.
All measurements in inches.

What are the values of S and E? On that point some readers may be able to give useful information. Some experiments made in the United States, by a Pittsburg manufacturer of springs, appeared to give for S a safe carrying capacity of 60,000lb. Is the modulus of elasticity the same for all sizes of steel, and is rolled steel better than drawn, or vice versâ? I have seen some calculations in which the experimenter had made some springs for the purpose, one of which was of ½in. round steel, 2¾in. diameter outside, of nine coils, flat ends not being counted. The actual deflection by a load of 100lb. was found to be 2¼in., while the above formula gave 2·39in. Another spring of 5-16in. round steel, in ten coils, but 3⅜in. outside diameter, gave a deflection of 2in., while the formula worked out to 2·07in. Some other experiments on actual springs indicated that the above formula must be very nearly accurate; but if your readers know any better I shall be glad to hear of it. **W. M. C.**

MATHEMATICS AND THE FINE ARTS.

[29137.]—When "H. T. R." (letter 29100, page 546), speaks of the mathematical view of infinity being expressed by the symbol ∞, without explaining how also the + and − were added by "three-wheeled Jews," he only confuses the issues. For instance, why could he not say that, with the ancients—

∞ = That portion of infinity comprised in the present age.
+∞ = That portion not comprised in the present age.
−∞ = Past time not comprised in the present age.
−∞ ∞ ∞ + = The real representation mathematically of time, past, present, and future.
= What the ancients used to call—*time, time and half a time*, or its equivalents.
= In its shortened form ±∞ = simply ∞.

E. W. D. W.

P.S.—Half explaining a term is but half doing the trick.

THE RAILWAY RACE.

[29138.]—The West-Coast men seem to be having things all their own way. I think it is time we had our turn. On Tuesday last the Scotch express, consisting of eight E. C. J. S. coaches, left King's Cross, heavily laden, at 10 p.m., sharp. It reached Grantham with two minutes in hand, but left York to time only—namely, 1.50. Newcastle was reached to time at 3.20, and left at 3.23; and the train arrived in Edinbro' at 5.32, or 13 minutes before it was due. The latter part of the journey was done in the extraordinary time of 2h. 8min., the distance being 124 miles. This is, I venture to think, the most wonderful run on record, considering the road and the train load. Indeed, the run throughout puts in the shade anything done on the West Coast; for the whole journey from London to Edinbro' was done in 7h. 33min., the distance being 397 miles, which, allowing for stops—Grantham, 3min.; York, 20min.; Newcastle, 3min.—gives an average speed of ·935 mile per minute all through, a performance which will, I think, stand an unbeaten testimony to the superiority of Great Northern and North Eastern engines for many a day to come. I should say that the journey was run to Newcastle and Edinbro' respectively by Worsdell Compounds, showing that they can do good work.

During the whole of last week the "Scotchman" has been run from York to Newcastle regularly by the "Exhibition" compound, which a number of readers have seen at Newcastle Exhibition, and the time kept has been excellent. As railway men well know, this is a very heavy test to apply to an engine, and the way in which the compound has stood the test only corroborates Tuesday's performance.

The insane race is over, for the L. and N.W.R. seem inclined to cry enough, even with their light train, and the East Coast may fairly rest on their laurels and claim superiority, both for engines and drivers. This, I take it, was the object with which the race was taken in hand, and now I suppose things will go on as usual. **N.E.R.**

[29139.]—It is, perhaps, not well advised to occupy valuable space in the "E.M." by merely discussing the rival merits of the new 7¾ hours trains in the present "railway race." A permanent record of their performances would be more to the point; but I think it hardly fair that "English Mechanic's" letter, anent what he terms "this job," should be passed over without comment.

It appears that his "shrewd suspicions" as to the comparative weight of the two trains are not altogether infallible; and it may be that, after his rapid journey from King's Cross to Euston in seven minutes, he was somewhat breathless, and so failed to note that the "four carriages" of the West Coast train were 42ft. radials of the new saloon build, weighing 20 tons each, and regarded by drivers as each equal to two ordinary 11-ton 6-wheel coaches in hauling. The eight coaches of the rival train are 6-wheel E.C.J.S., of slightly over 10 tons, unless I am greatly mistaken, though there may be one or two bogies on the train. Apropos of the engine: if built in 1868, it is now 25, and not 28 years old; and does "English Mechanic" recollect the "Ladies" before Mr. Webb rebuilt them? It is quite consistent of the L.N.W. to run this train with Ramsbottom's singles, inasmuch as they always employ them on light specials (as the Prince of Wales's train from Edge Hill to Euston in 3h. 40m. on March 28th, 1884, and the 40m. trains between Liverpool and Manchester); while Webb's compounds were designed for the ordinary heavy main-line trains of fifteen coaches at 46m.p.h. running average.

"English Mechanic" considers the East Coast gradients only "somewhat lighter" than those of the other route; but I refer him to back numbers of this paper for actual figures, and remind him that *Engineering* calls the E.C. route "infinitely easier"; while Mr. Foxwell ("Express Trains," 1883), in comparing the three routes to the north, calls the Midland "the severest," the North-Western "considerably easier," but the G.N. as "never rising to 400ft.," and therefore "scarcely a hilly section." Finally, the journey speed during 7¾ hours over 400¼ miles (West Coast) must be slightly greater than over 392½ miles (East Coast). Then, are not the latter now overcoming the water difficulty by using two engines north of Newcastle, thus avoiding a fourth stop (Berwick)? If this is so, the running average is slightly in favour of the West Coast train.

The present competition has given rise to a good deal of rubbish appearing in print about "panic-stricken and demoralised drivers," and has "excited not a few fears" among those unacquainted with English railway management, and ignorant of the protective powers of even that "wretched automatic vacuum brake," the employment of which by our leading railway engineers so greatly rouses "English Mechanic's" ire. The assertion of common sense in the shape of Mr. Acworth's recent letter to the *Times* is a welcome condemnation of such nonsense. The running of these trains is, after all, a forecast of what our express services will be generally in a few years' time, and is not to be foolishly condemned. The reasons for their being discontinued for the present are well set forth in the following opinion of perhaps the greatest authority on railway management in England, expressed not long ago to myself, as to "a strife of speed between railway companies, which I doubt is beneficial either to the railways, to their shareholders, or in the long run to the public, as much local accommodation has been sacrificed in the endeavour to accomplish rapid transit from terminus to terminus."

N. S. R.

[29140.]—In reply to several queries which have appeared lately in the "E.M.," I beg to forward you the latest official timing of the special Scotch expresses by the East and West Coast routes.

EAST COAST.

Miles.				Speed.
	King's Cross	dep.	10. 0 a.m.	55
105½	Grantham	arr.	11.55 a.m.	
	"	dep.	12. 0 noon	55
188	York	arr.	1.30 p.m.	
	"	dep.	1.50 p.m.	52⅓
268¼	Newcastle	arr.	3.23 p.m.	
	"	dep.	3.26 p.m.	53⅔
392½	Edinburgh	arr.	5.45 p.m.	

Journey speed (including stoppages) 392½ miles in 7¾ hours = 50⅔ miles per hour. Running time, 7h. 16m.; running average = 54 miles per hour. Weight of train (eight 6-wheelers) 100 tons, 150 passengers and luggage 20 tons; total load, *excluding* engine and tender, 120 tons.

WEST COAST.

Miles.				Speed.
	Euston	dep.	10. 0 a.m.	52¾
158¼	Crewe	arr.	1. 0 p.m.	
	"	dep.	1. 5 p.m.	53
209¼	Preston	arr.	2. 3 p.m.	
	"	dep.	2.23 p.m.	54
299¼	Carlisle	arr.	4. 3 p.m.	
	"	dep.	4. 8 p.m.	54
400¼	Edinburgh	arr.	6. 0 p.m.	

Journey speed (including stops), 400¼ miles in 8 hours = 50 miles per hour. Running time, 7h. 30m.; running average = 53⅓ miles per hour. Weight of train (four short 8-wheelers) 77 tons, 60 passengers and luggage 8 tons; total load, *excluding* engine and tender, 85 tons.

The statement that the West Coast Companies have also reduced the time to 7¾ hours is incorrect. On Monday last the train made a parade run, and reached Edinburgh in 7h. 39min.; but the schedule time still remains 8 hours; and since that day the train has reached Edinburgh only some three or four minutes before 6 o'clock. It should be noted that this run was made *against time*, and disregarding the schedule altogether. In fact, the train *left* Carlisle 16min. in front of time, and left two or three passengers also, who were unprepared for such an extraordinary manœuvre. The 21min. were made up steadily throughout the 400 miles. A very different performance was that of the East Coast train on the following day, when, with the usual load, and *without leaving any station in front of official time*, it ran into Edinburgh at 5.32 p.m., having performed the whole journey in 7h. 32min., the 13min. being all gained on the last section of 124¼ miles, between Newcastle and Edinburgh, which was covered, including four very considerable reductions of speed, in 126min. What time the East Coast companies could make if they ran against time, as the West Coast did on Monday, it would be difficult to guess; but, given good weather, I think it highly probable that the time would come nearer to 6½ than 7½ hours.

With regard to the comparative difficulty of the two routes, I am certain it has been greatly overestimated. When the West Coast companies took ten hours over the journey, it might have been truthfully said that the northern half of the road from Preston onwards was quite 15 minutes harder, mile for mile, than the corresponding section of the East Coast between York and Edinburgh; but then it was equally true that the southern section—London to Preston—was quite five minutes easier, leaving a balance of only ten minutes against the West Coast, to which, however, must be added a further ten minutes on account of the 7¾ miles further distance, making the West Coast 20 minutes harder on a ten hours' run.

But (and this appears to have been quite overlooked) if the West Coast is 20 minutes harder on a ten hours' run, it is only about a quarter of an hour harder on an eight hours' run, so that, without taking into account the fact that the East Coast carry nearly twice the weight carried by their opponents, and are very much more hampered by enforced reductions of speed (ten miles per hour through Peterborough, Darlington, Morpeth, and Berwick, and six others from 20 to 25 miles per hour), we may say that the two performances, in 7¾ hours and 8 hours respectively, are about equal in merit.

O. P.

THE WALTON RAILWAY AVERAGE SPEED OF 3½ MILES PER HOUR.

[29141.]—No one appears to have replied to me (letter 28665); I should have liked it to have come from the locality. This tramway was opened in 1870 or 1871—I am not certain which year. Its length is about 6½ miles from Quainton-road Station on the Aylesbury and Buckingham Railway. It is laid pretty near the surface of the land, there being no cuttings or banks, the gradients being from 1·40—1·50, and some appear a little steeper than these, and very sharp curves, which would not admit of a train running above five or eight miles speed. The rails are 30lb. to the yard, bridge section, and laid on longitudinal sleepers 6 by 6, with cross ties every 12ft. There are no stations—only a siding laid down at the principal level crossings of the main roads. The engine weighs from 10 to 12 tons, and is one of the Contractor class; the trucks and carriages are borrowed from the G.W.R. or L. and N.W.R., the traffic being farming produce and passengers, and worked as mixed trains: thus a train has to stop some time while the waggons are being shunted about. It is only a tramway, and is not returned in the Government Railway Returns. This is one together with the Aylesbury and Buckingham, Northampton and Banbury, East and West Junction Railways—which ought to have been constructed on the 3ft. gauge, when you consider that £1,855,284 have been spent on these lines of 68 miles, earning about £24,000 a year, and the working costing about £26,000 a year, thus entailing a loss of £2,000, to say nothing about the interest.

Had it been constructed on the 3ft. gauge, the same as the Isle of Man railways, or the Ballymana and Larne railway, these lines would have been built for about £600,000, and even at the present revenue, instead of a loss, it would be a profit of £8,000 a year, and a speed of 20 to 25 miles per hour, instead of these slow speeds.

The light 4ft. 8½in. railways are a failure: (1) They have to be worked at slow speed; (2) the cost of construction is considerably more than the 3ft. gauge; (3) the working expenses are greater than the 3ft. gauge in maintaining of way and locomotive power.

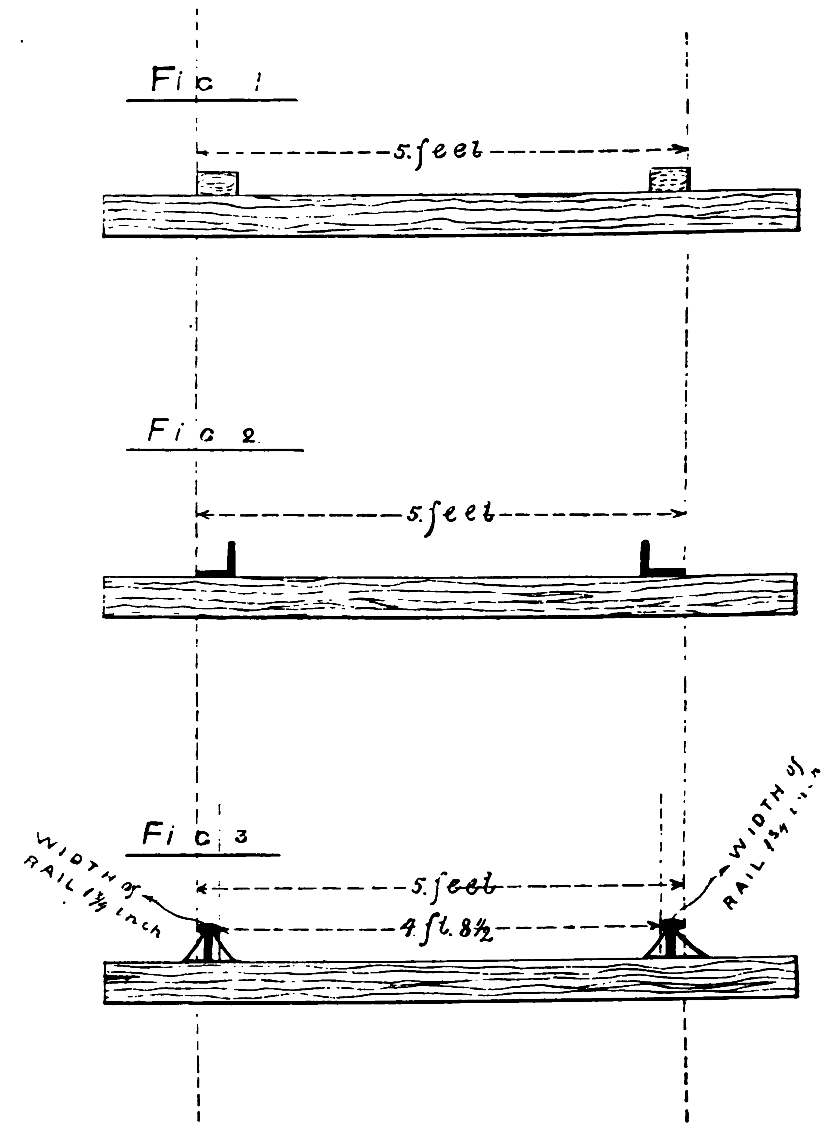
Dexter.

THE ORIGIN OF THE RAILWAY GAUGE.

[29142.]—Several questions and replies have appeared recently in the columns of the English Mechanic with reference to the origin of the present 4ft. 8½in. gauge, and as some difference of opinion appears to exist, I have made the annexed diagram, which will probably place the facts in a more clear form.

About the year 1630, Mr. Beaumont, at Newcastle-on-Tyne, introduced the "wooden way," which consisted of wooden planks nailed upon wooden cross-sleepers, as shown (Fig. 1); the width outside, or including the two planks, was *five feet.*

In the year 1767, at Colebrookdale Ironworks, cast-iron plate rails were introduced, having an upright ledge or flange on the inner side to keep the wheels upon the track. These plate rails (Fig. 2) were also laid at a width outside of 5ft.



In 1789, Mr. William Jessop, when constructing a railroad at Loughborough in Leicestershire, abandoned the flat wheels and flanged rails, and introduced the "edge rail" (shown Fig. 3) and flanged wheels. Jessop, it will be observed from the diagram, still adhered to the gauge of 5ft. outside, and as his rails were made 1¾in. wide, it will be seen that the width of two rails, or 3½in., deducted from the 5ft. outside measurement, leaves the present 4ft. 8½in. gauge. This is therefore the well-known origin of our present gauge, and the following extract from the ninth edition of the "Encyclopædia Britannica" is perfectly correct:—"The fact seems to be that the track of the original carts or trains, 5ft. wide outside the rails, was taken as a standard for the gauge of rails, which was measured outside also. The width of the single rail at the top being originally 1¾in., the width of the two rails together is 3½in., which leaves 4ft. 8½in. for the inside measure or true gauge."

Clement E. Stretton,
Consulting Engineer Associated Society of Engine-drivers and Firemen.

Leicester, Aug. 10.

LIGHTNING—MATHEMATICAL IDEAS—MANIFOLD SPACE—NON-EUCLIDIAN GEOMETRY.

[29143.]—Mr. Wenham's letter (29079, p. 523) brings to my mind the following items regarding lightning. Some 32 or 33 years ago, I often had occasion to pass a certain large barn of the gable-end (not hip-roof) kind. It must have been at least 30ft. high from the ground to ridge of roof. To the western gable was attached an old, and as far as I could judge, defective lightning-conductor. A few feet from this end of the barn was an ordinary field gate, with wooden posts about 6ft. or less, high. During a thunderstorm a flash missed the great barn and shivered one of the posts of this gate. It seemed a singular freak for the lightning to avoid, as it were, the high object and strike the low one at its base. It does not appear likely that the rusty, blunt-ended, insulated old rod could be any safeguard to the barn.

Again, in the spring of 1866, I was an inmate of a long, rambling two-story house. I was awoke one night by a blinding flash, accompanied by a terrific detonation. I felt sure the house was struck; but it was not. The stroke fell on a stump a couple of feet high, close by the opposite side of the building.

Most woodmen in hot countries no doubt have often remarked the vagaries of lightning—in sparing tall trees in a forest, while splitting open little ones close by. I can also corroborate Mr. John Williams's statements in the following letter (29080), same page, as to the zigzag appearance of what is popularly called "forked lightning."

It may be only an optical illusion due to the rapid passage of the spark; but to my eye it is exactly as represented by painters and engravers. I don't say it is always so, but I have thus seen it multitudes of times.

It is a little singular that when I read letter 29074, p. 522, on "Mathematical Terms," by Mr. W. J. Rendall, there was lying on my desk an old envelope on which was drawn a small square with its two diagonals. The right-angled isosceles triangles thus formed were coloured respectively yellow, red, green, and blue. It had been there for weeks, and was done to give my wife an idea of what a mathematical (barring the imperfection of human work) line and point was. It was quite successful. Previous to this, her idea of a line was derived from the cross wires of our former transit instrument and equatoreal, which, though fine and delicate, certainly had, as she maintained, appreciable breadth. To convey to her mind some idea of a surface, I laid one flat iron plate on another, and said, "These are two distinct pieces, not welded into one as it were. Between their two faces, which are thus lying together, is a surface—i.e., length and breadth without thickness."

While on this subject, I am utterly unable even to conceive of space other than that of three dimensions. I listened with the utmost attention to Dr. Spottiswoode's exposition of "manifold space," and afterwards read his pamphlet more than once, but all in vain. I am too hopelessly dull even to imagine it. Mr. Grey's idea that beings living in two-dimensional space would be just as incapable of understanding our three-dimensional existence does not help my ignorance in the least, as I am equally incapable of conceiving either "beings" or space of only two dimensions. A surface is not space to me. It would not be one whit more absurd to speak of "beings" and space of no dimension at all! Parallel lines that meet, finite space, &c., seem to me only like the ravings of a madman; but as some able mathematicians believe in them all, I must only lament that the bent of my mind and my defective training render can supply him with all he wishes to know on this subject. POTTER.

[66062.]—**Antipyrin.**—The following remarks, which I extract from an article on "The Comparative Therapeutics of Antipyrin and Antifebrin," by Robert Park, M.D., physician to the Glasgow Samaritan Hospital (*Lancet*), may be of interest to the querist:—"Beyer writes that Cappola found that 'toxic doses of antipyrin did not diminish blood pressure; the heart continued to beat with great energy, and was finally arrested in systole.' Filehne found the heart, on the contrary, after death, 'arrested in diastole.' Ardiun also states that 'it kills by heart paralysis.' Beyer's own conclusions, from experiments which appear to have been carefully planned and crucial, are that 'antipyrin, though largely dilating the veins, increases the power of contraction of both auricles and ventricles, and has no injurious influence upon the blood nor the muscular tissues, and therefore possesses, indeed, all the good qualities of a perfect antipyretic.' Now my clinical experience leads me entirely to endorse Beyer's views as to the physiological action of antipyrin; but, in practice, it is often found that the therapeutics of a drug is varied by a great number of conditions with which the physiologist has not to contend. I need not enumerate these, as they occur to the mind of every practitioner. Suffice it to recall here the fact that there are certain cases, and notably those of tuberculosis, where antipyrin fails to bring down the temperature, and where antifebrin is likewise powerless in this respect, though it may possibly prevent hyperpyrexia. The explanation is not to be found in dosage or mode of administration, but either in the patient or the disease, or the one modified by the other. Idiosyncrasy, no doubt, counts for something—that is, some of the recorded phenomena following slight doses of antipyrin can only be explained, on account of their anomalous character, by reference to some anomalous individual characteristic. Albeit I think we possess some clinical data whereon we can rest secure in saying at least that the question of whether the patient is sthenic or asthenic has a most important influence. To begin with, I may be permitted to refer to the case reported as showing the fact that antipyrin can be given continuously in full doses frequently in a sthenic case without harm, but with benefit. On the other hand, in the *Practitioner*, No. 238, Mr. Bokenham, of St. Bartholomew's Hospital, states that: 'In the headaches due to debility he had to confess that the results were not entirely satisfactory.' 'One of the patients, after the first dose of three grains, said "she felt as if the top of her head were being lifted off," and would not take any more.' He also relates another case of a medical man who took three grains for a headache and was seized with a feeling of 'weakness and giddiness.' Mr. Bokenham attributes this to idiosyncrasy. Supposing him to have been a strong and robust man, would the effect not have been much more serious if he had been an asthenic? To a lady weakened with long-continued illness I administered a single dose of ten grains on going to bed. She exclaimed shortly thereafter, as I am informed, 'Oh my! What a queer feeling! I feel cold all over! I feel as if I was freezing inside!' Hot bottles had to be procured and an additional supply of warm blankets, in order to bring about a reaction. That this effect of impending collapse was not due to idiosyncrasy in her case is proved by the fact that she has since had the same dose administered, but after she has been in bed and comfortably warm there. The drug was administered as an anodyne, no pyrexia being present. Then Friedländer's observations go to prove that 'antipyrin acts better on well-kept children than on those who are poorly taken care of.' According to Cappola, it produces a fall of temperature 'normal or pathological.' It will be admitted, I think, that a remedy capable of lowering normal temperature must be used with great care in asthenic patients. Turning now to antifebrin, Dr. Hamilton's experience that it is not adapted for asthenic cases is noteworthy, especially in view of the manner he prescribes it—viz., in small doses often repeated at short intervals. I do not think it is beneficial to administer it so for zymotic pyrexia at all, and even in cases of inflammatory pyrexia I think it should be given *ad hoc* in large doses at long intervals. I have had very disappointing results—unequal effects—from it given both ways; but I have no doubt now that the large dose and long-interval method is the right one. The only case of relapse of scarlet fever I have ever seen occurred lately in a sthenic case which had been treated by antifebrin; and in another sthenic case of S. anginosa, and an asthenic acute tuberculosis, the troubles were entirely unmodified unless it were by preventing hyperpyrexia. In asthenic enteric in twelve-grain doses it has seemed to induce earlier apyrexia, however, and to have answered well in various asthenic phlegmasiæ. As to the question of dose, I find Fürbringer has given thirty, forty-five, sixty, and in *one case 120 grains* without any toxic action of consequence. Then, in the same journal for January, 1887, the observations of Drs. Colin and Hepp at the clinic of Prof. Kussmaul of Strassburg are epitomised. They found 'it can be used in relatively large doses without causing toxic effects; the size of the dose was determined by the character, severity, and stage of the fever, and also the idiosyncrasies of the patient. The effects were quite as rapidly induced, and were four times stronger than those produced by antipyrin. The impression made by it on the pyrexia is better effected by larger doses at longer intervals than by smaller doses at shorter intervals.'" I think the above remarks make it abundantly clear that, whatever may be the virtues of antipyrin, it should be used only by those who, from experience or special training, have the requisite knowledge. ANTI-DRUGGIST.

[66063.]—**Breaking Weight of Rope.**—This would depend entirely on how tightly it is stretched, and how elastic it is. Probably, from 3cwt. to 5cwt.

Bristol. T. C.

[66073.]—**Plaster Pedestals.**—Made a model of the pedestal in clay. Divide the model in equal parts by placing pieces of clay up the sides; on that side to be run first, place pieces of clay the size and shape of half a marble on the partition pieces; these will form notches to hold the halves together. Fix a wall of clay, about an inch from the model, round the half to be run—this should be a little higher than the model to allow the plaster to cover the top. Mix and pour the plaster into the space between the model and outer wall of clay. When the plaster has set, take out the partition pieces, oil the plaster faces of the part run, place the clay wall as before, and run the second half. When the plaster has properly hardened, clean out the clay, oil the inside faces well, tie the halves together, mix and pour in the plaster, allow it to set, take away the outside cases, and the pedestal is formed. POTTER.

[66080.]—**Electrical.**—Calculate sectional area of space reserved on bobbin for wire, also average length of one turn—which equals $\pi \dfrac{d^1 + d^2}{2}$ where $\pi = 3{\cdot}1416$, d^1 = diameter of turn nearest bobbin, and d^2 = diameter of outside turn. From tables, which most copper wire manufacturers publish, select such a wire that the square of its diameter is to the sectional area of wire space, as the average length of one turn is to the length corresponding to the required resistance, or $\dfrac{d^2}{\text{area}} = \dfrac{l}{L}$. FRANK E. BEETON.

[66084.]—**Driving Shaft by Electricity.**—I would suggest working with constant current of, say, 10 ampères and high voltage of about 1,400 volts, as loss in leads with low tension current would be very great on such a long distance. The power required in watts would be, for shaft, say, 9,000; for lamp (1,000c.p.), say, 2,250; together, 11,250; to which add 25 per cent. for loss in leads, &c., making about 14,000. A cable of 7 strands of No. 17 wire would have about 11 ohms resistance for the four miles, and would carry the current well. Somewhat smaller leads might be used if power is cheap and cost of cables of more consequence than economical use of power. Switch could be easily arranged for current to be sent through lamp and on to motor driving shaft, or lamp cut out and current thrown direct on to motor. I might be able to give further information on receipt of details, and would be pleased to do so. FRANK E. BEETON.

274, Goswell-road, E.C.

[66085.]—**Direct Transformer.**—TO MR. W. PERREN-MAYCOCK.—Your failure is in the badness of the magnetic circuit. If you could not get Swedish or Norway iron, the next best would have been Lowmoor—surely not difficult to procure. If the ends of the wire cores had made good "magnetic" contact with the end nuts, and these with the yoke and pole-pieces, you would have had better results. A certain proof of this lies in the fact that you cannot get any considerable magnetisation at the secondary pole-piece. It is worth all the trouble to have the cores, yoke, and pole-pieces of the best iron, and in the given dimensions. More cells should be used, or, rather, one of large capacity. The paper is all right, but there was no necessity, that I can see, to use paraffin oil with the wax. It is better to have secondary wires at opposite ends, as between these the greatest insulation is required. Put on as much secondary as possible. You should use a condenser to absorb the extra current in the primary, which is the cause of the sparking, which sparking is destroying your contact points most unnecessarily. As I feel very interested in introducing this type of transformer, you can always depend on me for any suggestions that may lead you to success.

W. PERREN-MAYCOCK.

[66087.]—**Crane Jib.**—The diagonal bars and struts are mainly stiffeners, for which calculations are useless—experience and judgment being what are required. There is a little strain on the flat bars where the angle irons are curved, but it is slight. Of course the strain on the angle irons is compressive, and the area of angles being about 20sq.in. are amply strong for a load of only 10 tons. I am supposing that the jib has the usual rods to keep it in position.

Bristol. T. C.

[66097.]—**Annuity.**—The following formula will enable "Annuity" to solve this question—

$$p = \frac{a}{r}\left\{1 - \frac{1}{\left(1 + \frac{r}{4}\right)^{4t}}\right\}$$

in which p represents the present value of annuity, a the amount of annuity, r the interest of £1 for one year, and t the term of the annuity. By the data given, $a = 100$, $r = {\cdot}0275$, and $\frac{r}{4} = {\cdot}006875$, and $t = 90$. Then—

$$\frac{a}{r} = \frac{100}{{\cdot}0275} = 3636{\cdot}36.$$

And—

$$\left(1 + \frac{r}{4}\right)^{4t} = (1{\cdot}006875)^{360} = 360 \text{ log. } 1{\cdot}006875$$
$$= 360 \times {\cdot}002976$$
$$= 1{\cdot}07136$$
$$= \text{log. } 11{\cdot}7858$$

Hence—

$$p = \frac{3636{\cdot}36 \times 10{\cdot}7858}{11{\cdot}7858}$$

= £3327·82, value of annuity at 2¾ per cent. per annum. And in the same way we obtain the present value of the annuity at 3 per cent. to be £3107·087.

Hetton-le-Hole. LYONS.

[66099.]—**Electrical Sparks from Body.**—Try subject holding one handle and operator holding the other, and completing circuit by touching any part of the body. Does your friend mean that he was "charged" by Holtz or other electric machine? In this case he would have to be insulated by standing on stool with glass legs, a sheet of indiarubber or ebonite, &c.

FRANK E. BEETON.

[66100.]—**Frictional Electricity.**—Electricity is brought into evidence (not generated) when any two dissimilar surfaces are rubbed or passed over one another, be they metallic or not. The best machine for frictional or high potential electricity is the Wimshurst. I can recommend Dr. S. P. Thompson's book, "Elementary Lessons in Electricity and Magnetism" (Macmillan), as one of the very best for a beginner. After which, Prof. Ayrton's "Practical Electricity" (Cassell).

W. PERREN-MAYCOCK, A.S.T.E.

[66100.]—**Frictional Electricity.**—Friction between any two dissimilar metals or substances will produce electricity. The difference of potential between a pair would, however, be very low, and insufficient to charge a secondary battery, or to give more than a feeble charge to a condenser. Probably any elementary book on magnetism will give you information on this subject. Prof. S. P. Thompson's book, published at 4s. 6d. by Macmillan, is very good. The idea of developing electricity by friction is, I believe, not a good one. The direct result of friction is heat, not electricity, and this latter must be due to other causes, as is evidenced by the fact that the amount developed is not proportional to the work spent in overcoming the friction. FRANK E. BEETON.

[66105.]—**Mechanical Motions.**—Either by means of a valve and piston or by means of a properly-shaped cam. The latter will be noisy and cause considerable wear.

Bristol. T. C.

[66106.]—**Moist Water-Colours.**—Rub your dry colours up with a knife, using pure glycerine, and put back in their china cups. H. S. C.

[66117.]—**Power of Engine.**—This cannot be answered unless the point of cut-off is given. If there were no cut-off at all the power would vary directly as the pressure.

Bristol. T. C.

[66124.]—**Factorial of Zero.**—It is idle to speculate on the value of the "factorial of zero," since it simply does not exist; it is not even an "imaginasy quantity" like $\sqrt{(-1)}$. The factorial symbol $\underline{|n}$ is not a sign of any algebraic operation like $\sqrt{}$ or x, but simply an abbreviation for 1, 2, 3......n; consequently, when $n = 0$ it has no meaning whatever. Let us take an example. The number of different orders in which n men can be arranged is $n(n-1)(n-2)\ldots\ldots 3, 2, 1$—that is, $\underline{|n}$. If we have only one man, $n = 1$ and $\underline{|1} = 1$, or only one arrangement. If we have no men to arrange, $n = 0$ and $\underline{|0} = 1$, according to "F.S.S." Therefore, we get the astounding fact that if we have no men to arrange, there is still one way in which they can be placed. REYMOND.

[66126.]—**Silver Soldering.**—The pickle for silver is oil of vitriol and water equal parts; boil for a minute or so in a copper pan—if in no hurry then the borax will come off in time by allowing the article to lie in the pickle. Another pickle is boiling in a solution of alum and water.

DENS.

[66127.]—**Bending Hard Wood.**—Steep in boiling water for about half an hour, bend round a block of wood (or stout nails driven into a thick board) to shape required; fix in position until dry.

F. RUSSELL.

[66134.]—**Dynamo for 3-Man Gas Engine.**—A dynamo with a 4½in. Pacinotti ring armature, wound with at least 3lb. No. 20d.c.c., the field magnets being wound with 12lb. No. 22, connected up in shunt with the brushes, would give good results with the engine described by querist. The particular form given to the carcase is not of much importance; but I rather prefer for these small machines a single wrought-iron core, about 3in. diameter and 8in. long, to which are bolted (one at each extremity) the two standards, carrying massive pole-peices at the top end. Each standard and pole-piece may be cast in one piece, and carefully annealed before being finally bolted up. This ⲏ gives an idea of the form of the carcase, the wire being wound on the transverse or wrought-iron portion. The machine should light four or five 20-c.p. lamps.

S. BOTTONE.

[66137.]—**Communication Cords on Railways.**—All passenger trains, even if they stop every mile, should be fitted with some efficient means of communication between passengers and guards or driver. Did anybody ever hear of a case in which the cords acted when required? You might safely offer a reward for an authentic case. The Brighton have a very good system (electric?) fitted to local trains as well as express, and so have the South-Eastern. On the South-Western I have frequently seen express trains start from Waterloo with knots in the cord nearly as big as the fist just on the wrong side of a ring, thus rendering it useless. I once saw the end of the cord tied to the hand-rail outside a luggage-van, in which, of course, there was no guard.

Clapham Junction. REYMOND.

[66138.]—**Gramme Dynamo, 20c.p.**—TO MR. BOTTONE.—The following are the dimensions required:—Height of standards, 8¾in.; length of cores comprising pole-pieces, 6in. This allows 2in. for the pole-pieces and 2in. on each side for the F.M. cores. Thickness of standards, 1in. The F.M. cores should be 1⅛in. in diameter. They must be wound with 4lb. No. 22d.c.c. The armature must be 3½in. in diam. from cog to cog—12 cogs; inside diameter of ring, 2½in.; thickness of ring, ¼in.; height of cogs, ¼in.; wire on armature, 1lb. No. 20. The machine should be connected up as a shunt machine.

S. BOTTONE.

[66142.]—**To "Principia" or "Chemist."**—The solution which was taken from the iron cylinder is evidently a supersaturated solution of hydrogen sodium sulphate ($NaHSO_4$) in H_2SO_4 (not $2HSO_4$) and HFO_3; when it cooled, part of the sulphate crystallised out, leaving a saturated solution of the sulphate in the above acids. The addition of HCl and zinc caused the solution to become hot and dissolve a large quantity of the metal with the evolution of chlorine and chloronitric gas ($HOCl_2$); when cool, the liquid would deposit crystals of zinc sulphate. Probably there would also be given off hydrogen, HCl, HNO_3, and nitric oxide (N_2O_2); it is difficult to say if this would be so, as we do not know the proportions (atomic) of the different agents employed; and, besides, you have a very complicated mixture to deal with. You will find my address in last week's "Address Column." If you care to write, I will try to help you.

PRINCIPIA.

[66143.]—**Electro-Magnets to take Large Currents.**—TO MR. BOTTONE.—The amount of current which can be passed round the coils of an electro-magnet without injurious heating is entirely a function of the diameter of the copper wire used to coil it with. The following table gives approximately the current (in ampères) which can be safely borne by wires of different diameter:—

No.		
6	B. W. G.	60 Ampères.
8	"	43 "
10	"	36 "
12	"	20 "
14	"	15 "
16	"	8 "
18	"	5 "
20	"	2·5 "
22	"	1·5 "

Electro-magnets can be bought ready made at almost every electrician's; and, even if they are wound specially to take a large current, the cost is not great.

S. BOTTONE.

[66147.]—**Fuller's Battery.**—I should advise "One in Doubt" not to do away with his nitrate of soda battery for a Fuller, for the purpose he requires it. I have for some time past experimented with different kinds of batteries for electric lighting on a small scale, and find none answer so well as a nitrate of soda battery, especially if Judson's cells are used; I mean those cells where the outer one is made of carbon, thus forming a pole of the battery. "One in Doubt" will find that Fuller cells will require charging quite as often as the nitrate of soda ones, and the solution for the former more trouble to prepare, and nearly four times as expensive.

NEDRAW.

[66148.]—**Rats.**—As rats are subject to the law of gravity the same as anything else, I don't see how they are going to walk on ceilings, as they are not provided with suckers like flies. I fancy somebody has been "doing" "Mechanic" by dabbing a rat's foot on the ceiling, and leaving him to investigate.

F. RUSSELL.

[66151.]—**Weight of Live Fish.**—"E. L. G." was alluding to a question which someone asked Bacon (some say Charles II. or I.), which had been "theorised" on for a long while Bacon considered for a short time, then said: "But let us see first if it is so," and of course it proved to be false. Moral: experiment.

F. RUSSELL.

[66155.]—**The Race to Edinburgh.**—Marmion, No. 667, is a 7ft. 6in. single, built Jan., 1863. No. 275 (Vulcan), built Sept., 1870, is one of Ramsbottom's 6ft. 6in. four-coupled engines. The *Times* says that the accident at Shap was caused by the bursting of one of the boiler-tubes, which put the fire out. The engine was stated to be a Compound, which is extremely probable.

Clapham Junction. REYMOND.

[66158.]—**Battery for Electric Clock.**—If "Mc.S." will wind his bobbins with No. 36 s.c.c. wire and use a plate of copper about 4ft. square and a plate of zinc of similar size buried in moist earth about 1ft. apart, I think he will find that that will give him sufficient power to drive his clock by the pendulum bob. I had one working for four years continuously with excellent results.

NITRAM P. T.

[66160.]—**Barometer.**—I corrected my Fitzroy barometer simply by adding a sufficient quantity of mercury into the reservoir until the mercury in the tube ascended to the height required. Of course, I had to slide off the glass in front of the case, and undo the piece of muslin which is placed over the mouth of the reservoir to keep out the dust. A barometer at 40ft. above sea level will read about $\frac{1}{23}$in. lower than it would do at sea level.

ECNAL.

[66160.]—**Barometer.**—"E. V. H." had better first measure carefully the height of his column to ascertain whether there is any air above the mercury. A very small quantity would be sufficient to cause the column to be lower than it should be. If air is present, "E. V. H." had better invert the tube and heat it from the end upwards, so as to cause the mercury to boil and so carry the air with the vapour. If there is no air above the column then his scale is not in the correct position, and the remedy is obvious. Forty feet above sea-level would only lower the column about ·05in.

NITRAM P. T.

[66161.]—**Calculus of Finite Differences.**—If "Philomath," who, from the question he asks, I must assume to be acquainted with the principles of this (by no means easy) branch of mathematics, will again look in the treatise (written by Prof. Hall) to which he refers, he will find a whole chapter on equations of differences; and, at page 274, an explanation of the method of applying them to the discovery of the general term of a recurring series, when the scale of relation, which in this case is 1 + 1, is given. The equation I employed is an easy one of its kind; the auxiliary equation, the roots of which, raised to the x^{th} power and multiplied by arbitrary constants, form the general integral, being $a^2 = a + 1$.

Charing. J. R. C.

[66162.]—**Multiple Thread Screw-Cutting.**—"Poor Screw-Cutter" will find the process explained in a little shilling book published by Lockwood and Son, Stationers' Hall-court, E.C. The book is called "Screw Threads," and is sent post free for 1s.

AN OLD TURNER.

[66163.]—**Gums, Gum Resins, Venice Turpentine, Sealing-Wax.**—Genuine Venice turpentine can be obtained; but the stuff usually sold under that name is a mixture of resin and turps; the genuine stuff should be colourless, or nearly so. Crude turpentine is the lighter portion of the sap of the pine (Pinus sylvestris), which rises to the top after collecting, as distinguished from distilled, or, as it is commonly called, oil of turpentine. By Gallipot "X. L." evidently means Gallipoli, a coarse kind of olive oil. Canada balsam is the purest kind of pine turpentine: it is obtained from *Abies balsamea*, a native of Canada. In its fresh state it is about the consistency of treacle, of a pale yellow colour, nearly transparent. Here (Walsall) it is about 3s. a pound. Sandarach fuses at a lower temperature than shellac. Calcined magnesia is used to lighten the colour of sealing-wax as well as to make it harder. The gums used, or rather the resins, are shellac, resin, and sometimes pitch, sandarach, beeswax, guttapercha, paraffin wax, &c.

F. RUSSELL.

[66165.]—**Music Notation.**—The late Rev. J. J. Waite, Congregational minister, in various parts of the United Kingdom gave a course of lessons in Psalmody, in which he taught pupils to sing by a musical notation of figures concurrently with that of the staff notation. In his system the figure 1 indicated the tonic, and the remaining notes of the scale were indicated by consecutive numerals, the figure 7 being the highest indication. Should an accidental occur, it was written 4s or 7f, as the case might be. Practically, he had but one scale, the figure 6 indicating what would be regarded as the minor tonic in the staff notation. A system of sol fa once prevailed, as follows:—Fa, sol, la, fa, sol, la, mi, fa; the minor mode being—La, mi, fa, sol, la, fa, sol, la. The progressions were thus committed to memory, the distance between mi and fa, in all cases, being a semitone, by the following seven lines:—Above your mi, twice fa, sol, la, and under mi, twice la, sol, fa, and then comes mi in either way. The modern tonic sol-fa is a most ingenious manner of writing music, and is at present but upon the threshold of its development and scientific application.

I. F. BALLARD.

[66165.]—**Music Notation.**—I beg to inform "Pythagoras" there is such a system and notation as he requires; it is called the Chève method; it is as superior to the old or staff notation as modern numerals and arithmetic are to Roman. The tonic sol-fa is merely a very inferior copy of the Chève method. This method is taught in all the Government schools in France. I have achieved marvellous results with it. One case is sufficient to illustrate. I took the training of a rural choir (rawer materials it was impossible to find, being all agricultural labourers, mere clods, and the women as bad). Well, after three months' teaching, two evenings a week, we were able to sing, absolutely correctly, many simple choral pieces, including the "Huntsman's Chorus," by Weber. Several of my pupils were able to sing at sight airs presenting no difficulties of a farther stage than that they were then in; and what was more remarkable, they could not read the words to the air, being perfectly illiterate. To fully describe the advantages of this method over all others would take a whole page, and I should want to be sure the subject was of interest to the majority of our readers to feel justified in occupying this; but, briefly, it is a perfect introduction to the staff, for which it provides a movable doh; it is the only logical system of teaching music extant, and I dare contradiction. It was the work of four great musicians—Galen, Chève, and after his death his widow, and Paris. Madame Chève experimented for 30 years with "all sorts and conditions of men," to discover the order of difficulty of the intervals in music and combinations of time, or rather I should say divisions of beat, and from her observations wrote a series of exercises in these that are unrivalled. The only valid objection that I have ever heard advanced was by a violin tutor. He expressed surprise at my facility of reading pitch and measuring beat, and I explained it was owing to the exactness inculcated by the system on which I had learned. Next visit I showed him the exercises, &c., and explained the method thoroughly. I proved to him it did not take a quarter the time in learning that the other systems did. "Yes," said he, "and therefore you reduce one's pupils by three-fourths." This opinion amongst teachers is the true reason the method is discouraged. I have heard it said, "Well, but if the difficulty of music is removed, where would the distinction of being a musician be?" But is the limit of musical perfection attainable? Could not those who desire to excel their fellows still do so by a higher degree of proficiency? The secret of the success of the Chève method is this—in exercises two difficulties are never presented to the pupil's mind simultaneously, such as time and tune, and all objects for acquirement are given in the consecutive order of their difficulty. In conclusion, I wish someone would devise a system for the piano and other instruments based on just the same lines, first studying, by observations of beginners, what order the difficulties are in, as Madame Chève did for the ear, and then real "music for the masses" would become possible, and very quickly.

THE HARMONIOUS WHITESMITH.

[66170.]—**Cement.**—Have you tried the following? Take the best fish glue; to each pound add about 1oz. of green treacle; take some of this and make very thin. Make a strong decoction of nutgalls and add some to it. After stewing down, paint over with the thin, and when very near set, apply some of the thicker solution and glue, and with screw-clams make fast until set. Do not make more than you can use at the time with the gall added.

JACK OF ALL TRADES

[66167.]—**Colouring Cement.**—You will not want to stain right through. What I have seen done in scag. have only been faced. Wet your colours with glue-water before mixing with Keen's; red ochre, red lead, Chinese red, vermilion, burnt sienna. Greens must be chrome greens; blues should be ultramarine or smalts; Prussian blue mixed with rose-pink for violet. All should be ground with weak glue-water, very fine, with slab and muller. JACK OF ALL TRADES.

[66171.]—**Polishing Cedar Cabinet.**—Either get some dragon's blood and dissolve in methylated spirits or some Brazil raspings, and make a stain; or both may, after making, be mixed to suit the requirements. JACK OF ALL TRADES.

[66171.]—**Polishing Cedar Cabinet.**—Take equal quantities of clean rain-water, vinegar, turpentine, and boiled linseed oil, mix well in a bottle, and add as much colour as will make the desired shade, composed of ¼ of burnt sienna and ¾ Vandyke brown; rub on with a sponge and polish with clean soft dusters. H. H.

[66173.]—**Brass Castings.**—Cast-iron moulds will answer. They must be coated with a lick of fine charcoal and stale beer, and smoked, for the purpose of getting sharp castings.

JACK OF ALL TRADES.

[66173.]—**Brass Casting.**—Brass can be cast in iron moulds, but the sharpness of the casting depends on, first, the sharpness and smoothness of the mould; second, the heat of the metal when pouring; thirdly, the heat of the mould, which should be nearly of a red heat. Iron is best to use—wrought iron I mean, well blackleaded. If "Chill's" articles are small, they would be best stamped, which would turn them out sharp enough for anything. F. RUSSELL.

[66173.]—**Brass Casting.**—Metal moulds are of little use in brass casting, so far as sharpness of detail is concerned. I should advise "Chill" to try the fine casting sand supplied to dentists, and give a good facing of French chalk; after making the gates, dry the two halves of casting before the fire, then screw up and cast, using a pinch of sal-ammoniac to clear the brass in crucible and make it fluid just before pouring. This also applies to "H. C. D." (66183). He will get a thoroughly clean and smooth surface on his castings by using French chalk freely as a facing as well as a parting.

DENS.

[66174.]—**Aristotype.**—A piece of American oilcloth, such as is used to cover tables, &c., gives excellent results. It must be quite new.

S. BOTTONE.

[66175.]—**Estimation of Ammonia.**—A good method of estimating the ammonia in sulphate of ammonia is to boil the salt with magnesic oxide and water in a flask, leading the evolved ammonia into standard acid, which is titrated at the termination of the analysis. For details, see any good textbook on analysis. Sometimes caustic soda is used instead of magnesia, but the latter is preferable, as caustic soda would decompose any cyanides present in the salt with formation of ammonia, thus giving high results. F. I. C.

[66175.]—**Estimation of Ammonia.**—Place a given quantity of the sulphate in a flask with a little water. Connect this to another flask containing normal acid in excess by a tube dipping into the acid; all connections being tight, add a caustic alkali through a stoppered funnel to the flask containing the salt, and boil for about 15 or 20 minutes until all the ammonia is expelled. The excess of acid is ascertained by titration with a normal alkali. The percentage of ammonia in sulphate made in "open saturation" is always about 24 to 25; that made in the "closed" used to vary considerably. P. T. O. S., F.C.S.

[66175.]—**Estimation of Ammonia.**—If you are satisfied there are no admixtures of material, such as sulphate of soda or other material, but that the sulphate of ammonia is as it comes from the saturators, and you only want to know the per cent. of NH_3, a rough-and-ready method is simply to draw an average sample, grind it in mortar, and carefully weigh out, say, 50 grains in a watch-glass, then put this in water bath till weight is constant, and re-weigh and find per cent. of moisture present; then suppose it contained 5·5 per cent. of water, subtract that from 100, and multiply by 25·75 (amount of NH_3 in pure sulphate), and the answer will give amount of NH_3 in sample. Thus $94·5 \times 25·75 = 24·33$ per cent. NH_3 in sample. This is certainly a rough-and-ready method, and easy for an amateur. J. L.

[66177.]—**Engines in Hampton Wick Collision.**—The number of the light engine is 484, a leading-bogie side-tank, built by Neilson and Co. in 1885—weight about 56 tons. I do not know the number of the other engine, nor the amount of damage.

Clapham Junction. REYMOND.

[66183.]—**Brass Casting.**—See answer 66173.

JACK OF ALL TRADES.

[66186.]—**Methyl Orange Indicator.**—Methyl orange was first introduced into England in 1881 by Prof. G. Lunge, and was used for several years abroad prior to its introduction into England.

H. C. L. B.

[66186.]—**Methyl Orange Indicator.**—Methyl orange has been, to my knowledge, in use for the past two years. Whether it was in use before that I cannot say. I have not seen in any book an account of its use as an indicator in volumetric analysis. P.T.O.S., F.C.S.

[66186.]—**Methyl Orange Indicator.**—Methyl orange was introduced as an indicator in volumetric analysis by Dr. Lunge about eight or nine years ago, and has found several special applications since its introduction—such as the estimation of alkalies in presence of free carbonic acid, the estimation of free acids in manures, &c. For general work I prefer it to litmus, as it is equally delicate and more economical. Two shillingsworth purchased about eight years ago has kept me going ever since, using it nearly every day. F. I. C.

[66186.]—**Methyl Orange Indicator.**—I have perfectly reliable authority to state that methyl orange has been used for indicating purposes for at least eight or nine years. Thorpe is not an authority on indicators, but I think "Young Analyst" will not see methyl orange mentioned in any ordinary textbook on quantitative work. I did not become aware of the existence of the above body until after leaving college, and becoming engaged in practical work in a chemical laboratory. "Young Analyst" had better take my advice (which I gave him before), and read Thomson's papers in the *Chemical News* on indicators.

CHEMIST.

UNANSWERED QUERIES.

◆

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

65570.	Shafts, p. 360.
65579.	Boat, 360.
65593.	Cutting Spiral Grooves in Steel Rod, 361.
65611.	Shafting, 361.
65620.	Double Action Round Bellows, 362.
65624.	Metals, 362.
65630.	Causticising, 362.
65634.	S.E.R. Locomotives, 362.

65796.	Proportional Compass, 444.
65819.	Brilliantine Powder for Polishing Brass, 444.
65825.	Abbe Condenser for Microscope, 444.
65828.	Wool Network, 444.
65829.	Bath, 444.
65830.	Substitute for Lignum Vitæ, 445.
65853.	Developer, 445.
65855.	Telephone Appliances, 445.
65856.	Wire, 445.

Remarkable Tunnels.—Among the great tunnels which have been excavated, says a writer in *Scribner's Magazine*, the St. Gothard is the most remarkable. It is 9¼ miles long, with a section 26¼ft. wide by 19⅝ft. high. The work on this tunnel was continuous, and it required 9¼ years for its completion. The Mont Cenis tunnel, 8½ miles in length, was completed in 12 years. The Hoosac tunnel, 4¾ miles in length, 26ft. wide, and 21½ft. high, was not prosecuted continuously; it was completed in 1876. These tunnels are notable chiefly on account of their great length; there are others of more moderate extent which have peculiar features—one is unique. The tunnel is a portion of the St. Gothard railway, and not very far distant from the great tunnel referred to above. In the descent of the mountain it was absolutely necessary to secure a longer distance than a straight line or an ordinary curve would give. The line was therefore doubly curved upon itself. It enters the mountain at a high elevation, describes a circle through the rock, and, constantly descending, reappears under itself at the side; still descending, it enters the mountain at another point and continues in another circular tunnel until it finally emerges again, under itself, but at a comparatively short horizontal distance from its first entry, having gained the required descent by a continued grade through the tunnels.

AN exploring party of eight persons, led by Lieut. Israel, have set out from South Australia to explore the country north-east of Newcastle in Western Australia, and particularly the territory around Lake Moore and Lake Manga. The objects of the expedition are said to be partly scientific and partly commercial, and the funds have been supplied by a number of Australian capitalists.

THE highest railroad bridge in the United States is the Kinsua Viaduct, on the Erie road, 305ft. high. It is on the Forth Bridge cantilever system.

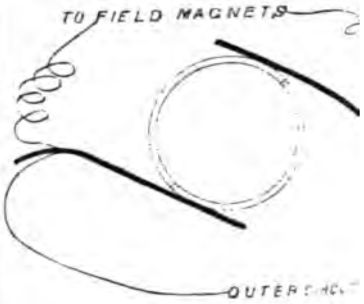
QUERIES.

◆

[66190.]—**Amalgamating Zincs.**—T has, I know, been frequently treated in the " in looking through back volumes I do not what I wish to know. Perhaps one of electrical subscribers will assist me? I have cells the zincs (hollow cylinders) of which amalgamated, particularly on rough places In No 1,194, 10 Feb., p. 563, "Botanist" solution of $Hg_2(NO_3)_2$—mercurous nitrate— state what strength. I have tried both this that of Hg in aq. regia—unsuccessfully in th It may be my solutions were not of good str aq. reg. solution very soon deposits Hg_2Cl_2, reaction possibly taking place—$2HgCl_2$ + + Hg_2Cl_2. Filing has been suggested, but is able in my case on account of the depressions Have any of our electricians tried the gre mentioned recently in the description of battery—viz., 100 tallow, 25 paraffin, 300 together? What thickness should the coating was another recipe given—viz., plunging into of 200 grains Hg in 1,000 grains aq. reg. (3 : 1 to nitric) and to which when dissolved 1,000 HCl are added. It is not stated how much wat BUNSENITE.

[66191.]—**Atlantic Passages.**—What fastest time taken by a screw steamship to New York to Liverpool, or vice versâ, in the GRANTON.

[66192.]—**Model Dynamo.**—To MR. Bott your kindly giving me the sizes and quantities use, I constructed a small dynamo. It will not give any current when connected as sketch,



being in shunt with the brushes. I disconnected of the fields from the brushes, and sent the current Bunsen cell through it, at the same time armature at a pretty high speed. I did not current from the armature as I put round magnets from the cell. It works all right Will you please tell me the various places be at fault?—L. B. E.

[66193.]—**Transparencies.**—I beg magic-lantern transparencies are treated them the rich brown tone as seen on a print.—W. D.

[66194.]—**Piccolo.**—Would "Vulcanite" kindly inform me about Pratten pattern piccolos? are their advantages over the ordinary system? what size bores are they made—small, medium, Is vulcanite superior in tone to cocus-wood?—

[66195.]—**Steam Launch.**—Would some kind inform me what size and pitch, and how many peller I should require to drive a boat [illegible] 6in. beam, with an engine 3½ bore by [illegible] pressure 45lb. per square inch?—A READER "MECHANIC."

[66196.]—**Renewing Old Plaster.**—Can your readers tell me how I can treat old (models, &c.), so as to be able to use it again AGNEW.

[66197.]—**Boiler.**—Will "T. C., Bristol," competent give me dimensions of a 1H.P. vertical Please give height of boiler from base to top, portion of height must be given to firebox, and firebox, thickness of plate, and diam. of flue.—ENGINEER.

[66198.]—**Painting Portable Engine.**— one kindly give me a few hints as to proper and what varnish to put on when finished? are corroded a good deal. How should I treat it ing? I want to do engine up as new.—A YOUNG

[66199.]—**Warming Chapel.**—Can any readers tell me the best and cheapest way to chapel, seating about 400 persons? The building long, 24ft. wide, 16ft. high. The floor runs level rostrum to about the middle of the building, mences to rise. Thus the floor is about at the end than the middle.—MONTE CRISTO.

[66200.]—**Whooping-Cough.**—Some years correspondent kindly gave an excellent cure the querist in the following number thanking stating it had quite cured his children. If either gentlemen are still subscribers, will they kindly as my four children have it very badly, and I all remedies I can hear without success? Will " Dispenser" also kindly help me?—GREEN.

[66201.]—**Smelting Metallic Oxides.**— "METALLURGIST."—Many thanks for your kind offer of assistance. I have tried several as directed by you, but as regards the zinc get a satisfactory result. The metallic in a measure, but the quantity in proportion very small, and it seems to me that a special furnace are required, as the zinc condenses in the retort and soon blocks it up. About how much zinc should be obtained from the oxide? I

5r/Bc

for condensing, length of stroke, size of ports, length and travel of valve, &c.? Steam cut-off. I thought of fixing pipe outside along bottom of boat to condense steam and arrange pump to feed same water back into boiler again. What do you think of that plan, or can you tell me anything better? I want to begin at the right end, so as to make her a nice smart boat, and labour is no object.—H. L. T.

[66243.]—**Heavy Ordnance.**—1. Assuming that a model of a gun be 24in. long, what should be the diameter of its bore? 2. At what distance from the breech will the greatest strain occur? 3. What would be the maximum strain such a model would need to stand to make it equal to the most powerful ordnance now made? 4. Is there a public establishment where such a model could be tested? There is, I think, a place in Whitechapel, London, where they test rifles. Could it be tested there? 5. If the scale named be too small for a fair test, what would be the minimum size for obtaining a reliable test? 6. What is the length and bore of the best 80-ton guns now made; what the size of the internal tube, and what its diameter at its strongest part? How long does it require to make such a gun, and its cost?—VINCENT.

[66244.]—**Divorce.**—Can "B. Sc., Plymouth," or any legal friend help me in the following? A friend residing in Ireland is in trouble. His wife has eloped, taking away a large sum of money and the only surviving child of the marriage. He has issued a writ of *habeas corpus*, and the child has been restored. He now wishes to get a divorce; but feels that the man with whom his wife eloped is a "man of straw" so that the cost of proceedings would have to be paid by him. Is there not some process of suing *in formâ pauperis*, so as to save fees, &c.? The parties, both husband, wife, and seducer, are English; but I presume the cause would have to be heard in Ireland.—SAXON.

[66245.]—**Babbit's Metal for Dies.**—Can "Os," "Dens," or any other dental reader assist me in this? I am using zinc at present for dies, but wish to get some metal or alloy on which I can strike up a sharper cast. I am unable to get melting point for above or any practical notes.—DENTIST.

[66246.]—**Indiarubber Tubing for Conveying Gas to a Movable Lamp.**—Which is the better, the grey or the red sort? The strong dark varnished tubing is not sufficiently pliable. It is said that the red rubber soon rots away. Is this true?—SIMONIDES.

[66247.]—**Zinc Plates.**—Would some brother-reader give me particulars of how to melt old worn-out zinc plates to make into new zincs? Also a very simple mould to make them 6in. long, 1½in. wide, and about ½in. thick, for bichromate batteries. Also how is the zinc made?—ANXIOUS ENQUIRER.

[66248.]—**Toning and Printing.**—Will some reader kindly say the cause of a white powder being deposited on paper during printing? Paper new and dry, negatives dry. Which is the right way for prints to lie in toning bath—face down or up, and are prints likely to be injured by making bath hot. I have followed Burton's method closely, but cannot succeed. The prints have half toned and refused to go any further, and the gold thrown down. I have made another bath with the same result. Should the bath be exposed to the air (in the dark, of course) or bottle stoppered? I always do the latter. What is the longest time prints should be kept before toning? Is a week too long if kept in an air-tight canister?—SHADOW CATCHER.

[66249.]—**Amalgamating Zincs.**—Is it necessary to amalgamate the zinc in a Bennett's battery? I was under the impression that it was not, but a friend tells me I am wrong. Perhaps one of your subscribers would be kind enough to say. The batteries I have are without porous cells, and consist of glass stoppered jars containing the elements—iron and zinc cylinders—the fluid being a saturated solution of caustic soda. If any local action takes place when circuit is not closed, what is it?—E. G. F.

[66250.]—**Intensity Coil.**—Would S. Bottone tell me whether it would interfere with the current, when making an intensity coil, if the wire on the secondary coil is joined, and how to arrange the different powers on an intensity coil, not the regulating tube?—ONE WHO TRIES.

[66251.]—**Proportional Speed—Problem.**—The express to Newcastle-on-Tyne, 270 miles, makes the journey in six hours' less time than the Parliamentary trains; but if both speeds are increased by 4 miles per hour, the difference of time between the two trains is only 4½ hours. What were the original speeds? Would some correspondent kindly show the simplest working of this by algebra, and say if such questions can be solved by arithmetic?—RAX.

[66252.]—**Heat of Gas Explosion.**—I desire to ascertain what amount of heat is developed by the explosion of 1 of gas to 6 air, and 1 gas to 9 air, or what other proportion is best to use in a gas-engine which will give most heat and force.—A. HUDSON.

[66253.]—**Bunsen Battery.**—TO MR. BOTTONE.—From advice received in these columns I bought ½gal. Bunsen battery for gilding chains. I have had it about three months. I find it expensive and seldom working well unless freshly charged. I only use it about once a fortnight, when all power seems gone. Could I convert it into a Smee by putting silver plate instead of porous pot, or is it because I do not understand it that it works so badly?—Q. E. D.

[66254.]—**Greenhouse Boiler.**—Is there any objection to buying a cast-iron boiler for heating hot-water pipes? Can some some one recommend a good and cheap one for working about 100ft. 4in. piping?—QUINTON.

[66255.]—**American Fruit Drier.**—Will some one give a description and sketch of an American fruit drier, and say if it is the quickest and best machine to dry fruit and herbs in?—A. B. C.

[66256.]—**Self-Acting Fountain.**—Would some fellow-reader give me instructions for making a small self acting fountain? Sketch would oblige.—SHEET METAL.

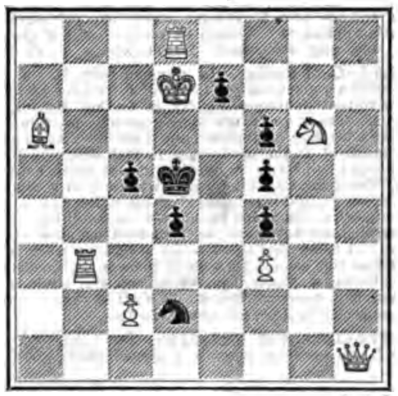
[66257.]—**Turning Hair White.**—What chemical *is used for* turning black or brown hair white?—HY. *HAMMETT.*

CHESS.

ALL communications for this department must be addressed "CHESS EDITOR, ENGLISH MECHANIC, 332, Strand."

PROBLEM MCXI.

Black.



White. [8 + 8

White to play and mate in two moves.

SOLUTION TO 1,109.

White.	*Black*
1. Kt-Kt 3.	1. Anything.
2. Q, R, B, or Kt mates.	

(Nine variations.)

NOTICES TO CORRESPONDENTS.

CORRECT solutions to 1,109 by W. Jay (an impossible position as Black's Ps at K 7 and B 5 must have taken two pieces to get in that position. This could not occur, as there are 15 of the 16 White pieces on the board), J. Bryden (who points out the same defect), H. Fellows, A. Fellows, J. Kistruck, Black Pawn (undoubtedly one of the finest, if not the best, two-mover in Tourney; key excellent and well disguised, but unfortunately position impossible), T. H. Billington, A. Dean, Link, G. W. Middleton, and H. Cross; to 1,108 by H. Fellows, J. Bryden (elementary), W. Jay, E. Lazareck, Link, A. Dean, J. Kilbee, H. A. Lindfield, E. W. Barnett, T. H. Billington, R. G. Briscoe, Sorrel (very easy), and H. Cross; to 1,107 by T. H. Billington (pretty fair problem, but spoilt by duals), Link, Sorrel (very puzzling), and E. W. Barnett.

J. BRYDEN AND BLACK PAWN.—Other things equal points would be scored by proving a position to be impossible, otherwise not. That is, if two candidates bracket equal for a prize, and one has indicated the above and the other not, the former would have precedence.

SORREL.—In your solution of 1,109 you have put 1. Kt K 3. We presume you mean Kt 3. If so, it is correct.

H. CROSS.—1. At present a Tourney is going on, but it will be concluded very shortly. 2. Certainly.

IN the *Nottingham Guardian* Solution Tourney just concluded, G. Hume (Nottingham) and C Wickwar (London) tie for first and second prizes with the full score, 145; G. W. Middleton (Mexborough) third prize, with 143; W. D. B (Boston) fourth, 142; and J. Bryden (Wimbledon) fifth, 140.

THE prizes in the Problem Tourney of the *Baltimore Sunday News* have been won by T. Taverner (Bolton), A. F. Mackenzie (Jamaica), Rev. J. Jespersen (Denmark), J. C. J. Wainwright (Boston), and F. Moeller (Germany), in the order named. We have great pleasure in congratulating Mr. Taverner on another brilliant success among worthy competitors.

VERY considerable interest has been aroused by the victories of Mr. F. J. Lee in the International Tournament over Messrs. Blackburne and Burn. Also of Herr Bardeleben over Captain Mackenzie. No little comment was excited by the fact that Mr. Mortimer should score his first game against Herr Bardeleben, this being also the first game lost by the latter master. It was a remarkable feature that on Thursday all the games that were won, except those of Blackburne and Gunsberg, were scored through oversights of the opponents, several really won games being lost by palpable blunders.

MR. J. SPENCER, president of the Manhattan Club, has been elected president of the Sixth American Congress. The meeting has been fixed for January next. Mr. Steinitz will not compete.

An Improvement in Photographing.—A German photographer, Herr Ottomar Anschultz, has succeeded in preparing photographic plates so sensitive that an exposure of 1-5000 of a second is sufficient. A very small lens must be used, so that the pictures are generally only 7-16 of an inch in length and breadth. Enlarged to an inch and a half on glass plates and rotated in series of 24 before a Geissler tube, the pictures are used for reproducing the motions of an animal on a large screen.

CAPTAIN ZALINSKI now expects soon to be able to fire the new 15in. pneumatic gun at Fort Lafayette, using a full charge of 600lb. of gelatine. It is a pity that the Government has nothing in the way of a target to offer for this trial in order that the effect of such an enormous quantity of the high explosive can be known. This gun, which has been built for the Italian Government, will be shipped to Spezzia during the autumn.

ANSWERS TO CORRESPONDENTS.

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*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustration on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to Hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, Aug. 22, and unacknowledged elsewhere:—

C. L. READE.—P.—W. P. Maycock.—Perks.—C.—Rapture.—Q.—Tin Foil.—Harrold.—Isaak Walton.—Beginner.—Harry.—Young Builder.—R. Hartland.—G. I. [illegible]—J. Brown, Belfast.—Tara.—B. Harcourt.—Dunan, Manchester.—W. M. J., Dublin.—S. S.

ONE IN DOUBT. (How is it that you, an "old subscriber," have failed to notice the statement so frequently made that, in the proper sense of the term, indiarubber cannot be "melted" and poured out into moulds. It is soluble in bisulphide of carbon and mineral naphtha: they are the cheapest solvents. Vulcanite, or ebonite, is indiarubber mixed with sulphur, and subjected to a curing process—that is, heat and pressure. You will find all about it in back volumes.)—FORTUNATUS. (A purely personal matter. Find a capitalist to join you, and then advertise the ointment freely.)—COUNTRY STATIONER. (The agreement, if made, would be legal enough; but it would be advisable to consult a solicitor with the actual terms of the agreement before him.)—AN ANXIOUS INQUIRER. (If you had given some idea of what the queries were about, we might have remembered. Perhaps they were not of general interest.)—SIPHON, &c. (The queries you send are merely examination questions, answers to which can be found in the usual textbooks.)—W. L. W. S. (See many replies in this and back volumes.)—E. M. F. A. (Is there not a dynamo that will suit you in the last half-dozen volumes? Look up recent back numbers.)—TIT-WILLOW. (See indices under Launch.)—THALES. (You will find several in back volumes: probably also in this, the index for which will be published in a few weeks.)—NOVICE. (Given many times, but not for copying pencil or charcoal. Richmond's "Grammar of Lithography," London: Wyman and Sons, is a good handbook of the art.)—YOUNG ONE. (To the secretary of each Institute. But you must be articled to a professional man before you can gain admission.)—STAR, Dr. F. (There is Dalziel's Work, published by Upcott Gill, 170, Strand.)—M. T. H. (Savile Kent's "Manual of the Infusoria," published by Allen, price £4 4s.)—W. P. (All about the fire grenades in Vol. XLIII. pp. 86, 109.)—PHILOMATH. (Did you not see previous answer—that there was not sufficient advantage? Even in Replies, the arrangement occasionally involves another line, and has been objected to by some correspondents.)—X. Y. Z. (You must be articled to a professional man. As to examinations, apply to the respective secretaries.)—W. P. W. (Perhaps the top of the tube is not perfectly sealed. Anyhow, you must shake over the mercury until the long limb is completely full, and, if necessary, must heat it in a spirit-lamp to drive out any air: then, on inverting, some of the mercury will flow back into the bulb, and the height at which the column remains in the long limb indicates the pressure of the atmosphere. From what you say, we should think there must be either air in the tube or a leak at the top. See several letters and replies in this number.)—MCS. (See indices and back numbers of this volume for many details of dynamos.)—H. T. BOBART. (We do not know. See advertisements.)—A. BALDWIN. (Couplers for American organs have been illustrated several times—both manual and octave. You will find one of the best octave couplers illustrated, with full details for making, in No. 1031, p. 370. See also No. 1186, p. 372, and the indices of back volumes.)—J. C. KERSHAW. (We cannot, for the simple reason that we do not know of one. There is "The Smithy and Forge," published by Lockwood and Sons, which may help you.)—H. E. BICKERTON. (Thank you: we want no more sketches "almost entirely from memory." With some correspondents the search for information about locomotives appears a mere fad.)

Impaired Vitality speedily restored by Harness' Electropathic Treatment. All sufferers from nervous exhaustion, brain fag, liver and kidney disorders, sleeplessness, rheumatic affections, &c., should call or write at once to Mr. C. B. Harness, Consulting Medical Electrician, 52, Oxford-street, London, W. (corner of Rathbone-place). Advice and pamphlet free, personally or by letter. Note only address as above.

The Preparation of Rhea.—The Board of Trade have received information through the Foreign Office to the effect that the opening of the competition of machinery and apparatus for the preparation of Rhea, which was to have taken place at Paris on the 15th of this month, has been postponed till the 25th prox. The period during which applications for permission to compete will be received has also been extended to the 30th of August.